AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

apart around the circumference of the tire at the area of greatest wear.

(b) *Type*. Vehicles should be equipped with tires on the same axle that are matched in construction and tire size designation, and dual tires shall be matched for overall diameter within one-half inch.

(1) *Inspection procedure*. Examine visually. A mismatch in size and construction between tires on the same axle, or a major deviation from the size recommended by the vehicle or tire manufacturer, is a cause for rejection. On a dual-tire arrangement the diameter of one of the duals must be within one-half inch of the other as measured by a gauge block inserted between the tire and a caliper.

(c) *General condition*. Tires shall be free from chunking, bumps, knots, or bulges evidencing cord, ply or tread separation from the casing.

(1) *Inspection procedure*. Examine visually for the conditions indicated.

(d) *Damage*. Tire cords or belting materials shall not be exposed, either to the naked eye or when cuts on the tire are probed. Reinforcement repairs to the cord body are allowable on tires other than front-mounted tires.

(1) *Inspection procedure*. Examine visually for the conditions indicated, using a blunt instrument if necessary to probe cuts and abrasions.

(e) *Special purpose tires*. Tires marked ''Not For Highway Use'' or ''Farm Use Only'' or other such restrictions shall not be used on any motor vehicles operating on public highways.

(1) *Inspection procedure*. Examine visually for tires labeled with specific restrictions.

§ 570.63 Wheel assemblies.

(a) *Wheel integrity*. A tire rim, wheel disc or spider shall have no visible cracks, elongated bolt holes, or indications of in-service repair by welding.

(1) *Inspection procedure*. Examine visually for the conditions indicated.

(b) *Cast wheels*. Cast wheels shall not be cracked or show evidence of excessive wear in the clamp area.

(1) *Inspection procedure*. Examine visually for the conditions indicated.

(c) *Mounting*. All wheel nuts shall be in place and tight.

(1) *Inspection procedure*. Check wheel retention for the conditions indicated.

PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS

Subpart A—General

Sec.

571.1 Scope.
571.3 Definitions.
571.4 Explanation of usage.
571.5 Matter incorporated by reference.
571.7 Applicability.
571.8 Effective date.
571.9 Separability.
571.10 Designation of seating positions.

Subpart B—Federal Motor Vehicle Safety Standards

571.101 Standard No. 101; Controls and displays.
571.102 Standard No. 102; Transmission shift position sequence, starter interlock, and transmission braking effect.
571.103 Standard No. 103; Windshield defrosting and defogging systems.
571.104 Standard No. 104; Windshield wiping and washing systems.
571.105 Standard No. 105; Hydraulic and electric brake systems.
571.106 Standard No. 106; Brake hoses.
571.107 [Reserved]
571.108 Standard No. 108; Lamps, reflective devices, and associated equipment.
571.109 Standard No. 109; New pneumatic tires for vehicles manufactured from 1949 to 1975, bias ply tires, and T-type spare tires.
571.110 Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information for motor vehicles with a GVWR of 4,536 kilograms (10,000 pounds) or less.
571.111 Standard No. 111; Rear visibility.
571.112 [Reserved]
571.113 Standard No. 113; Hood latch system.
571.114 Standard No. 114; Theft protection.
571.115 [Reserved]
571.116 Standard No. 116; Motor vehicle brake fluids.
571.117 Standard No. 117; Retreaded pneumatic tires.
571.118 Standard No. 118; Power-operated window, partition, and roof panel systems.
571.119 Standard No. 119; New pneumatic tires for motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds), specialty tires, and tires for motorcycles.

571.120 Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information for motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds).
571.121 Standard No. 121; Air brake systems.
571.122 Standard No. 122; Motorcycle brake systems.
571.122a Standard No. 122; Motorcycle brake systems.
571.123 Standard No. 123; Motorcycle controls and displays.
571.124 Standard No. 124; Accelerator control systems.
571.125 Standard No. 125; Warning devices.
571.126 Standard No. 126; Electronic stability control systems for light vehicles.
571.127 Standard No. 127; Automatic emergency braking systems for light vehicles.
571.128 [Reserved]
571.129 Standard No. 129; New non-pneumatic tires for passenger cars.
571.131 Standard No. 131; School bus pedestrian safety devices.
571.135 Standard No. 135; Light vehicle brake systems.
571.136 Standard No. 136; Electronic stability control systems for heavy vehicles.
571.138 Standard No. 138; Tire pressure monitoring systems.
571.139 Standard No. 139; New pneumatic radial tires for light vehicles.
571.141 Standard No. 141; Minimum Sound Requirements for Hybrid and Electric Vehicles.
571.201 Standard No. 201; Occupant protection in interior impact.
571.202 Standard No. 202; Head restraints; Applicable at the manufacturers option until September 1, 2009.
571.202a Standard No. 202a; Head restraints; Mandatory applicability begins on September 1, 2009.
571.203 Standard No. 203; Impact protection for the driver from the steering control system.
571.204 Standard No. 204; Steering control rearward displacement.
571.205 Standard No. 205; Glazing materials.
571.205(a) Glazing equipment manufactured before September 1, 2006 and glazing materials used in vehicles manufactured before November 1, 2006.
571.206 Standard No. 206; Door locks and door retention components.
571.207 Standard No. 207; Seating systems.
571.208 Standard No. 208; Occupant crash protection.
571.209 Standard No. 209; Seat belt assemblies.
571.210 Standard No. 210; Seat belt assembly anchorages.
571.211 [Reserved]
571.212 Standard No. 212; Windshield mounting.
571.213 Child restraint systems; Applicable unless a vehicle or child restraint system is certified to §571.213b.
571.213a Standard No. 213a; Child restraint systems—side impact protection.
571.213b Standard No. 213b; Child restraint systems; Mandatory applicability beginning December 5, 2026.
571.214 Standard No. 214; Side impact protection.
571.215 [Reserved]
571.216 Standard No. 216; Roof crush resistance; Applicable unless a vehicle is certified to §571.216a.
571.216a Standard No. 216a; Roof crush resistance; Upgraded standard.
571.217 Standard No. 217; Bus emergency exits and window retention and release.
571.217a Standard No. 217a; Anti-ejection glazing for bus portals; Mandatory applicability beginning October 30, 2027.
571.218 Standard No. 218; Motorcycle helmets.
571.219 Standard No. 219; Windshield zone intrusion.
571.220 Standard No. 220; School bus rollover protection.
571.221 Standard No. 221; School bus body joint strength.
571.222 Standard No. 222; School bus passenger seating and crash protection.
571.223 Standard No. 223; Rear impact guards.
571.224 Standard No. 224; Rear impact protection.
571.225 Standard No. 225; Child restraint anchorage systems.
571.226 Standard No. 226; Ejection Mitigation.
571.227 Standard No. 227; Bus rollover structural integrity.
571.301 Standard No. 301; Fuel system integrity.
571.302 Standard No. 302; Flammability of interior materials.
571.303 Standard No. 303; Fuel system integrity of compressed natural gas vehicles.
571.304 Standard No. 304; Compressed natural gas fuel container integrity.
571.305 Standard No. 305; electric-powered vehicles: electrolyte spillage and electrical shock protection; applicable unless a vehicle is certified to §571.305a.
571.305a Standard No. 305a; electric-powered vehicles: Electric powertrain integrity; mandatory applicability begins on September 1, 2027.
571.307 Standard No. 307; Fuel system integrity of hydrogen vehicles.
571.308 Standard No. 308; Compressed hydrogen storage system integrity.
571.401 Standard No. 401; Internal trunk release.
571.403 Standard No. 403; Platform lift systems for motor vehicles.
571.404 Standard No. 404; Platform lift installations in motor vehicles.

571.500 Standard No. 500; Low-speed vehicles.

APPENDIX A TO SUBPART B—SECTION 571.108 TABLE OF CONTENTS.

AUTHORITY: 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.95.

EDITORIAL NOTE: Nomenclature changes to part 571 appear at 69 FR 18803, Apr. 9, 2004.

Subpart A—General

§571.1 Scope.

This part contains the Federal Motor Vehicle Safety Standards for motor vehicles and motor vehicle equipment established under section 103 of the National Traffic and Motor Vehicle Safety Act of 1966 (80 Stat. 718).

[33 FR 19703, Dec. 25, 1968. Redesignated at 35 FR 5118, Mar. 26, 1970]

§571.3 Definitions.

(a) *Statutory definitions.* All terms defined in section 102 of the Act are used in their statutory meaning.

(b) *Other definitions.* As used in this chapter—

Act means the National Traffic and Motor Vehicle Safety Act of 1966 (80 Stat. 718).

Approved, unless used with reference to another person, means approved by the Secretary.

Boat trailer means a trailer designed with cradle-type mountings to transport a boat and configured to permit launching of the boat from the rear of the trailer.

Bus means a motor vehicle with motive power, except a trailer, designed for carrying more than 10 persons.

Curb weight means the weight of a motor vehicle with standard equipment; maximum capacity of engine fuel, oil, and coolant; and, if so equipped, air conditioning and additional weight optional engine.

Designated seating capacity means the number of designated seating positions provided.

Designated seating position means:

(1) For vehicles manufactured prior to September 1, 2011, any plan view location capable of accommodating a person at least as large as a 5th percentile adult female, if the overall seat configuration and design and vehicle design is such that the position is likely to be used as a seating position while the vehicle is in motion, except for auxiliary seating accommodations such as temporary or folding jump seats. Any bench or split-bench seat in a passenger car, truck or multipurpose passenger vehicle with a GVWR less than 4,536 kilograms (10,000 pounds), having greater than 127 centimeters (50 inches) of hip room (measured in accordance with Society of Automotive Engineers (SAE) Recommended Practice J1100a, revised September 1975, ''Motor Vehicle Dimensions'' (incorporated by reference, see §571.5), shall have not less than three designated seating positions, unless the seat design or vehicle design is such that the center position cannot be used for seating. For the sole purpose of determining the classification of any vehicle sold or introduced into interstate commerce for purposes that include carrying students to and from school or related events, any location in such vehicle intended for securement of an occupied wheelchair during vehicle operation shall be regarded as four designated seating positions.

(2) For vehicles manufactured on and after September 1, 2011, *designated seating position* means a seat location that has a seating surface width, as described in §571.10(c) of this part, of at least 330 mm (13 inches). The number of designated seating positions at a seat location is determined according to the procedure set forth in §571.10(b) of this part. However, for trucks and multipurpose passenger vehicles with a gross vehicle weight rating greater than 10,000 lbs, police vehicles as defined in S7 of FMVSS No. 208, firefighting vehicles, ambulances, and motor homes, a seating location that is labeled in accordance with S4.4 of FMVSS No. 207 will not be considered a designated seating position. For the sole purpose of determining the classification of any vehicle sold or introduced into interstate commerce for purposes that include carrying students to and from school or related events, any location in such a vehicle intended for securement of an occupied wheelchair during vehicle operation is regarded as four designated seating positions.

Driver means the occupant of a motor vehicle seated immediately behind the steering control system.

Driver air bag means the air bag installed for the protection of the occupant of the driver's designated seating position.

Driver dummy means the test dummy positioned in the driver's designated seating position.

Driver's designated seating position means a designated seating position providing immediate access to manually operated driving controls. As used in this part, the terms ''driver's seating position'' and ''driver's seat'' shall have the same meaning as ''driver's designated seating position.''

Emergency brake means a mechanism designed to stop a motor vehicle after a failure of the service brake system.

5th percentile adult female means a person possessing the dimensions and weight of the 5th percentile adult female specified for the total age group in ''Weight, Height, and Selected Body Dimensions of Adults: United States—1960–1962,'' first published as Public Health Service Publication No. 1000 Series 11–No. 8, June 1965 and republished as DHEW Publication No. (HRA) 76–1074 (incorporated by reference, see § 571.5).

Firefighting vehicle means a vehicle designed exclusively for the purpose of fighting fires.

Fixed collision barrier means a flat, vertical, unyielding surface with the following characteristics:

(1) The surface is sufficiently large that when struck by a tested vehicle, no portion of the vehicle projects or passes beyond the surface.

(2) The approach is a horizontal surface that is large enough for the vehicle to attain a stable attitude during its approach to the barrier, and that does not restrict vehicle motion during impact.

(3) When struck by a vehicle, the surface and its supporting structure absorb no significant portion of the vehicle's kinetic energy, so that a performance requirement described in terms of impact with a fixed collision barrier must be met no matter how small an amount of energy is absorbed by the barrier.

Forward control means a configuration in which more than half of the engine length is rearward of the foremost point of the windshield base and the steering wheel hub is in the forward quarter of the vehicle length.

Full trailer means a trailer, except a pole trailer, that is equipped with two or more axles that support the entire weight of the trailer.

Gross axle weight rating or *GAWR* means the value specified by the vehicle manufacturer as the load-carrying capacity of a single axle system, as measured at the tire-ground interfaces.

Gross combination weight rating or *GCWR* means the value specified by the manufacturer as the loaded weight of a combination vehicle.

Gross vehicle weight rating or *GVWR* means the value specified by the manufacturer as the loaded weight of a single vehicle.

H-Point means the pivot center of the torso and thigh on the three-dimensional device used in defining and measuring vehicle seating accommodation, as defined in Society of Automotive Engineers (SAE) Recommended Practice J1100, revised February 2001, ''Motor Vehicle Dimensions'' (incorporated by reference, see § 571.5).

Head impact area means all nonglazed surfaces of the interior of a vehicle that are statically contactable by a 6.5-inch diameter spherical head form of a measuring device having a pivot point to ''top-of-head'' dimension infinitely adjustable from 29 to 33 inches in accordance with the following procedure, or its graphic equivalent:

(a) At each designated seating position, place the pivot point of the measuring device—

(1) For seats that are adjustable fore and aft, at—

(i) The seating reference point; and

(ii) A point 5 inches horizontally forward of the seating reference point and vertically above the seating reference point an amount equal to the rise which results from a 5–inch forward adjustment of the seat or 0.75 inch; and

(2) For seats that are not adjustable fore and aft, at the seating reference point.

(b) With the pivot point to ''top-of-head'' dimension at each value allowed by the device and the interior dimensions of the vehicle, determine all contact points above the lower windshield

glass line and forward of the seating reference point.

(c) With the head form at each contact point, and with the device in a vertical position if no contact points exists for a particular adjusted length, pivot the measuring device forward and downward through all arcs in vertical planes to 90° each side of the vertical longitudinal plane through the seating reference point, until the head form contacts an interior surface or until it is tangent to a horizontal plane 1 inch above the seating reference point, whichever occurs first.

Interior compartment door means any door in the interior of the vehicle installed by the manufacturer as a cover for storage space normally used for personal effects.

Longitudinal or *longitudinally* means parallel to the longitudinal centerline of the vehicle.

Low-speed vehicle (LSV) means a motor vehicle,

(1) That is 4-wheeled,

(2) Whose speed attainable in 1.6 km (1 mile) is more than 32 kilometers per hour (20 miles per hour) and not more than 40 kilometers per hour (25 miles per hour) on a paved level surface, and

(3) Whose GVWR is less than 1,361 kilograms (3,000 pounds).

Manually operated driving controls means a system of controls:

(i) That are used by an occupant for real-time, sustained, manual manipulation of the motor vehicle's heading (steering) and/or speed (accelerator and brake); and

(ii) That is positioned such that they can be used by an occupant, regardless of whether the occupant is actively using the system to manipulate the vehicle's motion.

Motorcycle means a motor vehicle with motive power having a seat or saddle for the use of the rider and designed to travel on not more than three wheels in contact with the ground.

Motor-driven cycle means a motorcycle with a motor that produces 5-brake horsepower or less.

Motor home means a multipurpose passenger vehicle with motive power that is designed to provide temporary residential accommodations, as evidenced by the presence of at least four of the following facilities: Cooking; refrigeration or ice box; self-contained toilet; heating and/or air conditioning; a potable water supply system including a faucet and a sink; and a separate 110–125 volt electrical power supply and/or propane.

Multifunction school activity bus (MFSAB) means a school bus whose purposes do not include transporting students to and from home or school bus stops.

Multipurpose passenger vehicle means a motor vehicle with motive power, except a low-speed vehicle or trailer, designed to carry 10 persons or less which is constructed either on a truck chassis or with special features for occasional off-road operation.

Open-body type vehicle means a vehicle having no occupant compartment top or an occupant compartment top that can be installed or removed by the user at his convenience.

Outboard designated seating position means a designated seating position where a longitudinal vertical plane tangent to the outboard side of the seat cushion is less than 12 inches from the innermost point on the inside surface of the vehicle at a height between the design H-point and the shoulder reference point (as shown in fig. 1 of Federal Motor Vehicle Safety Standard No. 210) and longitudinally between the front and rear edges of the seat cushion. As used in this part, the terms ''outboard seating position'' and ''outboard seat'' shall have the same meaning as ''outboard designated seating position.''

Overall vehicle width means the nominal design dimension of the widest part of the vehicle, exclusive of signal lamps, marker lamps, outside rearview mirrors, flexible fender extensions, and mud flaps, determined with doors and windows closed and the wheels in the straight-ahead position.

Parking brake means a mechanism designed to prevent the movement of a stationary motor vehicle.

Passenger car means a motor vehicle with motive power, except a low-speed vehicle, multipurpose passenger vehicle, motorcycle, or trailer, designed for carrying 10 persons or less.

Passenger seating position means any designated seating position other than

the driver's designated seating position, except as noted below. As used in this part, the term ''passenger seat'' shall have the same meaning as ''passenger seating position.'' As used in this part, ''passenger seating position'' includes what was a ''driver's designated seating position'' prior to stowing of the present manually operated driving controls.

Pelvic impact area means that area of the door or body side panel adjacent to any outboard designated seating position which is bounded by horizontal planes 7 inches above and 4 inches below the seating reference point and vertical transverse planes 8 inches forward and 2 inches rearward of the seating reference point.

Pole trailer means a motor vehicle without motive power designed to be drawn by another motor vehicle and attached to the towing vehicle by means of a reach or pole, or by being boomed or otherwise secured to the towing vehicle, for transporting long or irregularly shaped loads such as poles, pipes, or structural members capable generally of sustaining themselves as beams between the supporting connections.

Recreation vehicle trailer means a trailer, except a trailer designed primarily to transport cargo, designed to be drawn by a vehicle with motive power by means of a bumper, frame or fifth wheel hitch and designed to provide temporary residential accommodations, as evidenced by the presence of at least four of the following facilities: cooking; refrigeration or ice box; self-contained toilet; heating and/or air conditioning; a potable water supply system including a faucet and a sink; and a separate 110–125 volt electrical power supply and/or propane. ''Recreation vehicle trailer'' includes trailers used for personal purposes, commonly known as ''sport utility RVs'' or ''toy haulers,'' which usually have spacious rather than incidental living quarters and provide a cargo area for smaller items for personal use such as motorcycles, mountain bikes, all terrain vehicles (ATVs), snowmobiles, canoes or other types of recreational gear.

Row means a set of one or more seats whose seat outlines do not overlap with the seat outline of any other seats, when all seats are adjusted to their rearmost normal riding or driving position, when viewed from the side.

School bus means a bus that is sold, or introduced in interstate commerce, for purposes that include carrying students to and from school or related events, but does not include a bus designed and sold for operation as a common carrier in urban transportation.

Seat outline means the outer limits of a seat projected laterally onto a vertical longitudinal vehicle plane.

Seating reference point (SgRP) means the unique design H-point, as defined in Society of Automotive Engineers (SAE) Recommended Practice J1100, revised June 1984, ''Motor Vehicle Dimensions'' (incorporated by reference, see § 571.5), which:

(1) Establishes the rearmost normal design driving or riding position of each designated seating position, which includes consideration of all modes of adjustment, horizontal, vertical, and tilt, in a vehicle;

(2) Has X, Y, and Z coordinates, as defined in Society of Automotive Engineers (SAE) Recommended Practice J1100, revised June 1984, ''Motor Vehicle Dimensions'' (incorporated by reference, see § 571.5), established relative to the designed vehicle structure;

(3) Simulates the position of the pivot center of the human torso and thigh; and

(4) Is the reference point employed to position the two-dimensional drafting template with the 95th percentile leg described in Society of Automotive Engineers (SAE) Standard J826, revised May 1987, ''Devices for Use in Defining and Measuring Vehicle Seating Accommodation'' (incorporated by reference, see § 571.5), or, if the drafting template with the 95th percentile leg cannot be positioned in the seating position, is located with the seat in its most rearward adjustment position.

Semitrailer means a trailer, except a pole trailer, so constructed that a substantial part of its weight rests upon or is carried by another motor vehicle.

Service brake means the primary mechanism designed to stop a motor vehicle.

Speed attainable in 1 mile means the speed attainable by accelerating at

maximum rate from a standing start for 1 mile, on a level surface.

Speed attainable in 2 miles means the speed attainable by accelerating at maximum rate from a standing start for 2 miles, on a level surface.

Steering control system means the manually operated driving control used to control the vehicle heading and its associated trim hardware, including any portion of a steering column assembly that provides energy absorption upon impact. As used in this part, the term ''steering wheel'' and ''steering control'' shall have the same meaning as ''steering control system.''

Torso line means the line connecting the ''H'' point and the shoulder reference point as defined in Society of Automotive Engineers (SAE) Standard J787b, revised September 1966, ''Motor Vehicle Seat Belt Anchorage'' (incorporated by reference, see §571.5).

Trailer means a motor vehicle with or without motive power, designed for carrying persons or property and for being drawn by another motor vehicle.

Trailer converter dolly means a trailer chassis equipped with one or more axles, a lower half of a fifth wheel and a drawbar.

Truck means a motor vehicle with motive power, except a trailer, designed primarily for the transportation of property or special purpose equipment.

Truck tractor means a truck designed primarily for drawing other motor vehicles and not so constructed as to carry a load other than a part of the weight of the vehicle and the load so drawn.

Unloaded vehicle weight means the weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use.

95th percentile adult male means a person possessing the dimensions and weight of the 95th percentile adult male specified ''Weight, Height, and Selected Body Dimensions of Adults: United States—1960–1962,'' first published as Public Health Service Publication No. 1000 Series 11-No. 8, June 1965 and republished as DHEW Publication No. (HRA) 76–1074 (incorporated by reference, see §571.5).

Vehicle fuel tank capacity means the tank's unusable capacity (i.e., the volume of fuel left at the bottom of the tank when the vehicle's fuel pump can no longer draw fuel from the tank) plus its usable capacity (i.e., the volume of fuel that can be pumped into the tank through the filler pipe with the vehicle on a level surface and with the unusable capacity already in the tank). The term does not include the vapor volume of the tank (i.e., the space above the fuel tank filler neck) nor the volume of the fuel tank filler neck.

[33 FR 19703, Dec. 25, 1968. Redesignated at 35 FR 5118, Mar. 26, 1970]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.3, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.4 Explanation of usage.

The word *any*, used in connection with a range of values or set of items in the requirements, conditions, and procedures of the standards or regulations in this chapter, means generally the totality of the items or values, any one of which may be selected by the Administration for testing, except where clearly specified otherwise.

Examples: ''The vehicle shall meet the requirements of S4.1 when tested at any point between 18 and 22 inches above the ground.'' This means that the vehicle must be capable of meeting the specified requirements at every point between 18 and 22 inches above the ground. The test in question for a given vehicle may call for a single test (a single impact, for example), but the vehicle must meet the requirement at whatever point the Administration selects, within the specified range.

''Each tire shall be capable of meeting the requirements of this standard when mounted on any rim specified by the manufacturer as suitable for use with that tire.'' This means that, where the manufacturer specifies more than one rim as suitable for use with a tire, the tire must meet the requirements with whatever rim the Administration selects from the specified group.

''Any one of the items listed below may, at the option of the manufacturer, be substituted for the hardware specified in S4.1.'' Here the wording clearly indicates that the

selection of items is at the manufacturer's option.

[36 FR 2511, Feb. 5, 1971]

§ 571.5 Matter incorporated by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, the National Highway Traffic Safety Administration (NHTSA) must publish a document in the FEDERAL REGISTER and the material must be available to the public. All approved incorporation by reference (IBR) material is available for inspection at NHTSA and at the National Archives and Records Administration (NARA). Contact NHTSA at: NHTSA, 1200 New Jersey Avenue SE, Washington, DC 20590, (202) 366–2588, website: *https://www.nhtsa.gov/about-nhtsa/electronic-reading-room*. For information on the availability of this material at NARA, email: *fr.inspection@nara.gov*, or go to: *www.archives.gov/federal-register/cfr/ibr-locations.html*. The material may be obtained from the sources in the following paragraphs of this section.

(b) American Association of Textile Chemists and Colorists (AATCC), 1 Davis Dr., P.O. Box 12215, Research Triangle Park, NC 27709. Web site: *https://www.aatcc.org*.

(1) AATCC Test Method 30–1981, ''Fungicides, Evaluation on Textiles: Mildew and Rot Resistance of Textiles,'' into § 571.209.

(2) AATCC Gray Scale for Evaluating Change in Color into §§ 571.209; 571.213.

(3) AATCC Evaluation Procedure (EP) 1–2007, Gray Scale for Color Change, reaffirmed 2007; into § 571.213b.

(c) American National Standards Institute (ANSI), 1899 L St., NW., 11th floor, Washington, DC 20036. Telephone: (202) 293–8020; Fax: (202) 293–9287; Web site: *https://www.ansi.org*. Copies of ANSI/RESNA Standard WC/Vol.1–1998 Section 13 may also be obtained from Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), 1700 North Moore St., Suite 1540, Arlington, VA 22209–1903. Telephone: (703) 524–6686; Web site *https://www.resna.org*.

(1) ANSI S1.11–2004, ''Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters,'' approved February 19, 2004, into § 571.141.

(2) ANSI Z26.1–1977, ''Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways,'' approved January 26, 1977, into § 571.205(a).

(3) ANSI Z26.1a–1980, ''Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways,'' approved July 3, 1980, into § 571.205(a).

(4) ANSI/SAE Z26.1–1996, ''American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways-Safety Standard,'' approved August 11, 1997, into § 571.205.

(5) ANSI/RESNA Standard WC/Vol. 1–1998, Section 13, ''Wheelchairs: Determination of Coefficient of Friction of Test Surfaces,'' into § 571.403.

(d) ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428–2959. Telephone: (610) 832–9500; Fax (610) 832–9555; Web site: *https://www.astm.org*.

(1) 1985 Annual Book of ASTM Standards, Vol. 05.04, ''Test Methods for Rating Motor, Diesel, Aviation Fuels, A2. Reference Materials and Blending Accessories, (''ASTM Motor Fuels section''),'' A2.3.2, A2.3.3, and A2.7, into §§ 571.108; 571.205(a).

(2) ASTM B117–64, ''Standard Method of Salt Spray (Fog) Testing,'' revised 1964, into § 571.125.

(3) ASTM B117–73 (Reapproved 1979), ''Standard Method of Salt Spray (Fog) Testing,'' approved March 29, 1973, into §§ 571.108; 571.209.

(4) ASTM B117–97, ''Standard Practice for Operating Salt Spray (Fog) Apparatus,'' approved April 10, 1997, into § 571.403.

(5) ASTM B117–03, ''Standard Practice for Operating Salt Spray (Fog) Apparatus,'' approved October 1, 2003, into §§ 571.106; 571.111.

(6) ASTM B456–79, ''Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium,'' approved January 26, 1979, into § 571.209.

(7) ASTM B456–95, ''Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium,'' approved October 10, 1995, into §571.403.

(8) ASTM C150–56, ''Standard Specification for Portland Cement,'' approved 1956, into §571.108.

(9) ASTM C150–77, ''Standard Specification for Portland Cement,'' approved February 26, 1977, into §571.108.

(10) ASTM D362–84, ''Standard Specification for Industrial Grade Toluene,'' approved March 30, 1984, into §§571.108; 571.205(a).

(11) ASTM D445–65, ''Standard Method of Test for Viscosity of Transparent and Opaque Liquids (Kinematic and Dynamic Viscosities),'' approved August 31, 1965, into §571.116.

(12) ASTM D471–98, ''Standard Test Method for Rubber Property—Effect of Liquids,'' approved November 10, 1998, into §571.106.

(13) ASTM D484–71, ''Standard Specification for Hydrocarbon Drycleaning Solvents,'' effective September 15, 1971, into §571.301.

(14) ASTM D756–78, ''Standard Practice for Determination of Weight and Shape Changes of Plastics under Accelerated Service Conditions,'' approved July 28, 1978, into §571.209.

(15) ASTM D1003–92, ''Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics,'' approved October 15, 1992, into §571.108.

(16) ASTM D1056–07, *Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber*, approved March 1, 2007; into §§571.213; 571.213b.

(17) ASTM D1121–67, ''Standard Method of Test for Reserve Alkalinity of Engine Antifreezes and Antirusts,'' accepted June 12, 1967, into §571.116.

(18) ASTM D1123–59, ''Standard Method of Test for Water in Concentrated Engine Antifreezes by the Iodine Reagent Method,'' revised 1959, into §571.116.

(19) ASTM D1193–70, ''Standard Specification for Reagent Water,'' effective October 2, 1970, into §571.116.

(20) ASTM D1193–06 (Reapproved 2018), *Standard Specification for Reagent Water*, approved March 15, 2018, into §571.308.

(21) ASTM D1415–68, ''Standard Method of Test for International Hardness of Vulcanized Natural and Synthetic Rubbers,'' accepted February 14, 1968, into §571.116.

(22) ASTM D2515–66, ''Standard Specification for Kinematic Glass Viscometers,'' adopted 1966, into §571.116.

(23) ASTM D3574–11, *Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams*, approved December 1, 2011; into §571.213b.

(24) ASTM D4329–99, ''Standard Practice for Fluorescent UV Exposure of Plastics,'' approved January 10, 1999, into §571.106.

(25) ASTM D4956–90, ''Standard Specification for Retroreflective Sheeting for Traffic Control,'' approved October 26, 1990, into §571.108.

(26) ASTM E1–68, ''Standard Specifications for ASTM Thermometers'' (including tentative revisions), accepted September 13, 1968, into §571.116.

(27) ASTM E4–79, ''Standard Methods of Load Verification of Testing Machines,'' approved June 11, 1979, into §571.209.

(28) ASTM E4–03, ''Standard Practices for Force Verification of Testing Machines,'' approved August 10, 2003, into §571.106.

(29) ASTM E8–89, ''Standard Test Methods of Tension Testing of Metallic Materials,'' approved May 15, 1989, into §571.221.

(30) ASTM E77–66, ''Standard Method for Inspection, Test, and Standardization of Etched-Stem Liquid-in-Glass Thermometers,'' revised 1966, into §571.116.

(31) ASTM E274–65T, ''Tentative Method of Test for Skid Resistance of Pavements Using a Two-Wheel Trailer,'' issued 1965, into §§571.208; 571.301.

(32) ASTM E274–70, ''Standard Method of Test for Skid Resistance of Paved Surfaces Using a Full-Scale Tire,'' revised July 1974, into §§571.105; 571.122a.

(33) ASTM E298–68, ''Standard Methods for Assay of Organic Peroxides,'' effective September 13, 1968, into §571.116.

(34) ASTM E308–66, ''Standard Practice for Spectrophotometry and Description of Color in CIE 1931 System,'' reapproved 1981, into §571.108.

(35) ASTM E1337–19, ''Standard Test Method for Determining Longitudinal

Peak Braking Coefficient (PBC) of Paved Surfaces Using Standard Reference Test Tire,'' approved December 1, 2019, into §§ 571.105; 571.121; 571.122; 571.126; 571.127; 571.135; 571.136; 571.500.

(36) ASTM F1805–20, ''Standard Test Method for Single Wheel Driving Traction in a Straight Line on Snow- and Ice-Covered Surfaces,'' approved May 1, 2020; into § 571.139.

(37) ASTM G23–81, ''Standard Practice for Generating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials,'' approved March 26, 1981, into § 571.209.

(38) ASTM G151–97, ''Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources,'' approved July 10, 1997, into § 571.106.

(39) ASTM G154–00, ''Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials,'' approved February 10, 2000, into § 571.106.

(e) Department of Defense, DODSSP Standardization Document Order Desk, 700 Robbins Ave., Philadelphia, PA 19111–5098. Web site: *https://dodssp.daps.dla.mil/*.

(1) MIL–S–13192, ''Military Specification, Shoes, Men's, Dress, Oxford,'' October 30, 1976, into § 571.214.

(2) MIL–S–13192P, ''Military Specification, Shoes, Men's, Dress, Oxford,'' 1988, including Amendment 1, October 14, 1994, into § 571.208.

(3) MIL–S–21711E, ''Military Specification, Shoes, Women's,'' 3 December 1982, including Amendment 2, October 14, 1994, into §§ 571.208; 571.214.

(f) General Services Administration (GSA), Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Telephone: (202) 512–1800; Web site: *https://www.gsa.gov*.

(1) GSA Federal Specification L–S–300, ''Sheeting and Tape, Reflective; Nonexposed Lens, Adhesive Backing,'' September 7, 1965, into § 571.108.

(2) [Reserved]

(g) Illuminating Engineering Society of North America (IES), 120 Wall St., 7th Floor, New York, NY 10005–4001. Telephone: (212) 248–5000; Web site: *https://www.iesna.org*.

(1) IES LM 45, ''IES Approved Method for Electrical and Photometric Measurements of General Service Incandescent Filament Lamps,'' approved April 1980, into § 571.108.

(2) [Reserved]

(h) International Commission on Illumination (CIE), CIE Central Bureau, Kegelgasse 27, A–1030 Vienna, Austria. *https://www.cie.co.at*.

(1) CIE 1931 Chromaticity Diagram, developed 1931, into § 571.108.

(2) [Reserved]

(i) International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH–1211 Geneva 20, Switzerland. Telephone: + 41 22 749 01 11. Fax: + 41 22 733 34 30. Web site: *https://www.iso.org/*.

(1) ISO 6270–2:2017(E), *Paints and Varnishes—Determination of Resistance to Humidity—Part 2: Condensation (In-Cabinet Exposure with Heated Water Reservoir)*, Second edition, November 2017, into § 571.308.

(2) ISO 7117:1995(E), ''Motorcycles—Measurement of maximum speed,'' Second edition, March 1, 1995, into § 571.122.

(3) ISO 10844:1994(E) ''Acoustics—Test Surface for Road Vehicle Noise Measurements,'' First edition, 1994–09–01, into § 571.141.

(4) ISO 10844: 2011(E) ''Acoustics—Specification of test tracks for measuring noise emitted by road vehicles and their tyres,'' Second edition, 2011–02–01 into § 571.141.

(5) ISO 10844: 2014(E) ''Acoustics—Specification of test tracks for measuring noise emitted by road vehicles and their tyres,'' Third edition, 2014–05–15 into § 571.141.

(j) National Center for Health Statistics, Centers for Disease Control (CDC), National Division for Health Statistics, Division of Data Services, Hyattsville, MD 20782. Telephone: 1 (800) 232–4636. Web site: *https://www.cdc.gov/nchs*.

(1) DHEW Publication No. (HRA) 76–1074, ''Weight, Height, and Selected Body Dimensions of Adults: United States—1960–1962,'' first published as Public Health Service Publication No. 1000 Series 11–No. 8, June 1965, into § 571.3.

(2) [Reserved]

(k) National Highway Traffic Safety Administration (NHTSA), 1200 New Jersey Ave. SE., Washington, DC 20590. Web site: *https://www.nhtsa.gov*.

(1) Drawing Package, ''NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2003,'' (consisting of drawings and a bill of materials), June 3, 2003, into §571.213.

(2) Drawing Package, SAS–100–1000, Standard Seat Belt Assembly with Addendum A, Seat Base Weldment (consisting of drawings and a bill of materials), October 23, 1998, into §571.213.

(3) ''Parts List; Ejection Mitigation Headform Drawing Package,'' December 2010, into §571.226.

(4) ''Parts List and Drawings; Ejection Mitigation Headform Drawing Package'' December 2010, into §571.226.

(5) ''Parts List and Drawings, NHTSA Standard Seat Assembly; FMVSS No. 213a—Side impact No. NHTSA–213a-2021, CHILD SIDE IMPACT SLED'' dated December 2021; into §571.213a.

(6) NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2021, *Parts List and Drawings, NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2021, Child Frontal Impact Sled*, March 2023; into §571.213b.

(7) Drawing No. 210–5000–1 (L), –2(R), Leg Assembly, *Parts List and Drawings, Subpart P Hybrid III 3-year-old child crash test dummy, (H–III3C, Alpha version),* September 2001, Drawing No. 210–5000–1(L), –2(R), Leg Assembly; into §571.213b.

(8) ''Drawing Package for the Force Application Device 1 (FAD1),'' April 9, 2024, into §571.210.

(9) ''Drawing Package for the Force Application Device 2 (FAD2),'' April 9, 2024, into §571.210.

(10) Drawing Package, *Anchorage Depth Tool*, dated April 2020; approved for §571.225.

(11) Drawing Package, *Clearance Angle Tool*, dated April 2020; approved for §571.225.

(l) SAE International, 400 Commonwealth Drive, Warrendale, PA 15096. Telephone: (724) 776–4841; Web site: *https://www.sae.org*.

(1) SAE Recommended Practice J100–1995, ''Class 'A' Vehicle Glazing Shade Bands,'' revised June 1995, into §571.205.

(2) SAE Recommended Practice J211a, ''Instrumentation for Impact Tests,'' revised December 1971, into §571.222.

(3) SAE Recommended Practice J211, *Instrumentation for Impact Tests*, revised June 1980; into §571.218.

(4) SAE Recommended Practice J211/1, *Instrumentation for Impact Tests—Part 1—Electronic Instrumentation;* revised March 1995; §§571.202a; 571.208; 571.213; 571.213a; 571.213b; 571.218; 571.403.

(5) SAE Recommended Practice J211–1 DEC2003, ''Instrumentation for Impact Test—Part 1—Electronic Instrumentation,'' revised December 2003, into §§571.206; 571.209.

(6) SAE Recommended Practice J227a, ''Electric Vehicle Test Procedure,'' revised February 1976, into §§571.105; 571.135.

(7) SAE Standard J527a, ''Brazed Double Wall Low Carbon Steel Tubing,'' revised May 1967, into §571.116.

(8) SAE Recommended Practice J567b, ''Bulb Sockets,'' revised April 1964, into §571.108.

(9) SAE Recommended Practice J573d, ''Lamp Bulbs and Sealed Units,'' revised December 1968, into §571.108.

(10) SAE Recommended Practice J575–1983, ''Tests for Motor Vehicle Lighting Devices and Components,'' revised July 1983, into §571.131.

(11) SAE Recommended Practice J578, ''Color Specification,'' revised May 1988, into §571.131.

(12) SAE Recommended Practice J578–1995, ''Color Specification,'' revised June 1995, into §571.403.

(13) SAE Recommended Practice J592 JUN92, ''Clearance, Side Marker, and Identification Lamps,'' revised June 1992, into §571.121.

(14) SAE Recommended Practice J592e–1972, ''Clearance, Side Marker, and Identification Lamps,'' revised July 1972, into §571.121.

(15) SAE Recommended Practice J602–1963, ''Headlamp Aiming Device for Mechanically Aimable Sealed Beam Headlamp Units,'' reaffirmed August 1963, into §571.108.

(16) SAE Recommended Practice J602–1980, ''Headlamp Aiming Device for Mechanically Aimable Sealed Beam Headlamp Units,'' revised October 1980, into §571.108.

(17) SAE Recommended Practice J673a, ''Automotive Glazing,'' revised August 1967, into §571.205(a).

(18) SAE Recommended Practice J673, ''Automotive Safety Glasses,'' revised April 1993, into § 571.205.

(19) SAE Recommended Practice J726 SEP79, ''Air Cleaner Test Code,'' revised April 1979, into § 571.209.

(20) SAE Recommended Practice J759 JAN95, ''Lighting Identification Code,'' revised January 1995, into § 571.121.

(21) SAE Standard J787b, ''Motor Vehicle Seat Belt Anchorage,'' revised September 1966, into § 571.3.

(22) SAE Recommended Practice J800c, ''Motor Vehicle Seat Belt Assembly Installations,'' revised November 1973, into § 571.209.

(23) SAE Standard J826–1980, ''Devices for Use in Defining and Measuring Vehicle Seating Accommodation,'' revised April 1980, into §§ 571.208; 571.214.

(24) SAE Standard J826 MAY87, ''Devices for Use in Defining and Measuring Vehicle Seating Accommodation,'' revised May 1987, into §§ 571.3; 571.210.

(25) SAE Standard J826–1992, ''Devices for Use in Defining and Measuring Vehicle Seating Accommodation,'' revised June 1992, into § 571.225.

(26) SAE Standard J826 JUL95, ''Devices for Use in Defining and Measuring Vehicle Seating Accommodation,'' revised July 1995, into §§ 571.10; 571.111; 571.202; 571.202a; 571.216a.

(27) SAE Recommended Practice J839b, ''Passenger Car Side Door Latch Systems,'' revised May 1965, into § 571.201.

(28) SAE Recommended Practice J839–1991, ''Passenger Car Side Door Latch Systems,'' revised June 1991, into § 571.206.

(29) SAE Recommended Practice J902, ''Passenger Car Windshield Defrosting Systems,'' revised August 1964, into § 571.103.

(30) SAE Recommended Practice J902a, ''Passenger Car Windshield Defrosting Systems,'' revised March 1967 (Editorial change June 1967), into § 571.103.

(31) SAE Recommended Practice J903a, ''Passenger Car Windshield Wiper Systems,'' revised May 1966, into § 571.104.

(32) SAE Recommended Practice J921, ''Instrument Panel Laboratory Impact Test Procedure,'' approved June 1965, into § 571.201.

(33) SAE Recommended Practice J941, ''Passenger Car Driver's Eye Range,'' approved November 1965, into § 571.104.

(34) SAE Recommended Practice J941b, ''Motor Vehicle Driver's Eye Range,'' revised February 1969, into § 571.108.

(35) SAE Recommended Practice J942, ''Passenger Car Windshield Washer Systems,'' approved November 1965, into § 571.104.

(36) SAE Recommended Practice J944 JUN80, ''Steering Control System—Passenger Car—Laboratory Test Procedure,'' revised June 1980, into § 571.203.

(37) SAE Standard J964 OCT84, ''Test Procedure for Determining Reflectivity of Rear View Mirrors,'' reaffirmed October 1984, into § 571.111.

(38) SAE Recommended Practice J972, ''Moving Rigid Barrier Collision Tests,'' revised May 2000, into § 571.105.

(39) SAE Recommended Practice J977, ''Instrumentation for Laboratory Impact Tests,'' approved November 1966, into § 571.201.

(40) SAE Recommended Practice J1100a, ''Motor Vehicle Dimensions,'' revised September 1975, into § 571.3.

(41) SAE Recommended Practice J1100 JUN84, ''Motor Vehicle Dimensions,'' revised June 1984, into §§ 571.3; 571.210.

(42) SAE Recommended Practice J1100–1993, ''Motor Vehicle Dimensions,'' revised June 1993, into § 571.225.

(43) SAE Recommended Practice J1100, ''Motor Vehicle Dimensions,'' revised February 2001, into § 571.3.

(44) SAE Recommended Practice J1133, ''School Bus Stop Arm,'' revised April 1984, into § 571.131.

(45) SAE Standard J1703b, ''Motor Vehicle Brake Fluid,'' revised July 1970, into § 571.116.

(46) SAE Standard J1703 NOV83, ''Motor Vehicle Brake Fluid,'' revised November 1983, into § 571.116.

(47) SAE RM–66–04, ''Compatibility Fluid,'' Appendix B to SAE Standard J1703 JAN95, ''Motor Vehicle Brake Fluid,'' revised January 1995, into §§ 571.106; 571.116.

(48) SAE Recommended Practice J2009, ''Discharge Forward Lighting

Systems,'' revised February 1993, into § 571.108.

(49) SAE J2400, ''Human Factors in Forward Collision Warning Systems: Operating Characteristics and User Interface Requirements,'' August 2003 into § 571.127.

(50) SAE Standard J2889–1, ''Measurement of Minimum Noise Emitted by Road Vehicles,'' December 2014 into § 571.141.

(51) SAE Aerospace-Automotive Drawing Standards, issued September 1963, into §§ 571.104; 571.202.

(m) United Nations Economic Commission for Europe (UNECE), United Nations, Conference Services Division, Distribution and Sales Section, Office C.115–1, Palais des Nations, CH–1211, Geneva 10, Switzerland. Web site: *www.unece.org/trans/main/wp29/wp29regs.html*.

(1) UNECE Regulation 17 ''Uniform Provisions Concerning the Approval of Vehicles with Regard to the Seats, their Anchorages and Any Head Restraints'': ECE 17 Rev. 1/Add. 16/Rev. 4 (July 31, 2002), into § 571.202.

(2) UNECE Regulation 48 ''Uniform Provisions Concerning the Approval of Vehicles With Regard to the Installation of Lighting and Light-Signaling Devices,'' E/ECE/324–E/ECE/TRANS/505, Rev.1/Add.47/Rev.1/Corr.2 (February 26, 1996), into § 571.108.

[77 FR 752, Jan. 6, 2012, as amended at 77 FR 11647, Feb. 27, 2012; 77 FR 51671, Aug. 24, 2012; 78 FR 21852, Apr. 12, 2013; 79 FR 19243, Apr. 7, 2014; 80 FR 36100, June 23, 2015; 81 FR 90514, Dec. 14, 2016; 87 FR 34808, June 8, 2022; 87 FR 39309, Aug. 1, 2022; 88 FR 84586, Dec. 5, 2023; 89 FR 39779, May 9, 2024; 89 FR 76271, Sept. 17, 2024; 90 FR 1341, Jan. 7, 2025; 90 FR 6277, Jan. 17, 2025]

§ 571.7 Applicability.

(a) *General.* Except as provided in paragraphs (c) and (d) of this section, each standard set forth in subpart B of this part applies according to its terms to all motor vehicles or items of motor vehicle equipment the manufacture of which is completed on or after the effective date of the standard.

(b) [Reserved]

(c) *Military vehicles.* No standard applies to a vehicle or item of equipment manufactured for, and sold directly to, the Armed Forces of the United States in conformity with contractual specifications.

(d) *Export.* No standard applies to a vehicle or item of equipment in the circumstances provided in section 108(b)(5) of the Act (15 U.S.C. 1397 (b)(5)).

(e) *Combining new and used components.* When a new cab is used in the assembly of a truck, the truck will be considered newly manufactured for purposes of paragraph (a) of this section, the application of the requirements of this chapter, and the Act, unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle.

(f) *Combining new and used components in trailer manufacture.* When new materials are used in the assembly of a trailer, the trailer will be considered newly manufactured for purposes of paragraph (a) of this section, the application of the requirements of this chapter, and the Act, unless, at a minimum, the trailer running gear assembly (axle(s), wheels, braking and suspension) is not new, and was taken from an existing trailer—

(1) Whose identity is continued in the reassembled vehicle with respect to the Vehicle Identification Number; and

(2) That is owned or leased by the user of the reassembled vehicle.

[33 FR 19703, Dec. 25, 1968. Redesignated at 35 FR 5118, Mar. 26, 1970, and amended at 36 FR 7855, Apr. 27, 1971; 38 FR 12808, May 16, 1973; 40 FR 49341, Oct. 22, 1975; 41 FR 27074, July 1, 1976]

§ 571.8 Effective date.

(a) *Firefighting vehicles.* Notwithstanding the effective date provisions of the motor vehicle safety standards in this part, the effective date of any standard or amendment of a standard issued after September 1, 1971, to which firefighting vehicles must conform shall be, with respect to such vehicles, either 2 years after the date on which such standard or amendment is published in the rules and regulations section of the FEDERAL REGISTER, or the effective date specified in the notice, whichever is later, except as such standard or amendment may otherwise

specifically provide with respect to firefighting vehicles.

(b) *Vehicles built in two or more stages vehicles and altered vehicles.* Unless Congress directs or the agency expressly determines that this paragraph does not apply, the date for manufacturer certification of compliance with any standard, or amendment to a standard, that is issued on or after September 1, 2006 is, insofar as its application to intermediate and final-stage manufacturers and alterers is concerned, one year after the last applicable date for manufacturer certification of compliance. Nothing in this provision shall be construed as prohibiting earlier compliance with the standard or amendment or as precluding NHTSA from extending a compliance effective date for intermediate and final-stage manufacturers and alterers by more than one year.

[70 FR 7435, Feb. 14, 2005]

§ 571.9 Separability.

If any standard established in this part or its application to any person or circumstance is held invalid, the remainder of the part and the application of that standard to other persons or circumstances is not affected thereby.

[33 FR 19705, Dec. 25, 1968. Redesignated at 35 FR 5118, Mar. 26, 1970]

§ 571.10 Designation of seating positions.

(a) *Application.* This section applies to passenger cars, trucks, multipurpose passenger vehicles, and buses manufactured on or after September 1, 2010. However, paragraph (b) of this section does not apply to trucks and multipurpose passenger vehicles with a gross vehicle weight rating greater than 10,000 lbs, school buses, police vehicles as defined in S7 of Standard No. 208 (49 CFR 571.208), firefighting vehicles, ambulances, or motor homes. To determine the number of passenger seating positions in school buses, see S4.1 of Standard No. 222 (49 CFR 571.222).

(b) *Number of designated seating positions.* The formula for calculating the number of designated seating positions (N) for any seat location with a seating surface width greater than 330 mm (13 inches) is as follows:

(1) For seat locations with a seating surface width, as described in paragraph (c), of less than 1400 mm (55.2 inches): N = The greater of 1 or [seating surface width (in mm)/350] rounded down to the nearest whole number;

(2) For seat locations with a seating surface width, as described in paragraph (c), greater than or equal to 1400 mm (55.2 inches): N = No less than [seating surface width (in mm)/450] rounded down to the nearest whole number.

(c) *Seating surface measurement.* (1) As used in this section, ''seating surface'' only includes the seat cushion and soft trim and excludes unpadded trim components such as a decorative seat shield, seat adjusters, or adjuster covers. As used in paragraphs (c)(1)(ii) and (iii) of this section, ''outboard'' and ''inboard'' are determined with respect to the measurement zone established in paragraph (c)(1)(i) of this section. As used in this section, ''seating surface width'' is the maximum horizontal width of a seating surface determined by the following procedure:

(i) Establish a measurement zone bounded by two vertical planes oriented perpendicular to the direction the seat is facing. One is located 150 mm (5.9 inches) behind the front leading surface of the seat and the other is located 250 mm (9.8 inches) behind the front leading surface of the seat. A measurement location within this zone is any vertical plane parallel to the planes establishing the boundary of the zone.

(ii) For each measurement location within the zone, establish vertical reference planes parallel to the direction the seat faces that intersect the most outboard point on each side of the seating surface at that measurement location. If outboard interior trim contacts the top surface of the seat cushion, establish another vertical plane parallel to the direction the seat faces that intersects the most inboard point of contact between outboard interior trim and the top surface of the seat cushion.

(iii) For measurement within the zone, measure horizontally between and perpendicular to the most inboard vertical reference planes established in (ii), as shown in Figure 1 (provided for illustration purposes).

(2) Adjacent seating surfaces are considered to form a single, continuous seating surface whose overall width is measured as specified in (c)(1) of this section, unless

(i) The seating surfaces are separated by:

(A) A fixed trimmed surface whose top surface is unpadded and that has a width not less than 140 mm (5.5 inches), as measured in each transverse vertical plane within that measurement zone, or

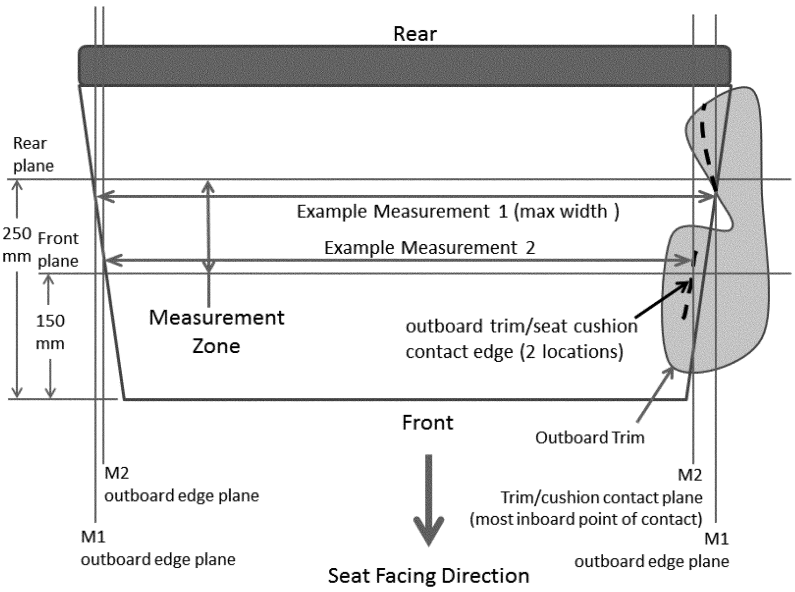
(B) A void whose cross section in each transverse vertical plane within that measurement zone is a rectangle that is not less than 140 mm (5.5 inches) wide and not less than 140 mm (5.5 inches) deep. The top edge of the cross section in any such plane is congruent with the transverse horizontal line that intersects the lowest point on the portion of the top profile of the seating surfaces that lie within that plane, or

(ii) Interior trim interrupts the measurement of the nominal hip room between adjacent seating surfaces, measured laterally along the ''X'' plane through the H-point. For purposes of this paragraph, the H-point is located using the SAE three-dimensional H-point machine per Society of Automotive Engineers (SAE) Surface Vehicle Standard J826, revised July 1995, ''Devices for Use in Defining and Measuring Vehicle Seating Accommodation'' (incorporated by reference, see section 571.5) with the legs and leg weights removed, or

(iii) The seating surfaces are adjacent outboard seats, and the lateral distance between any point on the seat cushion of one seat and any point on the seat cushion of the other seat is not less than 140 mm (5.5 inches).

(3) Folding, removable, and adjustable seats are measured in the configuration that results in the single largest maximum seating surface width.

FIGURE 1: Example Measurements for Seat Cushion Width



Plan view of a seat showing several example measurement locations for the determination of seating surface width. Measurement 1 is the seat surface width for this illustration.

[73 FR 58897, Oct. 8, 2008, as amended at 74 FR 68190, Dec. 23, 2009; 78 FR 68756, Nov. 15, 2013; 79 FR 57830, Sept. 26, 2014]

Subpart B—Federal Motor Vehicle Safety Standards

SOURCE: 36 FR 22902, Dec. 2, 1971, unless otherwise noted.

§ 571.101 Standard No. 101; Controls and displays.

S1. *Scope.* This standard specifies performance requirements for location, identification, color, and illumination of motor vehicle controls, telltales and indicators.

S2. *Purpose.* The purpose of this standard is to ensure the accessibility, visibility and recognition of motor vehicle controls, telltales and indicators, and to facilitate the proper selection of controls under daylight and nighttime conditions, in order to reduce the safety hazards caused by the diversion of the driver's attention from the driving task, and by mistakes in selecting controls.

S3. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S4. *Definitions.*

Adjacent, with respect to a control, telltale or indicator, and its identifier means:

(a) The identifier is in close proximity to the control, telltale or indicator; and

(b) No other control, telltale, indicator, identifier or source of illumination appears between the identifier and the telltale, indicator, or control that the identifier identifies.

Common space means an area on which more than one telltale, indicator, identifier, or other message may be displayed, but not simultaneously.

Control means the hand-operated part of a device that enables the driver to change the state or functioning of the vehicle or a vehicle subsystem.

Indicator means a device that shows the magnitude of the physical characteristics that the instrument is designed to sense.

Identifier means a symbol, word, or words used to identify a control, telltale, or indicator.

Multi-function control means a control through which the driver may select, and affect the operation of, more than one vehicle function.

Multi-task display means a display on which more than one message can be shown simultaneously.

Telltale means an optical signal that, when illuminated, indicates the actuation of a device, a correct or improper functioning or condition, or a failure to function.

S5. *Requirements.* Each passenger car, multipurpose passenger vehicle, truck and bus that is fitted with a control, a telltale or an indicator listed in Table 1 or Table 2 must meet the requirements of this standard for the location, identification, color, and illumination of that control, telltale or indicator. However, the requirements for telltales and indicators do not apply to vehicles with GVWRs of 4,536 kg or greater if these specified vehicles are manufactured before September 1, 2013.

S5.1 Location

S5.1.1 The controls listed in Table 1 and in Table 2 must be located so they are operable by the driver under the conditions of S5.6.2.

S5.1.2 The telltales and indicators listed in Table 1 and Table 2 and their identification must be located so that, when activated, they are visible to a driver under the conditions of S5.6.1 and S5.6.2.

S5.1.3 Except as provided in S5.1.4, the identification for controls, telltales and indicators must be placed on or adjacent to the telltale, indicator or control that it identifies.

S5.1.4 The requirement of S5.1.3 does not apply to a multi-function control, provided the multi-function control is associated with a multi-task display that:

(a) Is visible to the driver under the conditions of S5.6.1 and S5.6.2,

(b) Identifies the multi-function control with which it is associated graphically or using words,

(c) For multi-task displays with layers, identifies on the top-most layer each system for which control is possible from the associated multi-function control, including systems not otherwise regulated by this standard. Subfunctions of the available systems need not be shown on the top-most layer of the multi-task display, and

(d) Identifies the controls of Table 1 and Table 2 with the identification specified in those tables or otherwise required by this standard, whenever those are the active functions of the multi-function control. For lower levels of multi-task displays with layers, identification is permitted but not required for systems not otherwise regulated by this standard.

(e) Does not display telltales listed in Table 1 or Table 2.

S5.2 Identification

S5.2.1 Except for the Low Tire Pressure Telltale, each control, telltale and indicator that is listed in column 1 of Table 1 or Table 2 must be identified by the symbol specified for it in column 2 or the word or abbreviation specified for it in column 3 of Table 1 or Table 2. If a symbol is used, each symbol provided pursuant to this paragraph must be substantially similar in form to the symbol as it appears in Table 1 or Table 2. If a symbol is used, each symbol provided pursuant to this paragraph must have the proportional dimensional characteristics of the symbol as it appears in Table 1 or Table 2. The Low Tire Pressure Telltale (either the display identifying which tire has low pressure or the display which does not identify which tire has low pressure) shall be identified by the appropriate symbol designated in column 4, or both the symbol in column 4 and the words in column 3. No identification is required for any horn (*i.e.*, audible warning signal) that is activated by a lanyard or by the driver pressing on the center of the face plane of the steering wheel hub; or for a turn signal control that is operated in a plane essentially parallel to the face plane of the steering wheel in its normal driving position and which is located on the left side of the steering column so

that it is the control on that side of the column nearest to the steering wheel face plane. However, if identification is provided for a horn control in the center of the face plane of the steering wheel hub, the identifier must meet Table 2 requirements for the horn.

S5.2.2 Any symbol, word, or abbreviation not shown in Table 1 or Table 2 may be used to identify a control, a telltale or an indicator that is not listed in those tables.

S5.2.3 Supplementary symbols, words, or abbreviations may be used at the manufacturer's discretion in conjunction with any symbol, word, or abbreviation specified in Table 1 or Table 2.

S5.2.4 [Reserved]

S5.2.5 A single symbol, word, or abbreviation may be used to identify any combination of the control, indicator, and telltale for the same function.

S5.2.6 Except as provided in S5.2.7, all identifications of telltales, indicators and controls listed in Table 1 or Table 2 must appear to the driver to be perceptually upright. A rotating control that has an ''off'' position shall appear to the driver perceptually upright when the rotating control is in the ''off'' position.

S5.2.7 The identification of the following items need not appear to the driver to be perceptually upright:

(a) A horn control;

(b) Any control, telltale or indicator located on the steering wheel, when the steering wheel is positioned for the motor vehicle to travel in a direction other than straight forward; and

(c) Any rotating control that does not have an ''off'' position.

S5.2.8 Each control for an automatic vehicle speed system (cruise control) and each control for heating and air conditioning systems must have identification provided for each function of each such system.

S5.2.9 Each control that regulates a system function over a continuous range must have identification provided for the limits of the adjustment range of that function. If color coding is used to identify the limits of the adjustment range of a temperature function, the hot limit must be identified by the color red and the cold limit by the color blue. If the status or limit of a function is shown by a display not adjacent to the control for that function, both the control (unless it is a multi-function control complying with S5.1.4) and the display must be independently identified as to the function of the control, in compliance with S5.2.1, on or adjacent to the control and on or adjacent to the display.

Example 1. A slide lever controls the temperature of the air in the vehicle heating system over a continuous range, from no heat to maximum heat. Since the control regulates a single function over a quantitative range, only the extreme positions require identification.

Example 2. A switch has three positions, for heat, defrost, and air conditioning. Since each position regulates a different function, each position must be identified.

S5.3 Illumination

S5.3.1 Timing of illumination

(a) Except as provided in S5.3.1(c), the identifications of controls for which the word ''Yes'' is specified in column 5 of Table 1 must be capable of being illuminated whenever the headlamps are activated. This requirement does not apply to a control located on the floor, floor console, steering wheel, steering column, or in the area of windshield header, or to a control for a heating and air-conditioning system that does not direct air upon the windshield.

(b) Except as provided in S5.3.1(c), the indicators and their identifications for which the word ''Yes'' is specified in column 5 of Table 1 must be illuminated whenever the vehicle's propulsion system and headlamps are activated.

(c) The indicators, their identifications and the identifications of controls need not be illuminated when the headlamps are being flashed or operated as daytime running lamps.

(d) At the manufacturer's option, any control, indicator, or their identifications may be capable of being illuminated at any time.

(e) A telltale must not emit light except when identifying the malfunction or vehicle condition it is designed to indicate, or during a bulb check.

S5.3.2 Brightness of illumination of controls and indicators

S5.3.2.1 Means must be provided for illuminating the indicators, identifications of indicators and identifications

of controls listed in Table 1 to make them visible to the driver under daylight and nighttime driving conditions.

S5.3.2.2 The means of providing the visibility required by S5.3.2.1:

(a) Must be adjustable to provide at least two levels of brightness;

(b) At a level of brightness other than the highest level, the identification of controls and indicators must be barely discernible to the driver who has adapted to dark ambient roadway condition;

(c) May be operable manually or automatically; and

(d) May have levels of brightness, other than the two required visible levels of brightness, at which those items and identification are not visible.

(1) If the level of brightness is adjusted by automatic means to a point where those items or their identification are not visible to the driver, means shall be provided to enable the driver to restore visibility.

S5.3.3 Brightness of telltale illumination

(a) Means must be provided for illuminating telltales and their identification sufficiently to make them visible to the driver under daylight and nighttime driving conditions.

(b) The means for providing the required visibility may be adjustable manually or automatically, except that the telltales and identification for brakes, highbeams, turn signals, and safety belts may not be adjustable under any driving condition to a level that is invisible.

S5.3.4 *Brightness of interior lamps.* (a) Any source of illumination within the passenger compartment which is forward of a transverse vertical plane 110 mm rearward of the manikin ''H'' point with the driver's seat in its rearmost driving position, which is not used for the controls and displays regulated by this standard, which is not a telltale, and which is capable of being illuminated while the vehicle is in motion, shall have either:

(1) Light intensity which is manually or automatically adjustable to provide at least two levels of brightness;

(2) A single intensity that is barely discernible to a driver who has adapted to dark ambient roadway conditions;or

(3) A means of being turned off.

(b) Paragraph (a) of S5.3.4 does not apply to buses that are normally operated with the passenger compartment illuminated.

S5.3.5 The provisions of S5.3.4 do not apply to buses that are normally operated with the passenger compartment illuminated.

S5.4 Color

S5.4.1 The light of each telltale listed in Table 1 must be of the color specified for that telltale in column 6 of that table.

S5.4.2 Any indicator or telltale not listed in Table 1 and any identification of that indicator or telltale must not be a color that masks the driver's ability to recognize any telltale, control, or indicator listed in Table 1.

S5.4.3 Each identifier used for the identification of a telltale, control or indicator must be in a color that stands out clearly against the background. However, this requirement does not apply to an identifier for a horn control in the center of the face plane of the steering wheel hub. For vehicles with a GVWR of under 4,536 kg (10,000 pounds), the compliance date for this provision is September 1, 2011. For vehicles with a GVWR of 4,536 kg (10,000 pounds) or over, the compliance date for this provision is September 1, 2013.

S5.5 Common space for displaying multiple messages

S5.5.1 A common space may be used to show messages from any sources, subject to the requirements in S5.5.2 through S5.5.6.

S5.5.2 The telltales for any brake system malfunction required by Table 1 to be red, air bag malfunction, low tire pressure, electronic stability control malfunction (as of September 1, 2011), passenger air bag off, high beam, turn signal, and seat belt must not be shown in the same common space.

S5.5.3 The telltales and indicators that are listed in Table 1 and are shown in the common space must illuminate at the initiation of any underlying condition.

S5.5.4 Except as provided in S5.5.5, when the underlying conditions exist for actuation of two or more telltales, the messages must be either:

(a) Repeated automatically in sequence, or

(b) Indicated by visible means and capable of being selected for viewing by the driver under the conditions of S5.6.2.

S5.5.5 In the case of the telltale for a brake system malfunction, air bag malfunction, side air bag malfunction, low tire pressure, electronic stability control malfunction (as of September 1, 2011), passenger air bag off, high beam, turn signal, or seat belt that is designed to display in a common space, that telltale must displace any other symbol or message in that common space while the underlying condition for the telltale's activation exists.

S5.5.6(a) Except as provided in S5.5.6(b) and (c), messages displayed in a common space may be cancelable automatically or by the driver.

(b) Telltales for high beams, turn signal, low tire pressure, and passenger air bag off, and telltales for which the color red is required in table 1 to this section must not be cancelable while the underlying condition for their activation exists.

(c) Telltales for the seat belts must not be cancelable by the driver before the minimum durations are satisfied but may be cancellable automatically as specified in FMVSS No. 208 (§ 571.208).

S5.6 Conditions

S5.6.1 The driver has adapted to the ambient light roadway conditions.

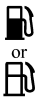
S5.6.2 The driver is restrained by the seat belts installed in accordance with 49 CFR 571.208 and adjusted in accordance with the vehicle manufacturer's instructions.

Table 1 to §571.101

Controls, Telltales, and Indicators With Illumination or Color Requirements[1]

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE-VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN-ATION	Column 6 COLOR
Highbeam [2]	 [3, 5]	-------	Telltale	-------	Blue or Green [4]
Turn signals [2]	 [3, 6]	-------	Control	-------	-------
			Telltale	-------	Green [4]
Hazard warning signal	 [3]	Hazard	Control	Yes	-------
		-------	Telltale [7]	-------	-------
Position, side marker, end-outline marker, identification, or clearance lamps	 [3,8]	Marker Lamps or MK Lps [8]	Control	Yes	-------
Windshield wiping system		Wiper or Wipe	Control	Yes	-------
Windshield washing system		Washer or Wash	Control	Yes	-------
Windshield washing and wiping system combined		Washer-Wiper or Wash-Wipe	Control	Yes	-------
Windshield defrosting and defogging system		Defrost, Defog, or Def.	Control	Yes	-------
Rear window defrosting and defogging system		Rear Defrost, Rear Defog, Rear Def., or R-Def.	Control	Yes	-------
Brake system malfunction	-------	Brake	Telltale	-------	Red [4]
Antilock brake system malfunction for vehicles subject to FMVSS 105 or 135	-------	Antilock, Anti-lock, or ABS [9]	Telltale	-------	Yellow

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE-VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN-ATION	Column 6 COLOR
Malfunction in Variable Brake Proportioning System	-------	Brake Proportioning [9]	Telltale	-------	Yellow
Regenerative brake system malfunction	-------	RBS or ABS/RBS [9]	Telltale	-------	Yellow
Malfunction in antilock system for vehicles other than trailers subject to FMVSS 121	-------	ABS or Antilock [9]	Telltale	-------	Yellow
Antilock brake system trailer fault for vehicles subject to FMVSS 121		Trailer ABS or Trailer Antilock	Telltale	-------	Yellow
Brake pressure (for vehicles subject to FMVSS 105 or 135)	-------	Brake Pressure [9]	Telltale	-------	Red [4]
Low brake fluid condition (for vehicles subject to FMVSS 105 or 135)	-------	Brake Fluid [9]	Telltale	-------	Red [4]
Parking brake applied (for vehicles subject to FMVSS 105 or 135)	-------	Park or Parking Brake [9]	Telltale	-------	Red [4]
Brake lining wear-out condition (for vehicles subject to FMVSS 135)	-------	Brake Wear [9]	Telltale	-------	Red [4]
Electronic Stability Control System Malfunction (for vehicles subject to FMVSS 126) [10, 11]		ESC [12]	Telltale	-------	Yellow
Electronic Stability Control System "OFF" (for vehicles subject to FMVSS 126) [10]		ESC OFF	Control	Yes	-------
			Telltale	-------	Yellow

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE-VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN-ATION	Column 6 COLOR
Electronic Stability Control System Malfunction (for vehicles subject to FMVSS 136) [11]		ESC	Telltale	-------	Yellow
Fuel Level		Fuel	Telltale	-------	-------
			Indicator	Yes	-------
Engine oil pressure	 [13]	Oil	Telltale	-------	-------
			Indicator	Yes	-------
Engine coolant temperature	 [13]	Temp	Telltale	-------	-------
			Indicator	Yes	-------
Electrical charge		Volts or Charge or Amp	Telltale	-------	-------
			Indicator	Yes	-------
Engine stop	-------	Engine Stop [14]	Control	Yes	-------
Automatic vehicle speed (cruise control)	-------	-------	Control	Yes	-------
Speedometer	-------	MPH, or MPH and km/h [15]	Indicator	Yes	-------
Heating and Air conditioning system	-------	-------	Control	Yes	-------

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE-VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN-ATION	Column 6 COLOR
Automatic *(park)* transmission *(reverse)* control *(neutral)* position *(drive)*	-------	P R N D [16]	Indicator	Yes	-------
Heating and/or air conditioning fan	 or	Fan	Control	Yes	-------
Low Tire Pressure (including malfunction) (See FMVSS 138)	 [17]	Low Tire [17]	Telltale	-------	Yellow
Low Tire Pressure (including malfunction that identifies involved tire) (See FMVSS 138)	 [17]	Low Tire [17]	Telltale	-------	Yellow
Tire Pressure Monitoring System Malfunction (See FMVSS 138) [18]	-------	TPMS [17, 19]	Telltale	-------	Yellow
Rear Seat Belt Warning[20]	-------	-------	Telltale	-------	Green or Red[21]

Notes to table 1 to § 571.101:

[1] An identifier is shown in this table if it is required for a control for which an illumination requirement exists or if it is used for a telltale for which a color requirement exists. If a line appears in column 2 and column 3, the control, telltale, or indicator is required to be identified, however the form of the identification is the manufacturer's option. Telltales are not considered to have an illumination requirement, because by definition the telltale must light when the condition for its activation exists.

[2] Additional requirements in FMVSS 108.

[3] Framed areas of the symbol may be solid; solid areas may be framed.

[4] Blue may be blue-green. Red may be red-orange.

[5] Symbols employing four lines instead of five may also be used.

[6] The pair of arrows is a single symbol. When the controls or telltales for left and right turn operate independently, however, the two arrows may be considered separate symbols and be spaced accordingly.

[7] Not required when arrows of turn signal telltales that otherwise operate independently flash simultaneously as hazard warning telltale.

[8] Separate identification is not required if function is combined with master lighting switch.

[9] Refer to FMVSS 105 or FMVSS 135, as appropriate, for additional specific requirements for brake telltale labeling and color. If a single telltale is used to indicate more than one brake system condition, the brake system malfunction identifier must be used.

[10] Requirement effective September 1, 2011.

[11] A manufacturer may use this telltale in flashing mode to indicate ESC operation.

[12] This symbol may also be used to indicate the malfunction of related systems/functions, including traction control, trailer stability assist, comer brake control, and other similar functions that use throttle and/or individual wheel torque control to operate and share common components with ESC.

[13] Combination of the engine oil pressure symbol and the engine coolant temperature symbol in a single telltale is permitted.

[14] Use when engine control is separate from the key locking system.

[15] If the speedometer is graduated in both miles per hour and in kilometers per hour, the scales must be identified "MPH" and "km/h", respectively, in any combination of upper- and lowercase letters.

[16] The letters 'P', 'R', 'N', and 'D' are considered separate identifiers for the individual gear positions. Their locations within the vehicle, and with respect to each other, are governed by FMVSS 102. The letter 'D' may be replaced by another alphanumeric character or symbol chosen by the manufacturer.

[17] Required only for FMVSS 138 compliant vehicles.

[18] Alternatively, either low tire pressure telltale may be used to indicate a TPMS malfunction. See FMVSS 138.

[19] Required only for vehicles manufactured on or after September I, 2007.

[20] Refer to FMVSS 208 for additional requirements.

[21] These are the colors if symbols or numbers are chosen. If a symbol or number is used to indicate to the driver how many or which rear seat belts are in use, the color of the illuminated symbol or number must be green. If a symbol or number is used to indicate to the driver how many or which rear seat belts are not in use, or how many or which rear seat belts have undergone a change of status from in use to not in use, the color of the illuminated symbol or number must be red. See FMVSS 208 S7.5(c)(3).

Table 2 to § 571.101

Identifiers for Controls, Telltales, and Indicators with No Color or Illumination Requirements

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORD(S) OR ABBREVIATION
Hand Throttle Control	-	Throttle
Engine Start Control	-	Engine Start[1]
Manual Choke Control	-	Choke
Odometer	-	Kilometers or km, if kilometers are shown. Otherwise, no identifier is required.[2]
Horn		Hom
Master Lighting Switch	 [3]	Lights
Headlamps and Taillamps Control	-	- [4,5]
Low Brake Air Pressure Telltale (for vehicles subject to FMVSS 121)	-	Brake Air
Front Seat Belt Unfastened Telltale		Fasten Belts or Fasten Seat Belts

Notes to table 2 to § 571.101:1. Use when engine control is separate from the key locking system.

2. Any combination of upper- or lowercase letters may be used.

3. Framed areas may be filled.

4. If a line appears in Column 2 and Column 3, the Control, Telltale or Indicator is required to be identified, however the form of the identification is the manufacturer's option.

5. Separate identification not required if function is combined with Master Lighting Switch.

[70 FR 48305, Aug. 17, 2005, as amended at 71 FR 27971, May 15, 2006; 72 FR 17305, Apr. 6, 2007; 73 FR 54537, Sept. 22, 2008; 74 FR 40764, Aug. 13, 2009; 80 FR 36100, June 23, 2015; 80 FR 54734, Sept. 11, 2015; 90 FR 459, Jan. 3, 2025]

§ 571.102 Standard No. 102; Transmission shift position sequence, starter interlock, and transmission braking effect.

S1. Purpose and scope. This standard specifies the requirements for the transmission shift position sequence, a starter interlock, and for a braking effect of automatic transmissions, to reduce the likelihood of shifting errors, to prevent starter engagement by the driver when the transmission is in any drive position, and to provide supplemental braking at speeds below 40 kilometers per hour (25 miles per hour).

S2. Application. This standard applies to passenger cars, multi-purpose passenger vehicles, trucks, and buses.

S3. Requirements.

S3.1 Automatic transmissions.

S3.1.1 Location of transmission shift positions on passenger cars. A neutral

position shall be located between forward drive and reverse drive positions.

S3.1.1.1 Transmission shift levers. If a steering-column-mounted transmission shift lever is used, movement from neutral position to forward drive position shall be clockwise. If the transmission shift lever sequence includes a park position, it shall be located at the end, adjacent to the reverse drive position.

S3.1.2 Transmission braking effect. In vehicles having more than one forward transmission gear ratio, one forward drive position shall provide a greater degree of engine braking than the highest speed transmission ratio at vehicle speeds below 40 kilometers per hour (25 miles per hour).

S3.1.3 Starter interlock. Except as provided in S3.1.3.1 through S3.1.3.3, the engine starter shall be inoperative when the transmission shift position is in a forward or reverse drive position.

S3.1.3.1 After the driver has activated the vehicle's propulsion system:

(a) The engine may stop and restart automatically when the transmission shift position is in any forward drive gear;

(b) The engine may not automatically stop when the transmission is in reverse gear; and

(c) The engine may automatically restart in reverse gear only if the vehicle satisfies (1) and (2):

(1) When the engine is automatically stopped in a forward drive shift position and the driver selects Reverse, the engine restarts immediately whenever the service brake is applied.

(2) When the engine is automatically stopped in a forward drive shift position and the driver selects Reverse, the engine does not start automatically if the service brake is not applied.

S3.1.3.2 Notwithstanding S3.1.3.1, the engine may stop and start at any time after the driver has activated the vehicle's propulsion system if the vehicle can meet the requirements specified in paragraphs (a) and (b):

(a) For passenger cars, multi-purpose passenger vehicles, trucks and buses with a GVWR less than or equal to 4,536 kg (10,000 pounds), the vehicle's propulsion system can propel the vehicle in the normal travel mode in all forward and reverse drive gears without the engine operating. For passenger cars, multipurpose passenger vehicles, trucks and buses with a GVWR greater than 4,536 kg (10,000 pounds), the vehicle's propulsion system can propel the vehicle in the normal travel mode in Reverse and at least one forward drive gear without the engine operating.

(b) If the engine automatically starts while the vehicle is traveling at a steady speed and steady accelerator control setting, the engine does not cause the vehicle to accelerate.

S3.1.3.3 If the transmission shift position is in Park, automatically stopping or restarting the engine shall not take the transmission out of Park.

S3.1.4 Identification of shift positions and of shift position sequence.

S3.1.4.1 Except as specified in S3.1.4.3, if the transmission shift position sequence includes a park position, identification of shift positions, including the positions in relation to each other and the position selected, shall be displayed in view of the driver whenever any of the following conditions exist:

(a) The ignition is in a position where the transmission can be shifted; or

(b) The transmission is not in park.

S3.1.4.2 Except as specified in S3.1.4.3, if the transmission shift position sequence does not include a park position, identification of shift positions, including the positions in relation to each other and the position selected, shall be displayed in view of the driver whenever the ignition is in a position in which the engine is capable of operation.

S3.1.4.3 Such information need not be displayed when the ignition is in a position that is used only to start the vehicle.

S3.1.4.4 All of the information required to be displayed by S3.1.4.1 or S3.1.4.2 shall be displayed in view of the driver in a single location. At the option of the manufacturer, redundant displays providing some or all of the information may be provided.

S3.2 Manual transmissions. Identification of the shift lever pattern of manual transmissions, except three forward speed manual transmissions having the standard ''H'' pattern, shall be displayed in view of the driver at all

times when a driver is present in the driver's seating position.

[70 FR 38051, July 1, 2005, as amended at 70 FR 75965, Dec. 22, 2005]

§ 571.103 Standard No. 103; Windshield defrosting and defogging systems.

S1. *Scope.* This standard specifies requirements for windshield defrosting and defogging systems.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. *Definitions. Road load* means the power output required to move a given motor vehicle at curb weight plus 180 kilograms on level, clean, dry, smooth portland cement concrete pavement (or other surface with equivalent coefficient of surface friction) at a specified speed through still air at 20 degrees Celsius, and standard barometric pressure (101.3 kilopascals) and includes driveline friction, rolling friction, and air resistance.

S4. *Requirements.* (a) Except as provided in paragraph (b) of this section, each passenger car shall meet the requirements specified in S4.1, S4.2, and S4.3, and each multipurpose passenger vehicle, truck, and bus shall meet the requirements specified in § 4.1.

(b) Each passenger car, multipurpose passenger vehicle, truck, and bus manufactured for sale in the noncontinental United States may, at the option of the manufacturer, have a windshield defogging system which operates either by applying heat to the windshield or by dehumidifying the air inside the passenger compartment of the vehicle, in lieu of meeting the requirements specified by paragraph (a) of this section.

S4.1 Each vehicle shall have a windshield defrosting and defogging system.

S4.2 Each passenger car windshield defrosting and defogging system shall meet the requirements of section 3 of SAE Recommended Practice J902 (1964) (incorporated by reference, see § 571.5) when tested in accordance with S4.3, except that ''the critical area'' specified in paragraph 3.1 of SAE Recommended Practice J902 (1964) shall be that established as Area C in accordance with Motor Vehicle Safety Standard No. 104, ''Windshield Wiping and Washing Systems,'' and ''the entire windshield'' specified in paragraph 3.3 of SAE Recommended Practice J902 (1964) shall be that established as Area A in accordance with § 571.104.

S4.3 *Demonstration procedure.* The passenger car windshield defrosting and defogging system shall be tested in accordance with the portions of paragraphs 4.1 through 4.4.7 of SAE Recommended Practice J902 (1964) or SAE Recommended Practice J902a (1967) (both incorporated by reference, see § 571.5) applicable to that system, except that—

(a) During the first 5 minutes of the test:

(1) For a passenger car equipped with a heating system other than a heat exchanger type that uses the engine's coolant as a means to supply the heat to the heat exchanger, the warm-up procedure is that specified by the vehicle's manufacturer for cold weather starting, except that connection to a power or heat source external to the vehicle is not permitted.

(2) For all other passenger cars, the warm-up procedure may be that recommended by the vehicle's manufacturer for cold weather starting.

(b) During the last 35 minutes of the test period (or the entire test period if the 5-minute warm-up procedure specified in paragraph (a) of this section is not used),

(1) For a passenger car equipped with a heating system other than a heat exchanger type that uses the engine's coolant as a means to supply the heat to the heat exchanger, the procedure shall be that specified by the vehicle's manufacturer for cold weather starting, except that connection to a power or heat source external to the vehicle is not permitted.

(2) For all other passenger cars, either—

(i) The engine speed shall not exceed 1,500 r.p.m. in neutral gear; or

(ii) The engine speed and load shall not exceed the speed and load at 40 kilometers per hour in the manufacturer's recommended gear with road load;

(c) A room air change of 90 times per hour is not required;

(d) The windshield wipers may be used during the test if they are operated without manual assist;

(e) One or two windows may be open a total of 25 millimeters;

(f) The defroster blower may be turned on at any time; and

(g) The wind velocity is at any level from 0 to 3 kilometers per hour.

(h) The test chamber temperature and the wind velocity shall be measured, after the engine has been started, at the forwardmost point of the vehicle or a point 914 millimeters from the base of the windshield, whichever is farther forward, at a level halfway between the top and bottom of the windshield on the vehicle centerline.

[36 FR 22902, Dec. 2, 1971, as amended at 40 FR 12992, Mar. 24, 1975; 40 FR 32336, Aug. 1, 1975; 50 FR 48775, Nov. 27, 1985; 59 FR 11006, Mar. 9, 1994; 60 FR 13642, Mar. 14, 1995; 77 FR 755, Jan. 6, 2012]

§571.104 Standard No. 104; Windshield wiping and washing systems.

S1. *Scope.* This standard specifies requirements for windshield wiping and washing systems.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. *Definitions.* The term *seating reference point* is substituted for the terms *manikin H point, manikin H point with seat in rearmost position* and *H point* wherever any of these terms appear in any SAE Standard or SAE Recommended Practice referred to in this standard.

Daylight opening means the maximum unobstructed opening through the glazing surface, as defined in paragraph 2.3.12 of section E, ''Ground Vehicle Practice,'' of SAE Aerospace-Automotive Drawing Standards (1963) (incorporated by reference, see §571.5).

Glazing surface reference line means the line resulting from the intersection of the glazing surface and a horizontal plane 635 millimeters above the seating reference point, as shown in Figure 1 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5).

Overall width means the maximum overall body width dimension ''W116'', as defined in section E, ''Ground Vehicle Practice,'' of SAE Aerospace-Automotive Drawing Standards (1963) (incorporated by reference, see §571.5).

Plan view reference line means—

(a) For vehicles with bench-type seats, a line parallel to the vehicle longitudinal centerline outboard of the steering wheel centerline 0.15 times the difference between one-half of the shoulder room dimension and the steering wheel centerline-to-car-centerline dimension as shown in Figure 2 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5); or

(b) For vehicles with individual-type seats, either—

(i) A line parallel to the vehicle longitudinal centerline which passes through the center of the driver's designated seating position; or

(ii) A line parallel to the vehicle longitudinal centerline located so that the geometric center of the 95 percent eye range contour is positioned on the longitudinal centerline of the driver's designated seating position.

Shoulder room dimension means the front shoulder room dimension ''W3'' as defined in section E, ''Ground Vehicle Practice,'' of SAE Aerospace-Automotive Drawing Standards (1963) (incorporated by reference, see §571.5).

95 percent eye range contour means the 95th percentile tangential cutoff specified in SAE Recommended Practice J941 (1965) (incorporated by reference, see §571.5).

S4. *Requirements.*

S4.1 *Windshield wiping system.* Each vehicle shall have a power-driven windshield wiping system that meets the requirements of S4.1.1.

S4.1.1 *Frequency.*

S4.1.1.1 Each windshield wiping system shall have at least two frequencies or speeds.

S4.1.1.2 One frequency or speed shall be at least 45 cycles per minute regardless of engine load and engine speed.

S4.1.1.3 Regardless of engine speed and engine load, the highest and one lower frequency or speed shall differ by at least 15 cycles per minute. Such lower frequency or speed shall be at least 20 cycles per minute regardless of engine speed and engine load.

S4.1.1.4 Compliance with subparagraphs S4.1.1.2 and S4.1.1.3 may be demonstrated by testing under the conditions specified in sections 4.1.1 and 4.1.2 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5).

S4.1.2 *Wiped area.* When tested wet in accordance with SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5), each passenger car windshield wiping system shall wipe the percentage of Areas A, B, and C of the windshield (established in accordance with S4.1.2.1) that (1) is specified in column 2 of the applicable table following subparagraph S4.1.2.1 and (2) is within the area bounded by a perimeter line on the glazing surface 25 millimeters from the edge of the daylight opening.

S4.1.2.1 Areas A, B, and C shall be established as shown in Figures 1 and 2 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5) using the angles specified in Columns 3 through 6 of Table I, II, III, or IV, as applicable.

TABLE I—PASSENGER CARS OF LESS THAN 1520 MILLIMETERS IN OVERALL WIDTH

Column 1—Area	Column 2—Minimum percent to be wiped	Angles in degrees			
		Column 3—Left	Column 4—Right	Column 5—Up	Column 6—Down
A	80	16	49	7	5
B	94	13	46	4	3
C	99	7	15	3	1

TABLE II—PASSENGER CARS OF 1520 OR MORE BUT LESS THAN 1630 MILLIMETERS IN OVERALL WIDTH

Column 1—Area	Column 2—Minimum percent to be wiped	Angles in degrees			
		Column 3—Left	Column 4—Right	Column 5—Up	Column 6—Down
A	80	17	51	8	5
B	94	13	49	4	3
C	99	7	15	3	1

TABLE III—PASSENGER CARS OF 1630 OR MORE BUT LESS THAN 1730 MILLIMETERS IN OVERALL WIDTH

Column 1—Area	Column 2—Minimum percent to be wiped	Angles in degrees			
		Column 3—Left	Column 4—Right	Column 5—Up	Column 6—Down
A	80	17	53	9	5
B	94	14	51	5	3

TABLE III—PASSENGER CARS OF 1630 OR MORE BUT LESS THAN 1730 MILLIMETERS IN OVERALL WIDTH—Continued

Column 1—Area	Column 2—Minimum percent to be wiped	Angles in degrees			
		Column 3—Left	Column 4—Right	Column 5—Up	Column 6—Down
C	99	8	15	4	1

TABLE IV—PASSENGER CARS OF 1730 OR MORE MILLIMETERS IN OVERALL WIDTH

Column 1—Area	Column 2—Minimum percent to be wiped	Angles in degrees			
		Column 3—Left	Column 4—Right	Column 5—Up	Column 6—Down
A	80	18	56	10	5
B	94	14	53	5	3
C	99	10	15	5	1

S4.2 *Windshield washing system.*

S4.2.1 Each passenger car shall have a windshield washing system that meets the requirements of SAE Recommended Practice J942 (1965) (incorporated by reference, see §571.5), except that the reference to ''the effective wipe pattern defined in SAE J903, paragraph 3.1.2'' in paragraph 3.1 of SAE Recommended Practice J942 (1965) shall be deleted and ''the areas established in accordance with subparagraph S4.1.2.1 of Motor Vehicle Safety Standard No. 104'' shall be inserted in lieu thereof.

S4.2.2 Each multipurpose passenger vehicle, truck, and bus shall have a windshield washing system that meets the requirements of SAE Recommended Practice J942 (1965) (incorporated by reference, see §571.5), except that the reference to ''the effective wipe pattern defined in SAE J903, paragraph 3.1.2'' in paragraph 3.1 of SAE Recommended Practice J942 (1965) shall be deleted and ''the pattern designed by the manufacturer for the windshield wiping system on the exterior surface of the windshield glazing'' shall be inserted in lieu thereof.

[36 FR 22902, Dec. 2, 1971, as amended at 58 FR 13023, Mar. 9, 1993; 60 FR 13643, Mar. 14, 1995; 63 FR 51000, Sept. 24, 1998; 77 FR 755, Jan. 6, 2012]

§571.105 Standard No. 105; Hydraulic and electric brake systems.

S1. *Scope.* This standard specifies requirements for hydraulic and electric service brake systems, and associated parking brake systems.

S2. *Purpose.* The purpose of this standard is to insure safe braking performance under normal and emergency conditions.

S3. *Application.* This standard applies to multi-purpose passenger vehicles, trucks, and buses with a GVWR greater than 3,500 kilograms (7,716 pounds) that are equipped with hydraulic or electric brake systems.

S4. *Definitions.*

Antilock brake system or *ABS* means a portion of a service brake system that automatically controls the degree of rotational wheel slip during braking by:

(1) Sensing the rate of angular rotation of the wheels;

(2) Transmitting signals regarding the rate of wheel angular rotation to one or more controlling devices which interpret those signals and generate responsive controlling output signals; and

(3) Transmitting those controlling signals to one or more modulators which adjust brake actuating forces in response to those signals.

Backup system means a portion of a service brake system, such as a pump, that automatically supplies energy, in the event of a primary brake power source failure.

Brake power assist unit means a device installed in a hydraulic brake system that reduces the operator effort required to actuate the system, and that if inoperative does not prevent the operator from braking the vehicle by a continued application of muscular force on the service brake control.

Brake power unit means a device installed in a brake system that provides the energy required to actuate the brakes, either directly or indirectly through an auxiliary device, with the operator action consisting only of modulating the energy application level.

Directly Controlled Wheel means a wheel for which the degree of rotational wheel slip is sensed, either at that wheel or on the axle shaft for that wheel and corresponding signals are transmitted to one or more modulators that adjust the brake actuating forces at that wheel. Each modulator may also adjust the brake actuating forces at other wheels that are on the same axle or in the same axle set in response to the same signal or signals.

Electric vehicle or *EV* means a motor vehicle that is powered by an electric motor drawing current from rechargeable storage batteries, fuel cells, or other portable sources of electrical current, and which may include a non-electrical source of power designed to charge batteries and components thereof.

Electrically-actuated service brakes means service brakes that utilize electrical energy to actuate the foundation brakes.

Full brake application means a brake application in which the force on the brake pedal reaches 150 pounds within 0.3 seconds from the point of application of force to the brake control.

Hydraulic brake system means a system that uses hydraulic fluid as a medium for transmitting force from a service brake control to the service brake, and that may incorporate a brake power assist unit, or a brake power unit.

Indirectly Controlled Wheel means a wheel at which the degree of rotational wheel slip is not sensed, but at which the modulator of an antilock braking system adjusts its brake actuating forces in response to signals from one or more sensed wheels.

Initial brake temperature means the average temperature of the service brakes on the hottest axle of the vehicle 0.2 mi before any brake application.

Lightly loaded vehicle weight means:

(a) For vehicles with a GVWR of 10,000 lbs. or less, unloaded vehicle weight plus 400 lbs. (including driver and instrumentation);

(b) For vehicles with a GVWR greater than 10,000 lbs., unloaded vehicle weight plus 500 lbs. (including driver and instrumentation).

Maximum drive-through speed means the highest possible constant speed at which the vehicle can be driven through 200 feet of a 500-foot radius curve arc without leaving the 12-foot lane.

Parking mechanism means a component or subsystem of the drive train that locks the drive train when the transmission control is placed in a parking or other gear position and the ignition key is removed.

Peak friction coefficient or *PFC* means the ratio of the maximum value of braking test wheel longitudinal force to the simultaneous vertical force occurring prior to wheel lockup, as the braking torque is progressively increased.

Pressure component means a brake system component that contains the brake system fluid and controls or senses the fluid pressure.

Regenerative braking system or *RBS* means an electrical energy system that is installed in an EV for recovering or dissipating kinetic energy, and which uses the propulsion motor(s) as a retarder for partial braking of the EV while returning electrical energy to the propulsion batteries or dissipating electrical energy.

Skid number means the frictional resistance of a pavement measured in accordance with ASTM E274–70 (incorporated by reference, see § 571.5) at 40 mph, omitting water delivery as specified in paragraphs 7.1 and 7.2 of that method.

Snub means the braking deceleration of a vehicle from a higher reference speed to a lower reference speed that is greater than zero.

Spike stop means a stop resulting from the application of 200 lbs of force on the service brake control in 0.08 s.

Split service brake system means a brake system consisting of two or more subsystems actuated by a single control, designed so that a single failure in any subsystem (such as a leakage-type failure of a pressure component of a hydraulic subsystem except structural failure of a housing that is common to two or more subsystems, or an electrical failure in an electric subsystem) does not impair the operation of any other subsystem.

Stopping distance means the distance traveled by a vehicle from the point of application of force to the brake control to the point at which the vehicle reaches a full stop.

Tandem axle means a group of two or more axles placed in close arrangement one behind the other with the center lines of adjacent axles not more than 72 inches apart.

Variable proportioning brake system means a system that automatically adjusts the braking force at the axles to compensate for vehicle static axle loading and/or dynamic weight transfer between axles during deceleration.

Wheel lockup means 100 percent wheel slip.

S5. *Requirements.*

S5.1 *Service brake systems.* Each vehicle must be equipped with a service brake system acting on all wheels. Wear of the service brake must be compensated for by means of a system of automatic adjustment. Each passenger car and each multipurpose passenger vehicle, truck, and bus with a GVWR of 10,000 pounds or less must be capable of meeting the requirements of S5.1.1 through S5.1.6 under the conditions prescribed in S6, when tested according to the procedures and in the sequence set forth in S7. Each school bus with a GVWR greater than 10,000 pounds must be capable of meeting the requirements of S5.1.1 through S5.1.5, and S5.1.7 under the conditions specified in S6, when tested according to the procedures and in the sequence set forth in S7. Each multipurpose passenger vehicle, truck and bus (other than a school bus) with a GVWR greater than 10,000 pounds must be capable of meeting the requirements of S5.1.1, S5.1.2, S5.1.3, and S5.1.7 under the conditions specified in S6, when tested according to the procedures and in the sequence set forth in S7. Except as noted in S5.1.1.2 and S5.1.1.4, if a vehicle is incapable of attaining a speed specified in S5.1.1, S5.1.2, S5.1.3, or S5.1.6, its service brakes must be capable of stopping the vehicle from the multiple of 5 mph that is 4 to 8 mph less than the speed attainable in 2 miles, within distances that do not exceed the corresponding distances specified in Table II. If a vehicle is incapable of attaining a speed specified in S5.1.4 in the time or distance interval set forth, it must be tested at the highest speed attainable in the time or distance interval specified.

S5.1.1 *Stopping distance.* (a) The service brakes shall be capable of stopping each vehicle with a GVWR of less than 8,000 pounds, and each school bus with

a GVWR between 8,000 pounds and 10,000 pounds in four effectiveness tests within the distances and from the speeds specified in S5.1.1.1, S5.1.1.2, S5.1.1.3, and S5.1.1.4.

(b) The service brakes shall be capable of stopping each vehicle with a GVWR of between 8,000 pounds and 10,000 pounds, other than a school bus, in three effectiveness tests within the distances and from the speeds specified in S5.1.1.1, S5.1.1.2, and S5.1.1.4.

(c) The service brakes shall be capable of stopping each vehicle with a GVWR greater than 10,000 pounds in two effectiveness tests within the distances and from the speeds specified in S5.1.1.2 and S5.1.1.3. Each school bus with a GVWR greater than 10,000 pounds manufactured after January 12, 1996 and before March 1, 1999 and which is equipped with an antilock brake system may comply with paragraph S5.1.1.2 and S5.5.1 rather than the first effectiveness test, as specified in S5.1.1.1. Each school bus with a GVWR greater than 10,000 pounds manufactured on or after March 1, 1999 shall be capable of meeting the requirements of S5.1.1 through S5.1.5, under the conditions prescribed in S6, when tested according to the procedures and in the sequence set forth in S7.

S5.1.1.1 In the first (preburnished) effectiveness test, the vehicle shall be capable of stopping from 30 mph and 60 mph within the corresponding distances specified in column I of table II.

S5.1.1.2 In the second effectiveness test, each vehicle with a GVWR of 10,000 pounds or less and each school bus with a GVWR greater than 10,000 pounds shall be capable of stopping from 30 mph and 60 mph, and each vehicle with a GVWR greater than 10,000 pounds (other than a school bus) shall be capable of stopping from 60 mph, within the corresponding distances specified in Column II of Table II. If the speed attainable in 2 miles is not less than 84 mph, a passenger car or other vehicle with a GVWR of 10,000 pounds or less shall also be capable of stopping from 80 mph within the corresponding distances specified in Column II of Table II.

S5.1.1.3 In the third effectiveness test the vehicle shall be capable of stopping at lightly loaded vehicle weight from 60 mph within the corresponding distance specified in column III of table II.

S5.1.1.4 In the fourth effectiveness test, a vehicle with a GVWR of 10,000 pounds or less shall be capable of stopping from 30 and 60 mph within the corresponding distances specified in column I of table II. If the speed attainable in 2 miles is not less than 84 mph, a passenger car, or other vehicle with a GVWR of 10,000 lbs., or less, shall also be capable of stopping from 80 mph within the corresponding distance specified in column I of table II.

If the speed attainable in 2 miles is not less than 99 mph, a passenger car shall, in addition, be capable of stopping from the applicable speed indicated below, within the corresponding distance specified in column I of table II.

Speed attainable in 2 miles (mph)	Required to stop from (mph)
Not less than 99 but less than 104	95
104 or more	100

For an EV, the speed attainable in 2 miles is determined with the propulsion batteries at a state of charge of not less than 95 percent at the beginning of the run.

S5.1.2 *Partial failure.*

S5.1.2.1 In vehicles manufactured with a split service brake system, in the event of a rupture or leakage type of failure in a single subsystem, other than a structural failure of a housing that is common to two or more subsystems, the remaining portion(s) of the service brake system shall continue to operate and shall be capable of stopping a vehicle from 60 mph within the corresponding distance specified in column IV of table II.

S5.1.2.2 In vehicles not manufactured with a split service brake system, in the event of any one rupture or leakage type of failure in any component of the service brake system the vehicle shall, by operation of the service brake control, be capable of stopping 10 times consecutively from 60 mph within the corresponding distance specified in column IV of table II.

S5.1.2.3 For a vehicle manufactured with a service brake system in which the brake signal is transmitted electrically between the brake pedal and

some or all of the foundation brakes, regardless of the means of actuation of the foundation brakes, the vehicle shall be capable of stopping from 60 mph within the corresponding distance specified in Column IV of Table II with any single failure in any circuit that electrically transmits the brake signal, and with all other systems intact.

S5.1.2.4 For an EV manufactured with a service brake system that incorporates RBS, the vehicle shall be capable of stopping from 60 mph within the corresponding distance specified in Column IV of Table II with any single failure in the RBS, and with all other systems intact.

S5.1.3 *Inoperative brake power assist unit or brake power unit.* A vehicle equipped with one or more brake power assist units shall meet the requirements of either S5.1.3.1, S5.1.3.2, or S5.1.3.4 (chosen at the option of the manufacturer), and a vehicle equipped with one or more brake power units shall meet the requirements of either S5.1.3.1, S5.1.3.3, or S5.1.3.4 (chosen at the option of the manufacturer).

S5.1.3.1 The service brakes on a vehicle equipped with one or more brake power assist units or brake power units, with one such unit inoperative and depleted of all reserve capability, shall be capable of stopping a vehicle from 60 mph within the corresponding distance specified in column IV of table II.

S5.1.3.2 *Brake power assist units.* The service brakes on a vehicle equipped with one or more brake power assist units, with one such unit inoperative, shall be capable of stopping a vehicle from 60 mph:

(a) In six consecutive stops at an average deceleration for each stop that is not lower than that specified in column I of table III, when the inoperative unit is not initially depleted of all reserve capability; and

(b) In a final stop, at an average deceleration that is not lower than 7 FPSPS for passenger cars (equivalent stopping distance 554 feet) or 6 FPSPS for vehicles other than passenger cars (equivalent stopping distance 646 feet), as applicable, when the inoperative unit is depleted of all reserve capacity.

S5.1.3.3 *Brake power units.* The service brakes of a vehicle equipped with one or more brake power units with an accumulator-type reserve system, with any one failure in any one unit shall be capable of stopping the vehicle from 60 mph—

(a) In 10 consecutive stops at an average deceleration for each stop that is not lower than that specified in column II of table III, when the unit is not initially depleted of all reserve capability; and

(b) In a final stop, at an average deceleration that is not lower than 7 FPSPS for passenger cars (equivalent stopping distance 554 feet) or 6 FPSPS for vehicles other than passenger cars (equivalent stopping distance 646 feet), as applicable, when the inoperative unit is depleted of all reserve capacity.

S5.1.3.4 *Brake power assist and brake power units.* The service brakes of a vehicle equipped with one or more brake power assist units or brake power units with a backup system, with one brake power assist unit or brake power unit inoperative and depleted of all reserve capability and with only the backup system operating in the failed subsystem, shall be capable of stopping the vehicle from 60 mph in 15 consecutive stops at an average deceleration for each stop that is not lower than 12 fpsps (equivalent stopping distance 323 feet).

S5.1.3.5 *Electric brakes.* Each vehicle with electrically-actuated service brakes (brake power unit) shall comply with the requirements of S5.1.3.1 with any single electrical failure in the electrically-actuated service brakes and all other systems intact.

S5.1.4 *Fade and recovery.* The service brakes shall be capable of stopping each vehicle in two fade and recovery tests as specified below.

S5.1.4.1 The control force used for the baseline check stops or snubs shall be not less than 10 pounds, nor more than 60 pounds, except that the control force for a vehicle with a GVWR of 10,000 pounds or more may be between 10 pounds and 90 pounds.

S5.1.4.2 (a) Each vehicle with GVWR of 10,000 lbs or less shall be capable of making 5 fade stops (10 fade stops on the second test) from 60 mph at a deceleration not lower than 15 fpsps for each stop, followed by 5 fade stops at the

maximum deceleration attainable from 5 to 15 fpsps.

(b) Each vehicle with a GVWR greater than 10,000 pounds shall be capable of making 10 fade snubs (20 fade snubs on the second test) from 40 mph to 20 mph at 10 fpsps for each snub.

S5.1.4.3 (a) Each vehicle with a GVWR of 10,000 pounds or less shall be capable of making five recovery stops from 30 mph at 10 fpsps for each stop, with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery stops of 150 pounds, and for the fifth stop, of 20 pounds more than the average control force for the baseline check; and

(2) A minimum of—

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the baseline check times 0.60,

whichever is lower (but in no case lower than 5 pounds).

(b) Each vehicle with a GVWR of more than 10,000 pounds shall be capable of making five recovery snubs from 40 mph to 20 mph at 10 fpsps for each snub, with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery snubs of 150 pounds, and for the fifth snub, of 20 pounds more than the average control force for the baseline check (but in no case more than 100 pounds); and

(2) A minimum of—

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the baseline check times 0.60,

whichever is lower (but in no case lower than 5 pounds).

S5.1.5 *Water recovery.* The service brakes shall be capable of stopping each vehicle in a water recovery test, as specified below.

S5.1.5.1 The control force used for the baseline check stops or snubs shall be not less than 10 pounds, nor more than 60 pounds, except that the control force for a vehicle with a GVWR of 10,000 pounds or more may be between 10 and 90 pounds.

S5.1.5.2(a) After being driven for 2 minutes at a speed of 5 mph in any combination of forward and reverse directions through a trough having a water dept of 6 inches, each vehicle with a GVWR of 10,000 pounds or less shall be capable of making five recovery stops from 30 mph at ten fpsps for each stop with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery stops of 150 pounds, and for the fifth stop, of 45 pounds more than the average control force for the baseline check (but in no case more than 90 pounds, except that the maximum control force for the fifth stop in the case of a vehicle manufactured before September 1, 1976, shall be not more than plus 60 pounds of the average control force for the baseline check (but in no case more than 110 pounds).

(2) A minimum of—

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the baseline check times 0.60,

whichever is lower (but in no case lower than 5 pounds).

(b) After being driven for 2 minutes at a speed of 5 mph in any combination of forward and reverse directions through a trough having a water depth of 6 inches, each vehicle with a GVWR of more than 10,000 pounds shall be capable of making five recovery stops from 30 mph at 10 fpsps for each stop with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery stops of 150 pounds, and for the fifth stop, of 60 pounds more than the average control force for the baseline check (but in no case more than 110 pounds); and

(2) A minimum of—

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the baseline check times 0.60,

whichever is lower (but in no case lower than 5 pounds).

S5.1.6 *Spike stops.* Each vehicle with a GVWR of 10,000 lbs. or less shall be capable of making 10 spike stops from 30 mph, followed by 6 effectiveness (check) stops from 60 mph, at least one

of which shall be within a corresponding stopping distance specified in column I of table II.

S5.1.7 Stability and control during braking. When stopped four consecutive times under the conditions specified in S6, each vehicle with a GVWR greater than 10,000 pounds manufactured on or after July 1, 2005 and each vehicle with a GVWR greater than 10,000 pounds manufactured in two or more stages on or after July 1, 2006 shall stop from 30 mph or 75 percent of the maximum drive-through speed, whichever is less, at least three times within the 12-foot lane, without any part of the vehicle leaving the roadway. Stop the vehicle with the vehicle at its lightly loaded vehicle weight, or at the manufacturer's option, at its lightly loaded vehicle weight plus not more than an additional 1000 pounds for a roll bar structure on the vehicle.

S5.2 *Parking Brake System.* Each vehicle shall be manufactured with a parking brake system of a friction type with a solely mechanical means to retain engagement, which shall under the conditions of S6, when tested according to the procedures specified in S7, meet the requirements specified in S5.2.1, S5.2.2, or S5.2.3 as appropriate, with the system engaged—

(a) In the case of a vehicle with a GVWR of 4,536 kilograms (10,000 pounds) or less, with a force applied to the control not to exceed 125 pounds for a foot-operated system and 90 pounds for a hand-operated system; and

(b) In the case of a vehicle with a GVWR greater than 4,536 kilograms (10,000 pounds), with a force applied to the control not to exceed 150 pounds for a foot-operated system and 125 pounds for a hand-operated system.

S5.2.1. Except as provided in § 5.2.2, the parking brake system on a passenger car and on a school bus with a GVWR of 10,000 pounds or less shall be capable of holding the vehicle stationary (to the limit of traction on the braked wheels) for 5 minutes in both a forward and reverse direction on a 30 percent grade.

S5.2.2 A vehicle of a type described in S5.2.1 at the option of the manufacturer may meet the requirements of S5.2.2.1, S5.2.2.2, and S5.2.2.3 instead of the requirements of S5.2.1 if:

(a) The vehicle has a transmission or transmission control which incorporates a parking mechanism, and

(b) The parking mechanism must be engaged before the ignition key can be removed.

S5.2.2.1 The vehicle's parking brake and parking mechanism, when both are engaged, shall be capable of holding the vehicle stationary (to the limit of traction of the braked wheels) for 5 minutes, in both forward and reverse directions, on a 30 percent grade.

S5.2.2.2 The vehicle's parking brake, with the parking mechanism not engaged, shall be capable of holding the vehicle stationary for 5 minutes, in both forward and reverse directions, on a 20 percent grade.

S5.2.2.3 With the parking mechanism engaged and the parking brake not engaged, the parking mechanism shall not disengage or fracture in a manner permitting vehicle movement, when the vehicle is impacted at each end, on a level surface, by a barrier moving at 2½ mph.

S5.2.3 (a) The parking brake system on a multipurpose passenger vehicle, truck or bus (other than a school bus) with a GVWR of 4,536 kilograms (10,000 pounds) or less shall be capable of holding the vehicle stationary for 5 minutes, in both forward and reverse directions, on a 20 percent grade.

(b) The parking brake system on a multipurpose passenger vehicle, truck, or bus (including a school bus) with a GVWR greater than 4,536 kilograms (10,000 pounds) shall be capable of holding the vehicle stationary for 5 minutes, in both forward and reverse directions, on a 20 percent grade.

S5.3 *Brake system indicator lamp.* Each vehicle shall have a brake system indicator lamp or lamps, mounted in front of and in clear view of the driver, which meet the requirements of S5.3.1 through S5.3.5. A vehicle with a GVWR of 10,000 pounds or less may have a single common indicator lamp. A vehicle with a GVWR of greater than 10,000 pounds may have an indicator lamp which is common for gross loss of pressure, drop in the level of brake fluid, or application of the parking brake, but shall have a separate indicator lamp for antilock brake system malfunction. However, the options provided in

S5.3.1(a) shall not apply to a vehicle manufactured without a split service brake system; such a vehicle shall, to meet the requirements of S5.3.1(a), be equipped with a malfunction indicator that activates under the conditions specified in S5.3.1(a)(4). This warning indicator shall, instead of meeting the requirements of S5.3.2 through S5.3.5, activate (while the vehicle remains capable of meeting the requirements of S5.1.2.2 and the ignition switch is in the ''on'' position) a continuous or intermittent audible signal and a flashing warning light, displaying the words ''STOP-BRAKE FAILURE'' in block capital letters not less than one-quarter of an inch in height.

S5.3.1 An indicator lamp shall be activated when the ignition (start) switch is in the ''on'' (''run'') position and whenever any of the conditions (a) or (b), (c), (d), (e), (f), and (g) occur:

(a) A gross loss of pressure (such as caused by rupture of a brake line but not by a structural failure of a housing that is common to two or more subsystems) due to one of the following conditions (chosen at the option of the manufacturer):

(1) Before or upon application of a differential pressure of not more than 225 lb/in^2 between the active and failed brake system measured at a master cylinder outlet or a slave cylinder outlet.

(2) Before or upon application of 50 pounds of control force upon a fully manual service brake.

(3) Before or upon application of 25 pounds of control force upon a service brake with a brake power assist unit.

(4) When the supply pressure in a brake power unit drops to a level not less than one-half of the normal system pressure.

(b) A drop in the level of brake fluid in any master cylinder reservoir compartment to less than the recommended safe level specified by the manufacturer or to one-fourth of the fluid capacity of that reservoir compartment, whichever is greater.

(c) A malfunction that affects the generation or transmission of response or control signals in an antilock brake system, or a total functional electrical failure in a variable proportioning brake system.

(d) Application of the parking brake.

(e) For a vehicle with electrically-actuated service brakes, failure of the source of electric power to the brakes, or diminution of state of charge of the batteries to less than a level specified by the manufacturer for the purpose of warning a driver of degraded brake performance.

(f) For a vehicle with electric transmission of the service brake control signal, failure of a brake control circuit.

(g) For an EV with RBS that is part of the service brake system, failure of the RBS.

S5.3.2 (a) Except as provided in paragraph (b) of this section, all indicator lamps shall be activated as a check of lamp function either when the ignition (start) switch is turned to the ''on'' (run) position when the engine is not running, or when the ignition (start) switch is in a position between ''on'' (run) and ''start'' that is designated by the manufacturer as a check position.

(b) The indicator lamps need not be activated when a starter interlock is in operation.

S5.3.3 (a) Each indicator lamp activated due to a condition specified in S5.3.1 shall remain activated as long as the malfunction exists, whenever the ignition (start) switch is in the ''on'' (run) position, whether or not the engine is running.

(b) For vehicles manufactured on and after September 1, 1999 with GVWRs greater than 10,000 lbs, each message about the existence of a malfunction, as described in S5.3.1(c), shall be stored in the antilock brake system after the ignition switch is turned to the ''off'' position and the indicator lamp shall be automatically reactivated when the ignition switch is again turned to the ''on'' position. The indicator lamp shall also be activated as a check of lamp function whenever the ignition is turned to the ''on'' (run) position. The indicator lamp shall be deactivated at the end of the check of lamp function unless there is a malfunction or a message about a malfunction that existed when the key switch was last turned to the ''off'' position.

S5.3.4 When an indicator lamp is activated it may be steady burning or flashing.

S5.3.5 (a) Each indicator lamp shall display word, words or abbreviation, in accordance with the requirements of Standard No. 101 (49 CFR 571.101) and/or this section, which shall have letters not less than ⅛-inch high and be legible to the driver in daylight when lighted. Words in addition to those required by Standard No. 101 and/or this section and symbols may be provided for purposes of clarity.

(b) If a single common indicator is used, the lamp shall display the word ''Brake''. The letters and background of a single common indicator shall be of contrasting colors, one of which is red.

(c)(1) If separate indicators are used for one or more of the conditions described in S5.3.1(a) through S5.3.1(g) of this standard, the indicator display shall include the word ''Brake'' and appropriate additional labeling, except as provided in (c)(1) (A) through (D) of this paragraph.

(A) If a separate indicator lamp is provided for gross loss of pressure, the words ''Brake Pressure'' shall be used for S5.3.1(a).

(B) If a separate indicator lamp is provided for low brake fluid, the words ''Brake Fluid'' shall be used for S5.3.1(b), except for vehicles using hydraulic system mineral oil.

(C) If a separate indicator lamp is provided for an anti-lock system, the single word ''Antilock'' or ''Anti-lock'', or the abbreviation ''ABS'', may be used for S5.3.1(c).

(D) If a separate indicator lamp is provided for application of the parking brake, the single word ''Park'' may be used for S5.3.1(d).

(E) If a separate indicator is used for the regenerative brake system, the symbol ''RBS'' may be used. RBS failure may also be indicated by a lamp displaying the symbol ''ABS/RBS.''

(2) Except for a separate indicator lamp for an anti-lock system, a regenerative system, or an indicator for both anti-lock and regenerative system, the letters and background of each separate indicator lamp shall be of contrasting colors, one of which is red. The letters and background of a separate lamp for an anti-lock system, a regenerative system, or a lamp displaying both an anti-lock and a regenerative system shall be of contrasting colors, one of which is yellow.

S5.4 *Reservoirs.*

S5.4.1 *Master cylinder reservoirs.* A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment.

S5.4.2 *Reservoir capacity.* Reservoirs, whether for master cylinders or other type systems, shall have a total minimum capacity equivalent to the fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoirs move from a new lining, fully retracted position (as adjusted initially to the manufacturer's recommended setting) to a fully worn, fully applied position, as determined in accordance with S7.18(c) of this standard. Reservoirs shall have completely separate compartments for each subsystem except that in reservoir systems utilizing a portion of the reservoir for a common supply to two or more subsystems, individual partial compartments shall each have a minimum volume of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem, during a full stroke of the piston. Each brake power unit reservoir servicing only the brake system shall have a minimum capacity equivalent to the fluid displacement required to charge the system piston(s) or accumulator(s) to normal operating pressure plus the displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir or accumulator(s) move from a new lining fully retracted position (as adjusted initially to the manufacturer's recommended setting) to a fully worn, fully applied position.

S5.4.3 *Reservoir labeling*—Each vehicle equipped with hydraulic brakes shall have a brake fluid warning statement that reads as follows, in letters at least one-eighth of an inch high: ''WARNING, Clean filler cap before removing. Use only _____ fluid from a sealed container.'' (Inserting the recommended type of brake fluid as specified in 49 CFR 571.116, e.g., ''DOT 3''). The lettering shall be—

(a) Permanently affixed, engraved, or embossed;

(b) Located so as to be visible by direct view, either on or within 4 inches of the brake fluid reservoir filler plug or cap; and

(c) Of a color that contrasts with its background, if it is not engraved or embossed.

S5.5 *Antilock and variable proportioning brake systems.*

S5.5.1 Each vehicle with a GVWR greater than 10,000 pounds, except for any vehicle with a speed attainable in 2 miles of not more than 33 mph, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle. On each vehicle with a GVWR greater than 10,000 pounds but not greater than 19,500 pounds and motor homes with a GVWR greater than 10,000 pounds but not greater than 22,500 pounds manufactured before March 1, 2001, the antilock brake system may also directly control the wheels of the rear drive axle by means of a single sensor in the driveline. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

S5.5.2 In the event of any failure (structural or functional) in an antilock or variable proportioning brake system, the vehicle shall be capable of meeting the stopping distance requirements specified in S5.1.2 for service brake system partial failure. For an EV that is equipped with both ABS and RBS that is part of the service brake system, the ABS must control the RBS.

S5.6 *Brake system integrity.* Each vehicle shall be capable of completing all performance requirements of S5 without—

(a) Detachment or fracture of any component of the braking system, such as brake springs and brake shoe or disc pad facing, other than minor cracks that do not impair attachment of the friction facing. All mechanical components of the braking system shall be intact and functional. Friction facing tearout (complete detachment of lining) shall not exceed 10 percent of the lining on any single frictional element.

(b) Any visible brake fluid or lubricant on the friction surface of the brake, or leakage at the master cylinder or brake power unit reservoir cover, seal and filler openings.

S6 *Test conditions.* The performance requirements of S5 shall be met under the following conditions. Where a range of conditions is specified, the vehicle shall be capable of meeting the requirements at all points within the range. Compliance of vehicles manufactured in two or more stages may, at the option of the final-stage manufacturer, be demonstrated to comply with this standard by adherence to the instructions of the incomplete manufacturer provided with the vehicle in accordance with §568.4(a)(7)(ii) and §568.5 of title 49 of the Code of Federal Regulations.

S6.1 *Vehicle weight.*

S6.1.1 Other than tests specified at lightly loaded vehicle weight in S7.5(a), S7.7, S7.8, and S7.9, the vehicle is loaded to its GVWR such that the weight on each axle as measured at the tire-ground interface is in proportion to its GAWR, except that each fuel tank is filled to any level from 100 percent of capacity (corresponding to full GVWR) to 75 percent. However, if the weight on any axle of a vehicle at lightly loaded vehicle weight exceeds the axle's proportional share of the gross vehicle weight rating, the load required to reach GVWR is placed so that the weight on that axle remains the same as a lightly loaded vehicle weight.

S6.1.2 For applicable tests specified in S7.5(a), S7.7, S7.8, and S7.9, vehicle weight is lightly loaded vehicle weight, with the added weight, except for the roll bar structure allowed for trucks and buses with a GVWR greater than 10,000 pounds, distributed in the front passenger seat area in passenger cars, multipurpose passenger vehicles, and trucks, and in the area adjacent to the driver's seat in buses.

S6.2 *Electric vehicles and electric brakes.*

S6.2.1 The state of charge of the propulsion batteries is determined in accordance with SAE Recommended Practice J227a (1976) (incorporated by reference, see §571.5). The applicable sections of SAE J227a (1976) are 3.2.1

through 3.2.4, 3.3.1 through 3.3.2.2, 3.4.1 and 3.4.2, 4.2.1, 5.2, 5.2.1, and 5.3.

S6.2.2 At the beginning of the first effectiveness test specified in S7.3, and at the beginning of each burnishing procedure, each EV's propulsion battery is at the maximum state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. If a battery is replaced rather than recharged, the replacement battery is to be charged and measured for state of charge in accordance with these procedures. During each burnish procedure, each propulsion battery is restored to the recommended state of charge or a state of charge of not less than 95 percent after each increment of 40 burnish stops until each burnish procedure is complete. The batteries may be charged at a more frequent interval if, during a particular 40-stop increment, the EV is incapable of achieving the initial burnish test speed. During each burnish procedure, the propulsion batteries may be charged by an external means or replaced by batteries that are charged to the state of charge recommended by the manufacturer or a state of charge of not less than 95 percent. For EVs having a manual control for setting the level of regenerative braking, the manual control, at the beginning of each burnish procedure, is set to provide maximum regenerative braking throughout the burnish.

S6.2.3 At the beginning of each performance test in the test sequence (S7,3, S7.5, S7.7 through S7.11, and S7.13 through S7.19 of this standard), unless otherwise specified, each propulsion battery of an EV is at the maximum state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. If batteries are replaced rather than recharged, each replacement battery shall be charged and measured for state of charge in accordance with these procedures. No further charging of any propulsion battery occurs during any of the performance tests in the test sequence of this standard. If the propulsion batteries are depleted during a test sequence such that the vehicle reaches automatic shut-down, will not accelerate, or the low state of charge warning lamp is illuminated, the vehicle is to be accelerated to brake test speed by auxiliary means.

S6.2.4 (a) For an EV equipped with RBS, the RBS is considered to be part of the service brake system if it is automatically controlled by an application of the service brake control, if there is no means provided for the driver to disconnect or otherwise deactivate it, and if it is activated in all transmission positions, including neutral. The RBS is operational during all burnishes and all tests, except for the test of a failed RBS.

(b) For an EV equipped with an RBS that is not part of the service brake system, the RBS is operational and set to produce the maximum regenerative braking effect during the burnishes, and is disabled during the test procedures. If the vehicle is equipped with a neutral gear that automatically disables the RBS, the test procedures which are designated to be conducted in gear may be conducted in neutral.

S6.2.5 For tests conducted ''in neutral,'' the operator of an EV with no ''neutral'' position (or other means such as a clutch for disconnecting the drive train from the propulsion motor(s)) does not apply any electromotive force to the propulsion motor(s). Any electromotive force that is applied to the propulsion motor(s) automatically remains in effect unless otherwise specified by the test procedure.

S6.2.6 A vehicle equipped with electrically-actuated service brakes also performs the following test series. Conduct 10 stopping tests from a speed of 100 kph or the maximum vehicle speed, whichever is less. At least two of the 10 stopping distances must be less than or equal to 70 meters. The vehicle is loaded to GVWR for these tests and the transmission is in the neutral position when the service brake control is actuated and throughout the remainder of the test. The battery or batteries providing power to those electrically-actuated brakes, at the beginning of each

test, shall be in a depleted state of charge for conditions (a), (b), or (c) of this paragraph as appropriate. An auxiliary means may be used to accelerate an EV to test speed.

(a) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries, and with automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at not more than five percent above the EV actual automatic shut-down critical value. The critical value is determined by measuring the state-of-charge of each propulsion battery at the instant that automatic shut-down occurs and averaging the states-of-charge recorded.

(b) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries, and with no automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at an average of not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.3.1(e) of this standard, is illuminated.

(c) For a vehicle which has an auxiliary battery (or batteries) that provides electrical energy to operate the electrically-actuated service brakes, the auxiliary battery(batteries) is (are) at (at an average of) not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.3.1(e) of this standard, is illuminated.

S6.3 *Tire inflation pressure.* Tire inflation pressure is the pressure recommended by the vehicle manufacturer for the GVWR of the vehicle.

S6.4 *Transmission selector control.* For S7.3, S7.5, S7.8, S7.15, S7.17, S7.11.1.2, S7.11.2.2, S7.11.3.2, and as required for S7.13, the transmission selector control is in neutral for all decelerations. For all other tests during all decelerations, the transmission selector is in the control position, other than overdrive, recommended by the manufacturer for driving on a level surface at the applicable test speed. To avoid engine stall during tests required to be run in gear a manual transmission may be shifted to neutral (or the clutch disengaged) when the vehicle speed decreases to 20 mph.

S6.5 *Engine.* Engine idle speed and ignition timing settings are according to the manufacturer's recommendations. If the vehicle is equipped with an adjustable engine speed governor, it is adjusted according to the manufacturer's recommendation.

S6.6 *Vehicle openings.* All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) are closed except as required for instrumentation purposes.

S6.7 *Ambient temperature.* The ambient temperature is any temperature between 32 °F. and 100 °F.

S6.8 *Wind velocity.* The wind velocity is zero.

S6.9 *Road surface.*

S6.9.1 For vehicles with a GVWR of 10,000 pounds or less, road tests are conducted on a 12-foot-wide, level roadway, having a skid number of 81. Burnish stops are conducted on any surface. The parking brake test surface is clean, dry, smooth, Portland cement concrete.

S6.9.2(a) For vehicles with a GVWR greater than 10,000 pounds, road tests (excluding stability and control during braking tests) are conducted on a 12-foot-wide, level roadway, having a peak friction coefficient of 1.02 when measured using an ASTM F2493 standard reference test tire, in accordance with ASTM E1337–19 (incorporated by reference, see §571.5), at a speed of 40 mph, without water delivery. Burnish stops are conducted on any surface. The parking brake test surface is clean, dry, smooth, Portland cement concrete.

(b) For vehicles with a GVWR greater than 10,000 pounds, stability and control during braking tests are conducted on a 500-foot-radius curved roadway with a wet level surface having a peak friction coefficient of 0.55 when measured on a straight or curved section of the curved roadway using an ASTM F2493 standard reference tire, in accordance with ASTM E1337–19 at a speed of 40 mph, with water delivery.

S6.10 *Vehicle position and wheel lock-up restrictions.* The vehicle is aligned in the center of the roadway at the start of each brake application. Stops, other than spike stops, are made without any

part of the vehicle leaving the roadway.

S6.10.1 For vehicles with a GVWR of 10,000 pounds or less, stops are made with wheel lockup permitted only as follows:

(a) At vehicle speeds above 10 mph, there may be controlled wheel lockup on an antilock-equipped axle, and lockup of not more than one wheel per vehicle, uncontrolled by an antilock system. (Dual wheels on one side of an axle are considered a single wheel.)

(b) At vehicle speeds of 10 mph or less, any wheel may lock up for any duration.

(c) Unlimited wheel lockup is allowed during spike stops (but not spike check stops), partial failure stops, and inoperative brake power or power assist unit stops.

S6.10.2 For vehicles with a GVWR greater than 10,000 pounds, stops are made with wheel lockup permitted only as follows:

(a) At vehicle speeds above 20 mph, any wheel on a nonsteerable axle other than the two rearmost nonliftable, nonsteerable axles may lock up for any duration. The wheels on the two rearmost nonliftable, nonsteerable axles may lock up according to (b).

(b) At vehicle speeds above 20 mph, one wheel on any axle or two wheels on any tandem may lock up for any duration.

(c) At vehicle speeds above 20 mph, any wheel not permitted to lock in (a) or (b) may lock up repeatedly, with each lockup occurring for a duration of one second or less.

(d) At vehicle speeds of 20 mph or less, any wheel may lock up for any duration.

(e) Unlimited wheel lockup is allowed during partial failure stops, and inoperative brake power or power assist stops.

S6.11 *Thermocouples.* The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in figure 1. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the metal rubbing surface of a drum or rotor. For centergrooved shoes or pads, thermocouples are installed within one-eighth of an inch to one-quarter inch of the groove and as close to the center as possible.

S6.12 *Initial brake temperature.* Unless otherwise specified the brake temperature is 150 °F. to 200 °F.

S6.13 *Control forces.* Unless otherwise specified, the force applied to a brake control is not less than 15 lb and not more than 150 lb.

S6.14 Special drive conditions. A vehicle with a GVWR greater than 10,000 pounds equipped with an interlocking axle system or a front wheel drive system that is engaged and disengaged by the driver is tested with the system disengaged.

S6.15 Selection of compliance options. Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S7. Test procedure and sequence. Each vehicle shall be capable of meeting all the applicable requirements of S5 when tested according to the procedures and sequence set forth below, without replacing any brake system part or making any adjustments to the brake system other than as permitted in the burnish and reburnish procedures and in S7.9 and S7.10. (For vehicles only having to meet the requirements of S5.1.1, S5.1.2, S5.1.3, and S5.1.7 in section S5.1, the applicable test procedures and sequence are S7.1, S7.2, S7.4, S7.5(b), S7.5(a), S7.8, S7.9, S7.10, and S7.18. However, at the option of the manufacturer, the following test procedure and sequence may be conducted: S7.1, S7.2, S7.3, S7.4, S7.5(b), S7.6, S7.7, S7.5(a), S7.8, S7.9, S7.10, and S7.18. The choice of this option must not be construed as adding to the requirements specified in S5.1.2 and S5.1.3.) Automatic adjusters must remain activated at all times. A vehicle shall be deemed to comply with the stopping distance requirements of S5.1 if at least one of

the stops at each speed and load specified in each of S7.3, S7.5(b), S7.8, S7.9, S7.10, S7.15 and S7.17 (check stops) is made within a stopping distance that does not exceed the corresponding distance specified in Table II. When the transmission selector control is required to be in neutral for a deceleration, a stop or snub must be obtained by the following procedures:

(a) Exceed the test speed by 4 to 8 mph;

(b) Close the throttle and coast in gear to approximately 2 mph above the test speed;

(c) Shift to neutral; and

(d) When the test speed is reached, apply the service brakes.

S7.1 *Brake warming.* If the initial brake temperature for the first stop in a test procedure (other than S7.7 and S7.16) has not been reached, heat the brakes to the initial brake temperature by making not more than 10 snubs from not more than 40 to 10 mph, at a deceleration not greater than 10 fpsps.

S7.2 *Pretest instrumentation check.* Conduct a general check of instrumentation by making not more than 10 stops from a speed of not more than 30 mph, or 10 snubs from a speed of not more than 40 to 10 mph, at a deceleration of not more than 10 fpsps. If instrument repair, replacement, or adjustment is necessary, make not more than 10 additional stops or snubs after such repair, replacement, or adjustment.

S7.3 *Service brake system—first (preburnish) effectiveness test.* Make six stops from 30 mph. Then make six stops from 60 mph.

S7.4 *Service brake system—burnish procedure.*

S7.4.1 *Vehicles with GVWR of 10,000 lb or less.*

S7.4.1.1 *Burnish.* Burnish the brakes by making 200 stops from 40 mph at 12 fpsps (the 150 lb control force limit does not apply here). The interval from the start of one service brake application to the start of the next shall be either the time necessary to reduce the initial brake temperature to between 230 °F. and 270 °F., or the distance of 1 mile, whichever occurs first. Accelerate to 40 mph after each stop and maintain that speed until making the next stop.

S7.4.1.2 *Brake adjustment—post burnish.* After burnishing, adjust the brakes in accordance with the manufacturer's published recommendations.

S7.4.2 *Vehicles with GVWR greater than 10,000 pounds.*

S7.4.2.1 *Burnish.* Vehicles are burnished according to the following procedures. Make 500 snubs between 40 mph and 20 mph at a deceleration rate of 10 f.p.s.p.s. Except where an adjustment is specified, after each brake application accelerate to 40 mph and maintain that speed until making the next brake application at a point 1 mile from the initial point of the previous brake application. If the vehicle cannot attain a speed of 40 mph in 1 mph, continue to accelerate until the vehicle reaches 40 mph or until the vehicle has traveled 1.5 miles from the initial point of the previous brake application, whichever occurs first. The brakes shall be adjusted three times during the burnish procedure, in accordance with the manufacturer's recommendations, after 125, 250, and 375 snubs.

S7.4.2.2 *Brake adjustment—post burnish.* After burnishing, adjust the brakes in accordance with the manufacturer's published recommendations.

S7.5 (a) Stability and control during braking (vehicles with a GVWR greater than 10,000 pounds). Make four stops in the lightly-loaded weight condition specified in S5.1.7. Use a full brake application for the duration of the stop, with the clutch pedal depressed or the transmission selector control in the neutral position, for the duration of each stop.

(b) Service brake system—second effectiveness test. For vehicles with a GVWR of 10,000 pounds or less, or any school bus, make six stops from 30 mph. Then, for any vehicle, make six stops from 60 mph. Then, for a vehicle with a GVWR of 10,000 pounds or less, make four stops from 80 mph if the speed attainable in 2 miles is not less than 84 mph.

S7.6 *First reburnish.* Repeat S7.4, except make 35 burnish stops or snubs. In the case of vehicles burnished in accordance with S7.4.2.1(a) of this section, reburnish the vehicle by making 35 snubs from 60 to 20 mph, but if the hottest brake temperature reaches 500

°F ±50 °F, make the remainder of the brake applications from the highest snub condition listed in Table IV that will maintain the hottest brake temperature at 500 °F ±50 °F. If at a snub condition of 40 to 20 mph, the temperature of the hottest brake exceeds 550 °F, make the remainder of the 35 brake applications from the snub condition without regard to brake temperature.

S7.7 *Parking brake test.* The parking brake tests for any vehicle on different grades, in different directions, and for different loads may be conducted in any order. The force required for actuation of a hand-operated brake system shall be measured at the center of the hand grip area or at a distance of 1½ inches from the end of the actuation lever, as illustrated in Figure II.

S7.7.1 *Test procedure for requirements of S5.2.1 and S5.2.3.*

S7.7.1.1 Condition the parking brake friction elements so that the temperature at the beginning of the test is at any level not more than 150 °F. (when the temperature of components on both ends of an axle are averaged).

S7.7.1.2 Drive the vehicle, loaded to GVWR, onto the specified grade with the longitudinal axis of the vehicle in the direction of the slope of the grade, stop the vehicle and hold it stationary by application of the service brake control, and place the transmission in neutral.

S7.7.1.3 With the vehicle held stationary by means of the service brake control, apply the parking brake by a single application of the force specified in (a), (b), or (c) of this paragraph, except that a series of applications to achieve the specified force may be made in the case of a parking brake system design that does not allow the application of the specified force in a single application:

(a) In the case of a passenger car or other vehicle with a GVWR of 10,000 lbs. or less, not more than 125 pounds for a foot-operated system, and not more than 90 pounds for a hand-operated system; and

(b) In the case of a vehicle with a GVWR greater than 4,536 kilograms (10,000 pounds) not more than 150 pounds for a foot-operated system, and not more than 125 pounds for a hand-operated system.

(c) For a vehicle using an electrically-activated parking brake, apply the parking brake by activating the parking brake control.

S7.7.1.4 Following the application of the parking brake in accordance with S7.7.1.3, release all force on the service brake control and commence the measurement of time if the vehicle remains stationary. If the vehicle does not remain stationary, reapplication of the service brake to hold the vehicle stationary, with reapplication of a force to the parking brake control at the level specified in S7.7.1.3 (a) or (b) as appropriate for the vehicle being tested (without release of the ratcheting or other holding mechanism of the parking brake) may be used twice to attain a stationary position.

S7.7.1.5 Following observation of the vehicle in a stationary condition for the specified time in one direction, repeat the same test procedure with the vehicle orientation in the opposite direction on the specified grade.

S7.7.1.6 Check the operation of the parking brake application indicator required by S5.3.1(d).

S7.7.2 *Test procedure for requirements of S5.2.2* (a) Check that transmission must be placed in park position to release key;

(b) Test as in S7.7.1, except in addition place the transmission control to engage the parking mechanism; and

(c) Test as in S7.7.1 except on a 20 percent grade, with the parking mechanism not engaged.

S7.7.3 *Lightly loaded vehicle.* Repeat S7.7.1 or S7.7.2 as applicable except with the vehicle at lightly loaded vehicles weight or at manufacturer's option, for a vehicle with GVWR greater than 10,000 pounds, at lightly loaded vehicle weight plus not more than an additional 1,000 pounds for a roll bar structure on the vehicle.

S7.7.4 *Non-service brake type parking brake systems.* For vehicles with parking brake systems not utilizing the service brake friction elements, burnish the friction elements of such systems prior to parking brake tests according to the manufacturer's published recommendations as furnished to the purchaser. If no recommendations are furnished, run the vehicle in an unburnished condition.

S7.8 *Service brake system test—lightly loaded vehicle (third effectiveness) test.* Make six stops from 60 mph with vehicle at lightly vehicle weight, or at the manufacturer's option for a vehicle with GVWR greater than 10,000 pounds, at lightly loaded vehicle weight plus not more than an additional 1,000 pounds for a roll bar structure on the vehicle. (This test is not applicable to a vehicle which has a GVWR of not less than 7,716 pounds and not greater than 10,000 pounds and is not a school bus.)

S7.9 *Service brake system test—partial failure.*

S7.9.1 With the vehicle at lightly loaded vehicle weight or at the manufacturer's option for a vehicle with a GVWR greater than 10,000 pounds, at lightly loaded vehicle weight plus not more than an additional 1,000 pounds for a roll bar structure on the vehicle, alter the service brake system to produce any one rupture or leakage type of failure, other than a structural failure of a housing that is common to two or more subsystems. Determine the control force, pressure level, or fluid level (as appropriate for the indicator being tested) necessary to activate the brake system indicator lamp. Make four stops if the vehicle is equipped with a split service brake system, or 10 stops if the vehicle is not so equipped, each from 60 mph, by a continuous application of the service brake control. Restore the service brake system to normal at completion of this test.

S7.9.2 Repeat S7.9.1 for each of the other subsystems.

S7.9.3 Repeat S7.9.1 and S7.9.2 with vehicle at GVWR. Restore the service brake system to normal at completion of this test.

S7.9.4 (For vehicles with antilock and/or variable proportioning brake systems.) With vehicle at GVWR, disconnect functional power source, or otherwise render antilock system inoperative. Disconnect variable proportioning brake system. Make four stops, each from 60 mph. If more than one antilock or variable proportioning brake subsystem is provided, disconnect or render one subsystem inoperative and run as above. Restore system to normal at completion of this test. Repeat for each subsystem provided.

Determine whether the brake system indicator lamp is activated when the electrical power source to the antilock or variable proportioning unit is disconnected.

S7.9.5 For a vehicle in which the brake signal is transmitted electrically between the brake pedal and some or all of the foundation brakes, regardless of the means of actuation of the foundation brakes, the tests in S7.9.1 through S7.9.3 of this standard are conducted by inducing any single failure in any circuit that electrically transmits the brake signal, and all other systems intact. Determine whether the brake system indicator lamp is activated when the failure is induced.

S7.9.6 For an EV with RBS that is part of the service brake system, the tests specified in S7.9.1 through S7.9.3 are conducted with the RBS disconnected and all other systems intact. Determine whether the brake system indicator lamp is activated when the RBS is disconnected.

S7.10 *Service brake system—inoperative brake power unit or brake power assist unit test.* (For vehicles equipped with brake power unit or brake power assist unit.)

S7.10.1 *Regular procedure.* (This test need not be run if the option in S7.10.2 is selected.) On vehicles with brake power assist units, render the brake power assist unit inoperative, or one of the brake power assist unit subsystems if two or more subsystems are provided, by disconnecting the relevant power supply. Exhaust any residual brake power reserve capability of the disconnected system. On vehicles with brake power units, disconnect the primary source of power. Make four stops, each from 60 mph by a continuous application of the service brake control. Restore the system to normal at completion of this test. For vehicles equipped with more than one brake power unit or brake power assist unit, conduct tests of each in turn.

S7.10.2 *Optional Procedures.* On vehicles with brake power assist units, the unit is charged to maximum prior to start of test. (Engine may be run up in speed, then throttle closed quickly to

attain maximum charge on vacuum assist units.) Brake power units shall also be charged to maximum accumulator pressure prior to start of test. No recharging is allowed after start of test.

(a) (For vehicles with brake power assist units.) Disconnect the primary source of power. Make six stops each from 60 mph, to achieve the average deceleration for each stop as specified in table III. Apply the brake control as quickly as possible. Maintain control force until vehicle has stopped.

At the completion of the stops specified above, deplete the system of any residual brake power reserve capability. Make one stop from 60 mph at an average deceleration of not lower than 7 fpsps for passenger cars (equivalent stopping distance 554 feet), or 6 fpsps for vehicles other than passenger cars (equivalent stopping distance 646 feet) and determine whether the control force exceeds 150 pounds.

(b) (For vehicles with brake power units with accumulator type systems.) Test as in S7.10.2(a), except make 10 stops instead of 6 and, at the completion of the 10 stops, deplete the failed element of the brake power unit of any residual brake power reserve capability before making the final stop.

(c) (For vehicles with brake power assist or brake power units with backup systems.) If the brake power or brake power assist unit operates in conjunction with a backup system and the backup system is activated automatically in the event of a primary power failure, the backup system is operative during this test. Disconnect the primary source of power of one subsystem. Make 15 stops, each from 60 mph, with the backup system activated for the failed subsystem, to achieve an average deceleration of 12 fpsps for each stop.

(d) Restore systems to normal at completion of these tests. For vehicles equipped with more than one brakepower assist or brakepower unit, conduct tests of each in turn.

S7.10.3 *Electric brakes.*

(a) For vehicles with electrically-actuated service brakes, the tests in S7.10.1 or S7.10.2 are conducted with any single electrical failure in the electric brake system instead of the brake power or brake power assist systems, and all other systems intact.

(b) For EVs with RBS that is part of the service brake system, the tests in S7.10.1 or S7.10.2 are conducted with the RBS discontinued and all other systems intact.

S7.11 *Service brake system—first fade and recovery test.*

S7.11.1 *Baseline check stops or snubs.*

S7.11.1.1 *Vehicles with GVWR of 10,000 lb or less.* Make three stops from 30 mph at 10 fpsps for each stop. Control force readings may be terminated when vehicle speed falls to 5 mph. Average the maximum brake control force required for the three stops.

S7.11.1.2 *Vehicles with GVWR greater than 10,000 pounds.* With transmission in neutral (or declutched), make three snubs from 40 to 20 mph at 10 fpsps for each snub. Average the maximum brake control force required for the three snubs.

S7.11.2 *Fade stops or snubs.*

S7.11.2.1 *Vehicles with GVWR of 10,000 pounds or less.* Make 5 stops from 60 mph at 15 fpsps followed by 5 stops at the maximum attainable deceleration between 5 and 15 fpsps for each stop. Establish an initial brake temperature before the first brake application of 130° to 150 °F. Initial brake temperatures before brake applications for subsequent stops are those occurring at the distance intervals. Attain the required deceleration within 1 second and, as a minimum, maintain it for the remainder of the stopping time. Control force readings may be terminated when vehicle speed falls to 5 mph. Leave an interval of 0.4 mi between the start of brake applications. Accelerate immediately to the initial test speed after each stop. Drive 1 mi at 30 mph after the last fade stop, and immediately follow the recovery procedure specified in S7.11.3.1.

S7.11.2.2 *Vehicles with GVWR greater than 10,000 lb.* With transmission in neutral (or declutched) make 10 snubs from 40 to 20 mph at 10 fpsps for each snub. Establish an initial brake temperature before the first brake application of 130 °F. to 150 °F. Initial brake temperatures before brake application for subsequent snubs are those occurring in the time intervals specified below. Attain the required deceleration

within 1 s and maintain it for the remainder of the snubbing time. Leave an interval of 30 s between snubs (start of brake application to start of brake application). Accelerate immediately to the initial test speed after each snub. Drive for 1.5 mi at 40 mph after the last snub and immediately follow the recovery procedure specified in S7.11.3.2.

S7.11.3 *Recovery stops or snubs.*

S7.11.3.1 *Vehicles with GVWR of 10,000 lb or less.* Make five stops from 30 mph at 10 fpsps for each stop. Control force readings may be terminated when vehicle speed falls to 5 mph. Allow a braking distance interval of 1 mi. Immediately after each stop accelerate at maximum rate to 30 mph and maintain that speed until making the next stop. Record the maximum control force for each stop.

S7.11.3.2 *Vehicles with GVWR greater than 10,000 lb.* With transmission in neutral (or declutched) make five snubs from 40 to 20 mph at 10 fpsps for each snub. After each snub, accelerate at maximum rate to 40 mph and maintain that speed until making the next brake application at a point 1.5 mi from the point of the previous brake application. Record the maximum control force for each snub.

S7.12 *Service brake system—second reburnish.* Repeat S7.6.

S7.13 *Service brake system—second fade and recovery test.* Repeat S7.11 except in S7.11.2 run 15 fade stops or 20 snubs instead of 10.

S7.14 *Third reburnish.* Repeat S7.6.

S7.15 *Service brake system—fourth effectiveness test.* Repeat S7.5. Then (for passenger cars) make four stops from either 95 mph if the speed attainable in 2 mi is 99 to (but not including) 104 mph, or 100 mph if the speed attainable in 2 mi is 104 mph or greater.

S7.16 *Service brake system—water recovery test.*

S7.16.1 *Baseline check stop.* Make three stops from 30 mph at 10 fpsps for each stop. Control force readings may be terminated when vehicle speed falls to 5 mph. Average the maximum brake control force required for the three stops.

S7.16.2 *Wet brake recovery stops.* With the brakes fully released at all times, drive the vehicle for 2 min at a speed of 5 mph in any combination of forward and reverse directions, through a trough having a water depth of 6 in. After leaving the trough, immediately accelerate at a maximum rate to 30 mph without a brake application. Immediately upon reaching that speed make five stops, each from 30 mph at 10 fpsps for each stop. After each stop (except the last), accelerate the vehicle immediately at a maximum rate to a speed of 30 mph and begin the next stop.

S7.17 *Spike stops.* Make 10 successive spike stops from 30 mph with the transmission in neutral, with no reverse stops. Make spike stops by applying a control force of 200 lb while recording control force versus time. Maintain control force until vehicle has stopped. At completion of 10 spike stops, make six effectiveness stops from 60 mph.

S7.18 *Final inspection.* Inspect—

(a) The service brake system for detachment or fracture of any components, such as brake springs and brake shoes or disc pad facing.

(b) The friction surface of the brake, the master cylinder or brake power unit reservoir cover and seal and filler openings, for leakage of brake fluid or lubricant.

(c) The master cylinder or brake power unit reservoir for compliance with the volume and labeling requirements of S5.4.2 and S5.4.3. In determining the fully applied worn condition assume that the lining is worn to: (1) Rivet or bolt heads on riveted or bolted linings, or (2) within one thirty-seconds of an inch of shoe or pad mounting surface on bonded linings, or (3) the limit recommended by the manufacturer, whichever is larger relative to the total possible shoe or pad movement. Drums or rotors are assumed to be at nominal design drum diameter or rotor thickness. Linings are assumed adjusted for normal operating clearance in the released position.

(d) The brake system indicator light(s), for compliance with operation in various key positions, lens color, labeling, and location, in accordance with S5.3.

S7.19 *Moving barrier test.* (Only for vehicles that have been tested according to S7.7.2.) Load the vehicle to GVWR, release parking brake, and

place the transmission selector control to engage the parking mechanism. With a moving barrier as described in paragraph 4.3 of SAE Recommended Practice J972 (2000) (incorporated by reference, see § 571.5), impact the vehicle from the front at 2½ mph. Keep the longitudinal axis of the barrier parallel with the longitudinal axis of the vehicle. Repeat the test, impacting the vehicle from the rear.

NOTE: The vehicle used for this test need not be the same vehicle that has been used for the braking tests.

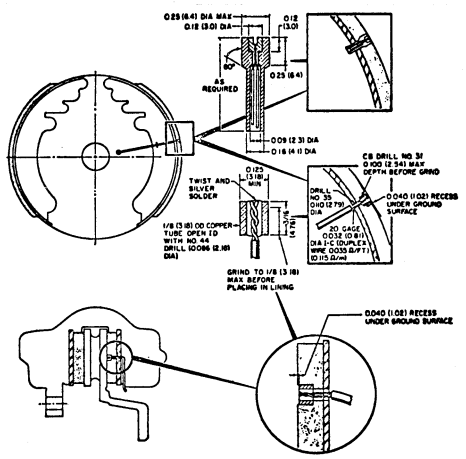
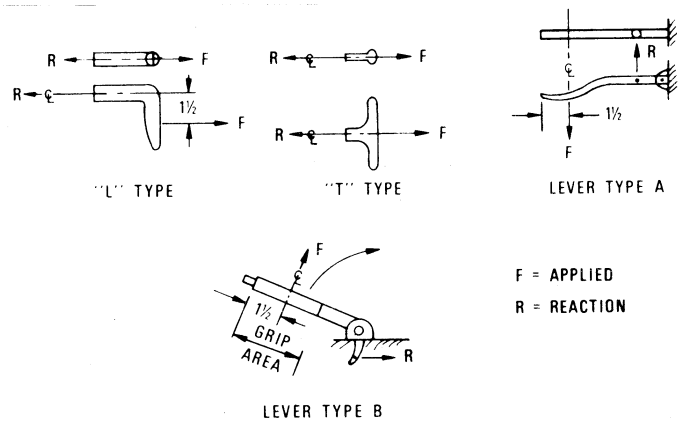


FIGURE 1—TYPICAL PLUG THERMOCOUPLE INSTALLATIONS

NOTE: The second thermocouple shall be installed at .080 inch depth within 1 inch circumferentially of the thermocouple installed at .040 inch depth.



LOCATION FOR MEASURING BRAKE APPLICATION FORCE (HAND BRAKE)

TABLE I—BRAKE TEST PROCEDURE SEQUENCE AND REQUIREMENTS

Sequence	Test load		Test procedure	Requirements
	Light	GVWR		
1. Instrumentation check			S7.2	
2. First (preburnish) effectiveness test		X	S7.3	S5.1.1.1
3. Burnish procedure		X	S7.4	
4. Second effectiveness test		X	S7.5(b)	S5.1.1.2
5. First reburnish		X	S7.6	
6. Parking brake	X	X	S7.7	S5.2
7. Stability and control during braking (braking-in-a-curve test).	X		S7.5(a)	S5.1.7
8. Third effectiveness (lightly loaded vehicle)	X		S7.8	S5.1.1.3
9. Partial failure	X	X	S7.9	S5.1.2
10. Inoperative brake power and power assist units		X	S7.10	S5.1.3
11. First fade and recovery		X	S7.11	S5.1.4
12. Second reburnish		X	S7.12	
13. Second fade and recovery		X	S7.13	S5.1.4
14. Third reburnish		X	S7.14	
15. Fourth effectiveness		X	S7.15	S5.1.1.4
16. Water recovery		X	S7.16	S5.1.5
17. Spike stops		X	S7.17	S5.1.6
18. Final inspection			S7.18	S5.6
19. Moving barrier test		X	S7.19	S5.2.2.3

TABLE II - STOPPING DISTANCES

Vehicle Test Speed (miles per hour)	Stopping Distance in feet for tests indicated															
	I-1st (preburnished) & 4th effectiveness; spike effectiveness check				II-2d effectiveness				III-3d (lightly loaded vehicles) effectiveness					IV-Inoperative brake power and power assist unit; partial failure		
	(a)	(b)	(c)	(d)	(a)	(b) & (c)	(d)	(e)	(a)	(b)	(c)	(d)	(e)	(a)	(b) & (c)	(d) & (e)
30	[1] 57	[1,2] 65	[1,2] 69 (1st) [1,2] 65 (4th and spike) [1] 72	88	[1] 54	[1] 57	78	[1,2] 70	51	57	65	84	70	114	130	170
35	74	83	91	132	70	74	106	96	67	74	83	114	96	155	176	225
40	96	108	119	173	91	96	138	124	87	96	108	149	124	202	229	288
45	121	137	150	218	115	121	175	158	110	121	137	189	158	257	291	358
50	150	169	185	264	142	150	216	195	135	150	169	233	195	317	359	435
55	181	204	224	326	172	181	261	236	163	181	204	281	236	383	433	530
60	[1] 216	[1] 242	[1] 267	388	[1] 204	[1] 216	[1] 310	[1] 280	[1] 194	[1] 216	[1] 242	[1] 335	[1] 280	[1] 456	[1] 517	[1] 613
80	[1] 405	[1] 459	[1] 510	NA	[1] 383	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
95	[1] 607	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	[1] 673	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[1] Distance for specified tests. [2] Applicable to school buses only. NA = Not applicable
Note: (a) Passenger cars; (b) vehicles other than passenger cars with GVWR of less than 8,000 lbs; (c) Vehicles with GVWR of not less than 8,000 lbs and not more than 10,000 lbs; (d) vehicles, other than buses, with GVWR greater than 10,000 lbs; (e) buses, including school buses, with GVWR greater than 10,000 lbs.

TABLE III—INOPERATIVE BRAKE POWER ASSIST AND BRAKE POWER UNITS

Stop No.	Average deceleration, FPSPS				Equivalent stopping distance, feet			
	Column 1—brake power assist		Column 2—brake power unit		Column 3—brake power assist		Column 4—brake power unit	
	(a)	(b) and (c)	(a)	(b) and (c)	(a)	(b) and (c)	(a)	(b) and (c)
1	16.0	14.0	16.0	13.0	242	277	242	298
2	12.0	12.0	13.0	11.0	323	323	298	352
3	10.0	10.0	12.0	10.0	388	388	323	388
4	9.0	8.5	11.0	9.5	431	456	352	409
5	8.0	7.5	10.0	9.0	484	517	388	431
6	7.5	6.7	9.5	8.5	517	580	409	456
7	[1] 7.0	[1] 6.0	9.0	8.0	554	646	431	484
8	NA	NA	8.5	7.5	NA	NA	456	517
9	NA	NA	8.0	7.0	NA	NA	484	554
10	NA	NA	7.5	6.5	NA	NA	517	596
11	NA	NA	[1] 7.0	[1] 6.0	NA	NA	554	646

[1] Depleted. (a) Passenger cars; (b) vehicles other than passenger cars with GVWR of 10,000 lbs or less; (c) vehicles with GVWR greater than 10,000 lbs; NA = Not applicable.

[41 FR 29696, July 19, 1976]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.105, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 571.106 Standard No. 106; Brake hoses.

S1. *Scope*. This standard specifies labeling and performance requirements for motor vehicle brake hose, brake hose assemblies, and brake hose end fittings.

S2. *Purpose*. The purpose of this standard is to reduce deaths and injuries occurring as a result of brake system failure from pressure or vacuum loss due to hose or hose assembly rupture.

S3. *Application*. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, buses, trailers, and motorcycles, and to hydraulic, air, and vacuum brake hose, brake hose assemblies, and brake hose end fittings for use in those vehicles.

S4. *Definitions*.

Armor means protective material installed on a brake hose to increase the resistance of the hose or hose assembly to abrasion or impact damage.

Brake hose means a flexible conduit, other than a vacuum tubing connector, manufactured for use in a brake system to transmit or contain the fluid pressure or vacuum used to apply force to a vehicle's brakes. For hose, a dimensional description such as ''¼-inch hose'' refers to the nominal inside diameter. For tubing, a dimensional description such as ''¼-in tubing'' refers to the nominal outside diameter.

Brake hose assembly means a brake hose, with or without armor, equipped with end fittings for use in a brake system, but does not include an air or vacuum assembly prepared by the owner or operator of a used vehicle, by his employee, or by a repair facility, for installation in that used vehicle.

Brake hose end fitting means a coupler, other than a clamp, designed for attachment to the end of a brake hose.

Free length means the linear measurement of hose exposed between the end fittings of a hose assembly in a straight position.

Permanently attached end fitting means an end fitting that is attached by deformation of the fitting about the hose by crimping or swaging, or an end fitting that is attached by use of a sacrificial sleeve or ferrule that requires replacement each time a hose assembly is rebuilt.

Preformed means a brake hose that is manufactured with permanent bends and is shaped to fit a specific vehicle without further bending.

Rupture means any failure that results in separation of a brake hose from its end fitting or in leakage.

Vacuum tubing connector means a flexible conduit of vacuum that (i) connects metal tubing to metal tubing in a brake system, (ii) is attached without end fittings, and (iii) when installed, has an unsupported length less than the total length of those portions that cover the metal tubing.

S5. *Requirements—hydraulic brake hose, brake hose assemblies, and brake hose end fittings.*

S5.1 *Construction*. (a) Each hydraulic brake hose assembly shall have permanently attached brake hose end fittings which are attached by deformation of the fitting about the hose by crimping or swaging.

(b) Each hydraulic brake hose assembly that is equipped with a permanent supplemental support integrally attached to the assembly and is manufactured as a replacement for use on a vehicle not equipped, as an integral part of the vehicle's original design, with a means of attaching the support to the vehicle shall be equipped with a bracket that is integrally attached to the supplemental support and that adapts the vehicle to properly accept this type of brake hose assembly.

S5.2 *Labeling*.

S5.2.1 Each hydraulic brake hose, except hose sold as part of a motor vehicle, shall have at least two clearly identifiable stripes of at least one-sixteenth of an inch in width, placed on opposite sides of the brake hose parallel to its longitudinal axis. One stripe may be interrupted by the information required by S5.2.2, and the other stripe

may be interrupted by additional information at the manufacturer's option. However, hydraulic brake hose manufactured for use only in an assembly whose end fittings prevent its installation in a twisted orientation in either side of the vehicle, need not meet the requirements of S5.2.1.

S5.2.2 Each hydraulic brake hose shall be labeled, or cut from bulk hose that is labeled, at intervals of not more than 6 inches, measured from the end of one legend to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on hose that is sold as part of a brake hose assembly or a motor vehicle.

(a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS–222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The marking may consist of a designation other than block capital letters required by S5.2.2.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

(d) The nominal inside diameter of the hose expressed in inches or fractions of inches, or in millimeters followed by the abbreviation ''mm.''

(e) Either ''HR'' to indicate that the hose is regular expansion hydraulic hose or ''HL'' to indicate that the hose is low expansion hydraulic hose.

S5.2.3 *Package labeling for brake hose assemblies designed to be used with a supplemental support.* (a) Each hydraulic brake hose assembly that is equipped with a permanent supplemental support integrally attached to the assembly and is manufactured as a replacement assembly for a vehicle equipped, as an integral part of the vehicle's original design, with a means of attaching the support to the vehicle shall be sold in a package that is marked or labeled as follows: ''FOR USE ON [*insert Manufacturer, Model Name*] ONLY'';

(b) Each hydraulic brake hose assembly that is equipped with a permanent supplemental support integrally attached to the assembly and is manufactured as a replacement for use on a vehicle not equipped, as an integral part of the vehicle's original design, with a means of attaching the support to the vehicle shall comply with paragraphs (a) (1) and (2) of this section:

(1) Be sold in a package that is marked or labeled as follows: ''FOR USE ONLY WITH A SUPPLEMENTAL SUPPORT.''

(2) Be accompanied by clear, detailed instructions explaining the proper installation of the brake hose and the supplemental support bracket to the vehicle and the consequences of not attaching the supplemental support bracket to the vehicle. The instructions shall be printed on or included in the package specified in paragraph (a)(1) of this section.

S5.2.4 Each hydraulic brake hose assembly, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake hose assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S5.2.4.1. The band may at the manufacturer's option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped in block capital letters, numerals or symbols at least one-eighth of an inch high, with the following information:

(a) The symbol DOT constituting certification by the hose assembler that the hose assembly conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS–222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

S5.2.4.1 At least one end fitting of a hydraulic brake hose assembly shall be etched, stamped or embossed with a designation at least one-sixteenth of an inch high that identifies the manufacturer of the hose assembly and is filed in accordance with S5.2.4(b).

S5.3 *Test requirements.* A hydraulic brake hose assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S6. However, a particular hose assembly or appropriate part thereof need not meet further requirements after having been subjected to and having met the constriction requirement (S5.3.1) and any one of the requirements specified in S5.3.2 through S5.3.13.

S5.3.1 *Constriction.* Except for that part of an end fitting which does not contain hose, every inside diameter of any section of a hydraulic brake hose assembly shall be not less than 64 percent of the nominal inside diameter of the brake hose (S6.12).

S5.3.2 *Expansion and burst strength.* The maximum expansion of a hydraulic brake hose assembly at 1,000 psi, 1,500 psi and 2,900 psi shall not exceed the values specified in Table I (S6.1), except that a brake hose larger than 3⁄16 inch or 5 mm is not subject to the 2,900 psi expansion test requirements. The hydraulic brake hose assembly shall then withstand water pressure of 4,000 psi for 2 minutes without rupture, and then shall not rupture at less than 7,000 psi for a 1⁄8 inch, 3 mm, or smaller diameter hose, or at less than 5,000 psi for a hose with a diameter larger than 1⁄8 inch or 3 mm (S6.2).

TABLE I—MAXIMUM EXPANSION OF FREE LENGTH BRAKE HOSE, CC/FT

Hydraulic brake hose, inside diameter	Test pressure					
	1,000 psi		1,500 psi		2,900 psi	
	Regular expansion hose	Low expansion hose	Low expansion hose	Regular expansion hose	Regular expansion hose	Low expansion hose
1⁄8 inch, or 3mm, or less	0.66	0.33	0.79	0.42	1.21	0.61
>1⁄8 inch or 3mm, to 3⁄16 inch or 5 mm	0.86	0.55	1.02	0.72	1.67	0.91
>3⁄16 inch or 5 mm	1.04	0.82	1.30	1.17	*	*

S5.3.3 *Whip resistance.* A hydraulic brake hose assembly shall not rupture when run continuously on a flexing machine for 35 hours (S6.3).

S5.3.4 *Tensile strength.* A hydraulic brake hose assembly shall withstand a pull of 325 pounds without separation of the hose from its end fittings during a slow pull test, and shall withstand a pull of 370 pounds without separation of the hose from its end fittings during a fast pull test (S6.4).

S5.3.5 *Water absorption and burst strength.* A hydraulic brake hose assembly, after immersion in water for 70 hours (S6.5), shall withstand water pressure of 4,000 psi for 2 minutes, and then shall not rupture at less than 5,000 psi (S6.2).

S5.3.6 *Water absorption and tensile strength.* A hydraulic brake hose assembly, after immersion in water for 70 hours (S6.5), shall withstand a pull of 325 pounds without separation of the hose from its end fittings during a slow pull test, and shall withstand a pull of 370 pounds without separation of the hose from its end fittings during a fast pull test (S6.4).

S5.3.7 *Water absorption and whip resistance.* A hydraulic brake hose assembly, after immersion in water for 70 hours (S6.5), shall not rupture when run continuously on a flexing machine for 35 hours (S6.3).

S5.3.8 *Low-temperature resistance.* A hydraulic brake hose conditioned at a temperature between minus 49 degrees Fahrenheit (minus 45 degrees Celsius) and minus 54 degrees Fahrenheit (minus 48 degrees Celsius) for 70 hours shall not show cracks visible without magnification when bent around a cylinder as specified in S6.6 (S6.6).

S5.3.9 *Brake fluid compatibility, constriction, and burst strength.* Except for

brake hose assemblies designed for use with mineral or petroleum-based brake fluids, a hydraulic brake hose assembly shall meet the constriction requirement of S5.3.1 after having been subjected to a temperature of 248 degrees Fahrenheit (120 degrees Celsius) for 70 hours while filled with SAE RM–66–04 ''Compatibility Fluid,'' as described in Appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see §571.5). It shall then withstand water pressure of 4,000 psi for 2 minutes and thereafter shall not rupture at less than 5,000 psi (S6.2 except all sizes of hose are tested at 5,000 psi).

S5.3.10 *Ozone resistance.* A hydraulic brake hose shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours at 104 °F. (S6.8).

S5.3.11 *Dynamic ozone test.* A hydraulic brake hose shall not show cracks visible without magnification after having been subjected to a 48-hour dynamic ozone test (S6.9).

S5.3.12 *High temperature impulse test.* A brake hose assembly tested under the conditions in S6.10:

(a) Shall withstand pressure cycling for 150 cycles, at 295 degrees Fahrenheit (146 degrees Celsius) without leakage;

(b) Shall not rupture during a 2-minute, 4,000 psi pressure hold test, and;

(c) Shall not burst at a pressure less than 5,000 psi.

S5.3.13 *End fitting corrosion resistance.* After 24 hours of exposure to salt spray, a hydraulic brake hose end fitting shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information has caused displacement of the protective coating (S6.11).

S6. *Test procedures—Hydraulic brake hose, brake hose assemblies, and brake hose end fittings.*

S6.1. *Expansion test.*

S6.1.1 *Apparatus.* Utilize a test apparatus (as shown in Figure 1) which consists of:

(a) Source for required fluid pressure;

(b) Test fluid of water without any additives and free of gases;

(c) Reservoir for test fluid;

(d) Pressure gauges;

(e) Brake hose end fittings in which to mount the hose vertically; and

(f) Graduate burette with 0.05 cc increments.

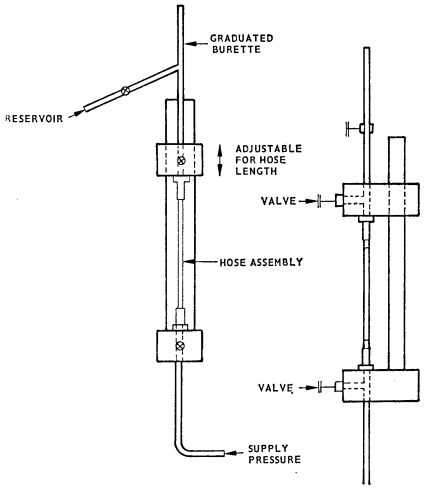


FIG. 1—EXPANSION TEST APPARATUS

S6.1.2 *Preparation.* (a) Measure the free length of the hose assembly.

(b) Mount the hose so that it is in a vertical straight position without tension when pressure is applied.

(c) Fill the hose with test fluid and bleed all gases from the system.

(d) Close the valve to the burette and apply 1,500 psi for 10 seconds; then release pressure.

S6.1.3 *Calculation of expansion at 1,000 and 1,500 psi.* (a) Adjust the fluid level in the burette to zero.

(b) Close the valve to the burette, apply pressure at the rate of 15,000 psi per minute, and seal 1,000 psi in the hose (1,500 psi in the second series, and 2,900 psi in the third series).

(c) After 3 seconds open the valve to the burette for 10 seconds and allow the fluid in the expanded hose to rise into the burette.

(d) Repeat the procedure in steps (b) and (c) twice. Measure the amount of test fluid which has accumulated in the burette as a result of the three applications of pressure.

(e) Calculate the volumetric expansion per foot by dividing the total accumulated test fluid by 3 and further

dividing by the free length of the hose in feet.

S6.2 *Burst strength test.* (a) Connect the brake hose to a pressure system and fill it completely with water, allowing all gases to escape.

(b) Apply water pressure of 4,000 psi at a rate of 15,000 psi per minute.

(c) After 2 minutes at 4,000 psi, increase the pressure at the rate of 15,000 psi per minute until the pressure exceeds 5,000 psi for a brake hose larger than ⅛ inch or 3 mm diameter, or until the pressure exceeds 7,000 psi for a brake hose of ⅛ inch, 3 mm, or smaller diameter.

S6.3 *Whip resistance test.*

S6.3.1 *Apparatus.* Utilize test apparatus that is dynamically balanced and includes:

(a) A movable header consisting of a horizontal bar equipped with capped end fittings and mounted through bearings at each end to points 4 inches from the center of two vertically rotating disks whose edges are in the same vertical plane;

(b) An adjustable stationary header parallel to the movable header in the same horizontal plane as the centers of the disks, and fitted with open end fittings;

(c) An elapsed time indicator; and

(d) A source of water pressure connected to the open end fittings.

S6.3.2 *Preparation.* (a) Except for the supplemental support specified in S6.3.2(d), remove all external appendages including, but not limited to, hose armor, chafing collars, mounting brackets, date band and spring guards.

(b) Measure the hose free length.

(c) Mount the hose in the whip test machine, introducing slack as specified in Table II for the size hose tested, measuring the projected length parallel to the axis of the rotating disks. The manufacturer may, at his option, adapt the fitting attachment points to permit mounting hose assemblies equipped with angled or other special fittings in the same orientation as hose assemblies equipped with straight fittings.

(d) In the case of a brake hose assembly equipped with a permanent supplemental support integrally attached to the assembly, the assembly may be mounted using the supplemental support and associated means of simulating its attachment to the vehicle. Mount the supplemental support in the same vertical and horizontal planes as the stationary header end of the whip test fixture described in S6.3.1(b). Mount or attach the supplemental support so that it is positioned in accordance with the recommendation of the assembly manufacturer for attaching the supplemental support on a vehicle.

TABLE II—HOSE LENGTHS

Free length between end fittings, inches	Slack, inches	
	⅛ inch or 3 mm hose or less	More than ⅛ inch or 3 mm hose
8 to 15½, inclusive	1.750	
10 to 15½, inclusive		1,000
Over 15½ to 19 inclusive	1.250	
Over 19 to 24, inclusive	0.750	

S6.3.3 *Operation.* (a) Apply 235 psi water pressure and bleed all gases from the system.

(b) Drive the movable head at 800 rpm.

S6.4 *Tensile strength test.* Utilize a tension testing machine conforming to the requirements of ASTM E4–03 (incorporated by reference, see § 571.5) and provided with a recording device to measure the force applied.

S6.4.1 *Preparation.* Mount the hose assembly to ensure straight, evenly distributed machine pull.

S6.4.2 *Operation.* (a) Conduct the slow pull test by applying tension at a rate of 1 inch per minute travel of the moving head until separation occurs.

(b) Conduct the fast pull test by applying tension at a rate of 2 inches per minute travel of the moving head until separation occurs.

S6.5 *Water absorption sequence tests.* (a) Prepare three brake hose assemblies and measure the free length of the hose assemblies.

(b) Immerse the brake hose assemblies in distilled water at 185 degrees Fahrenheit (85 degrees Celsius) for 70 hours. Remove the brake hose assemblies from the water and condition in air at room temperature for 30 minutes.

(c) Conduct the tests in S6.2, S6.3, and S6.4, using a different hose for each sequence.

S6.6 *Low temperature resistance test.*

S6.6.1 *Preparation.* (a) Remove hose armor, if any, and condition the hose in a straight position in air at a temperature between minus 49 degrees Fahrenheit and minus 54 degrees Fahrenheit (minus 45 degrees Celsius and minus 48 degrees Celsius) for 70 hours.

(b) Condition a cylinder in air at a temperature between minus 49 degrees Fahrenheit and minus 54 degrees Fahrenheit (minus 45 degrees Celsius and minus 48 degrees Celsius) for 70 hours, using a cylinder of 2½ inches in diameter for tests of hose less than ⅛ inch or 3mm, 3 inches in diameter for tests of ⅛ inch or 3 mm hose, 3½ inches in diameter for tests of 3/16 to ¼ inch hose or 4 mm to 6 mm hose, and 4 inches in diameter for tests of hose greater than ¼ inch or 6 mm in diameter.

S6.6.2 *Flexibility testing.* Bend the conditioned hose 180 degrees around the conditioned cylinder at a steady rate in a period of 3 to 5 seconds. Examine without magnification for cracks.

S6.7 *Brake fluid compatibility test.*

S6.7.1 *Preparation.* (a) Attach a hose assembly below a 1-pint reservoir filled with 100 ml. of SAE RM–66–04 Compatibility Fluid as shown in Figure 2.

(b) Fill the hose assembly with brake fluid, seal the lower end, and place the test assembly in an oven in a vertical position.

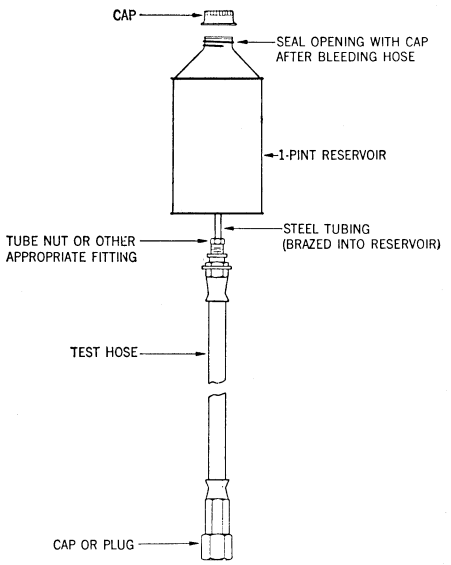


FIG. 2. BRAKE FLUID COMPATABILITY APPARATUS

S6.7.2 *Oven treatment.* (a) Condition the hose assembly at 200 °F. for 70 hours.

(b) Cool the hose assembly at room temperature for 30 minutes.

(c) Drain the brake hose assembly, immediately determine that every inside diameter of any section of the hose assembly, except for that part of an end fitting which does not contain hose, is not less than 64 percent of the nominal inside diameter of the hose, and conduct the test specified in S6.2.

S6.8 *Ozone resistance test.* Utilize a cylinder with a diameter eight times the nominal outside diameter of the brake hose excluding armor.

S6.8.1 *Preparation.* After removing any armor, bind a hydraulic brake hose 360° around the cylinder. In the case of hose shorter than the circumference of the cylinder, bend the hose so that as much of its length as possible is in contact.

S6.8.2 *Exposure to ozone.* (a) Condition the hose on the cylinder in air at room temperature for 24 hours.

(b) Immediately thereafter, condition the hose on the cylinder for 70 hours in an exposure chamber having an ambient air temperature of 104 degrees Fahrenheit (40 degrees Celsius) during the test and containing air mixed with

ozone in the proportion of 100 parts of ozone per 100 million parts of air by volume.

(c) Examine the hose for cracks under 7-power magnification, ignoring areas immediately adjacent to or within the area covered by binding.

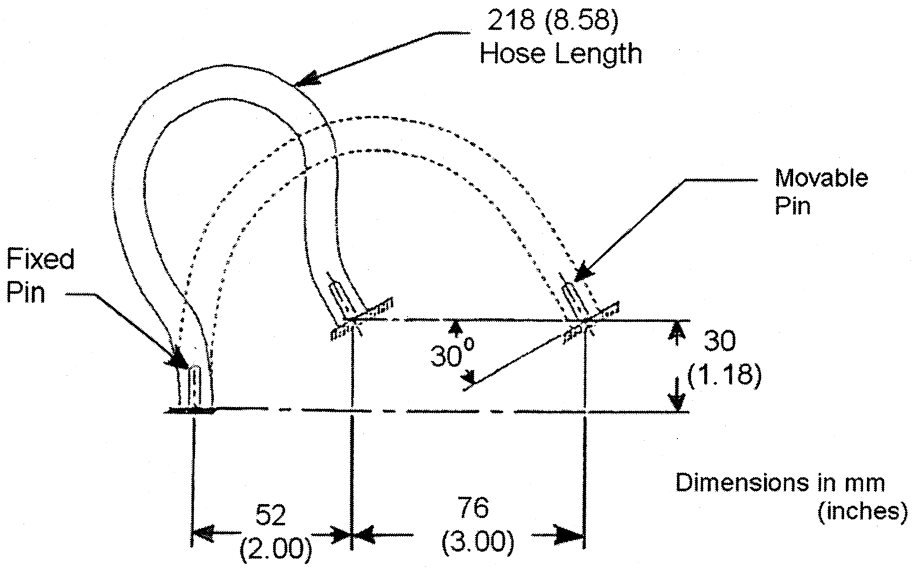
S6.9 *Dynamic ozone test.*

S6.9.1 *Apparatus.* Utilize a test apparatus shown in Figure 3 which is constructed so that:

(a) It has a fixed pin with a vertical orientation over which one end of the brake hose is installed.

(b) It has a movable pin that is oriented 30 degrees from vertical, with the top of the movable pin angled towards the fixed pin. The moveable pin maintains its orientation to the fixed pin throughout its travel in the horizontal plane. The other end of the brake hose is installed on the movable pin.

Figure 3. Dynamic Ozone Test Apparatus



S6.9.2 *Preparation.* (a) Precondition the hose assembly by laying it on a flat surface in an unstressed condition, at room temperature, for 24 hours.

(b) Cut the brake hose assembly to a length of 8.6 inches (218 mm), such that no end fittings remain on the cut hose.

(c) Mount the brake hose onto the test fixture by fully inserting the fixture pins into each end of the hose. Secure the hose to the fixture pins using a band clamp at each end of the hose.

(d) Place the test fixture into an ozone chamber

(e) Stabilize the atmosphere in the ozone chamber so that the ambient temperature is 104 °F (40 degrees Celsius) and the air mixture contains air mixed with ozone in the proportion of 100 parts of ozone per 100 million parts

of air by volume. This atmosphere is to remain stable throughout the remainder of the test.

(f) Begin cycling the movable pin at a rate of 0.3 Hz. Continue the cycling for 48 hours.

(g) At the completion of 48 hours of cycling, remove the test fixture from the ozone chamber. Without removing the hose from the test fixture, visually examine the hose for cracks without magnification, ignoring areas immediately adjacent to or within the area covered by the band clamps. Examine the hose with the movable pin at any point along its travel.

S6.10 *High temperature impulse test.*

S6.10.1 *Apparatus.* (a) A pressure cycling machine to which one end of the brake hose assembly can be attached, with the entire hose assembly installed vertically inside of a circulating air oven. The machine shall be capable of increasing the pressure in the hose from zero psi to 1600 psi, and decreasing the pressure in the hose from 1600 psi to zero psi, within 2 seconds.

(b) A circulating air oven that can reach a temperature of 295 degrees Fahrenheit (146 degrees Celsius) within 30 minutes, and that can maintain a constant 295 degrees F (146 degrees Celsius) thereafter, with the brake hose assembly inside of the oven and attached to the pressure cycling machine.

(c) A burst test apparatus to conduct testing specified in S6.2

S6.10.2 *Preparation.* (a) Connect one end of the hose assembly to the pressure cycling machine and plug the other end of the hose. Fill the pressure cycling machine and hose assembly with SAE RM–66–04 ''Compatibility Fluid,'' as described in Appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see §571.5) and bleed all gases from the system.

(b) Place the brake hose assembly inside of the circulating air oven in a vertical position. Increase the oven temperature to 295 degrees F (146 degrees Celsius) and maintain this temperature throughout the pressure cycling test.

(c) During each pressure cycle, the pressure in the hose is increased from zero psi to 1600 psi and held constant for 1 minute, then the pressure is decreased from 1600 psi to zero psi and held constant for 1 minute. Perform 150 pressure cycles on the brake hose assembly.

(d) Remove the brake hose assembly from the oven, disconnect it from the pressure cycling machine, and drain the fluid from the hose. Cool the brake hose assembly at room temperature for 45 minutes.

(e) Wipe the brake hose using acetone to remove residual Compatibility Fluid. Conduct the burst strength test in S6.2, except all sizes of hose are tested at 5,000 psi.

S6.11 *End fitting corrosion test.* Utilize the apparatus described in ASTM B117–03 (incorporated by reference, see §571.5).

S6.11.1 *Construction. Construct the salt spray chamber so that:*

(a) The construction material does not affect the corrosiveness of the fog.

(b) The hose assembly is supported or suspended 30 degrees from the vertical and parallel to the principal direction of the horizontal flow of fog through the chamber.

(c) The hose assembly does not contact any metallic material or any material capable of acting as a wick

(d) Condensation which falls from the assembly does not return to the solution reservoir for respraying.

(e) Condensation from any source does not fall on the brake hose assemblies or the solution collectors.

(f) Spray from the nozzles is not directed onto the hose assembly.

S6.11.2 *Preparation.* (a) Plug each end of the hose assembly.

(b) Mix a salt solution five parts by weight of sodium chloride to 95 parts of distilled water, using sodium chloride substantially free of nickel and copper, and containing on a dry basis not more than 0.1 percent of sodium iodide and not more than 0.3 percent total impurities. Ensure that the solution is free of suspended solids before the solution is atomized.

(c) After atomization at 95 degrees Fahrenheit (35 degrees Celsius), ensure that the collected solution is in the PH range of 6.5 to 7.2. Make the PH measurements at 77 degrees Fahrenheit (28 degrees Celsius).

(d) Maintain a compressed air supply to the nozzle or nozzles free of oil and dirt and between 10 and 25 psi.

S6.11.3 *Operation.* Subject the brake hose assembly to the salt spray continuously for 24 hours.

(a) Regulate the mixture so that each collector will collect from 1 to 2 milliliters of solution per hour for each 80 square centimeters of horizontal collecting area.

(b) Maintain exposure zone temperature at 95 degrees Fahrenheit (35 degrees Celsius).

(c) Upon completion, remove the salt deposit from the surface of the hose by washing gently or dipping in clean running water not warmer than 100 degrees Fahrenheit (38 degrees Celsius) and then drying immediately.

S6.12 *Constriction test.* Brake hose constriction test requirements shall be met using at least one of the methods specified in S6.12.1, S6.12.2, or S6.12.3.

S6.12.1 *Plug gauge.* (a) Utilize a plug gauge as shown in Figure 4. Diameter ''A'' is equal to 64 percent of the nominal inside diameter of the hydraulic brake hose being tested.

(b) Brake hose assemblies that are to be used for additional testing have constriction testing only at each end fitting. Other brake hose assemblies may be cut into 3-inch lengths to permit constriction testing of the entire assembly. Hose assemblies with end fittings that do not permit entry of the gauge (*e.g.*, restrictive orifice or banjo fitting) are cut 3 inches from the point at which the hose terminates in the end fitting and then tested from the cut end.

(c) Hold the brake hose in a straight position and vertical orientation.

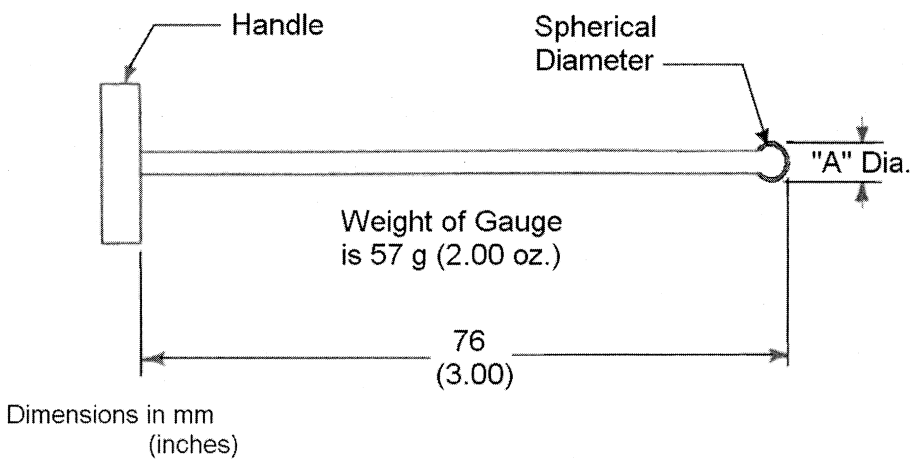
(d) Place the spherical end of the plug gauge just inside the hose or end fitting. If the spherical end will not enter the hose or end fitting using no more force than gravity acting on the plug gauge, this constitutes failure of the constriction test.

(e) Release the plug gauge. Within 3 seconds, the plug gauge shall fall under the force of gravity alone up to the handle of the gauge. If the plug gauge does not fully enter the hose up to the handle of the gauge within three seconds, this constitutes failure of the constriction test.

S6.12.2 *Extended plug gauge.* (a) The test in 6.12.1 may be conducted with an extended plug gauge to enable testing of the entire brake hose from one end fitting, without cutting the brake hose. The extended plug gauge weight and spherical diameter specifications are as shown in Figure 4, but the handle portion of the gauge may be deleted and the gauge length may be greater than 3 inches.

(b) The required performance of the extended plug gauge in S6.12.1(e) is that after the plug gauge is released, the extended plug gauge shall fall under the force of gravity alone at an average rate of 1 inch per second until the spherical diameter of the extended gauge passes through all portions of the brake hose assembly containing hose. If the extended plug gauge does not pass through all portions of the brake hose assembly containing hose at an average rate of 1 inch per second, this constitutes failure of the constriction test.

FIGURE 4. CONSTRICTION TEST PLUG GAUGE



S6.12.3 *Drop ball test.* (a) Utilize a rigid spherical ball with a diameter equal to 64 percent of the nominal inside diameter of the hydraulic brake hose being tested. The weight of the spherical ball shall not exceed 2 ounces (57 grams).

(b) Hold the brake hose in a straight position and vertical orientation.

(c) Hold the ball just above the end fitting.

(d) Release the ball. The ball shall fall under the force of gravity alone completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second. Failure of the ball to pass completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second, constitutes failure of the constriction test.

S7. *Requirements—Air brake hose, brake hose assemblies, and brake hose end fittings.*

S7.1 *Construction.* Each air brake hose assembly shall be equipped with permanently attached brake hose end fittings or reusable brake hose end fittings. Each air brake hose constructed of synthetic or natural elastomeric rubber shall conform to the dimensional requirements specified in Table III, except for brake hose manufactured in metric sizes.

S7.2 *Labeling*

S7.2.1 *Hose.* Each air brake hose shall be labeled, or cut from bulk hose that is labeled, at intervals of not more than 6 inches, measured from the end of one legend to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on hose that is sold as part of a brake hose assembly or a motor vehicle.

(a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS–222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

(d) The nominal inside diameter of the hose expressed in inches or fractions of inches or in millimeters. The abbreviation ''mm'' shall follow hose sizes that are expressed in millimeters. (Examples: 3/8, 1/2 (1/2SP in the case of 1/2 inch special air brake hose), 4mm, 6mm.)

(e) The type designation corresponding to the brake hose dimensions in Table III. Type A shall be labeled with the letter ''A'', Type AI shall be labeled with the letters ''AI'', and type AII shall be labeled with the letters ''AII''. Metric air brake hose shall be labeled with the letter ''A.''

TABLE III—AIR BRAKE HOSE DIMENSIONS—INSIDE DIAMETER (ID) AND OUTSIDE DIAMETER (OD) DIMENSIONS IN INCHES (MILLIMETERS)

	Type A—Hose Size—Nominal Inside Diameter					
	1/4	5/16	3/8	7/16	1/2 SP (1)	5/8
Min. I.D.	0.227 (5.8)	0.289 (7.3)	0.352 (8.9)	0.407 (10.3)	0.469 (11.9)	0.594 (15.1)
Max. I.D.	0.273 (6.9)	0.335 (8.5)	0.398 (10.1)	0.469 (11.9)	0.531 (13.5)	0.656 (16.7)
Min. O.D.	0.594 (15.1)	0.656 (16.7)	0.719 (18.3)	0.781 (19.8)	0.844 (21.4)	1.031 (26.2)
Max. O.D.	0.656 (16.7)	0.719 (18.3)	0.781 (19.8)	0.843 (21.4)	0.906 (23.0)	1.094 (27.8)
	Type AI (2)—Hose Size—Nominal Inside Diameter					
	3/16	1/4	5/16	13/32	1/2	5/8
Min. I.D.	0.188 (4.8)	0.250 (6.4)	0.312 (7.9)	0.406 (10.3)	0.500 (12.7)	0.625 (15.9)
Max. I.D.	0.214 (5.4)	0.281 (7.1)	0.343 (8.7)	0.437 (11.1)	0.539 (13.7)	0.667 (16.9)
Min. O.D.	0.472 (12.0)	0.535 (13.6)	0.598 (15.1)	0.714 (18.1)	0.808 (20.5)	0.933 (23.7)
Max. O.D.	0.510 (13.0)	0.573 (14.6)	0.636 (16.2)	0.760 (19.3)	0.854 (21.7)	0.979 (24.9)
	Type AII (2)—Hose Size—Nominal Inside Diameter					
	3/16	1/4	5/16	13/32	1/2	5/8
Min. I.D.	0.188 (4.8)	0.250 (6.4)	0.312 (7.9)	0.406 (10.3)	0.500 (12.7)	0.625 (15.9)
Max. I.D.	0.214 (5.4)	0.281 (7.1)	0.343 (8.7)	0.437 (11.1)	0.539 (13.7)	0.667 (16.9)
Min. O.D.	0.500 (12.7)	0.562 (14.3)	0.656 (16.7)	0.742 (18.8)	0.898 (22.8)	1.054 (26.8)
Max. O.D.	0.539 (13.7)	0.602 (15.3)	0.695 (17.7)	0.789 (20.1)	0.945 (24.0)	1.101 (27.9)

(1) Notes: Type A, sizes 3/8, 7/16, and 1/2 Special can be assembled with reusable end fittings. All sizes can be assembled using permanently-attached (crimped) end fittings.
(2) Types AI and AII, all sizes, can be assembled with reusable or permanently-attached (crimped) end fittings.

S7.2.2 *End fittings.* Except for an end fitting that is attached by deformation of the fitting about a hose by crimping or swaging, at least one component of each air brake hose fitting shall be etched, embossed, or stamped in block capital letters and numerals at least

one-sixteenth of an inch high with the following information:

(a) The symbol DOT, constituting a certification by the manufacturer of that component that the component conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of that component of the fitting, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS–222, National Highway Traffic Safety Administration, 400 Seventh St. S.W., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The letter ''A'' shall indicate intended use in air brake systems. In the case of an end fitting intended for use in a reusable assembly with brake hose subject to Table III, ''AI'' or ''AII'' shall indicate use with Type I or Type II hose, respectively.

(d) The nominal inside diameter of the hose to which the fitting is properly attached expressed in inches or fractions of inches or in millimeters. (See examples in S7.2.1 (d).) The abbreviation ''mm'' shall follow hose sizes that are expressed in millimeters.

S7.2.3 *Assemblies.* Each air brake hose assembly made with end fittings that are attached by crimping or swaging, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake hose assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S7.2.3.1. The band may at the manufacturer's option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped in block capital letters, numerals or symbols at least one-eighth of an inch high, with the following information:

(a) The symbol DOT, constituting certification by the hose assembler that the hose assembly conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics Division, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

S7.2.3.1 At least one end fitting of an air brake hose assembly made with end fittings that are attached by crimping or swaging shall be etched, stamped or embossed with a designation at least one-sixteenth of an inch high that identifies the manufacturer of the hose assembly and is filed in accordance with S7.2.3(b).

S7.3 *Test requirements.* Each air brake hose assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S8. However, a particular hose assembly or appropriate part thereof need not meet further requirements after having met the constriction requirement (S7.3.1) and then having been subjected to any one of the requirements specified in S7.3.2 through S7.3.13.

S7.3.1 *Constriction.* Every inside diameter of any section of an air brake hose assembly shall not be less than 66 percent of the nominal inside diameter of the brake hose. (S8.14)

S7.3.2 *High temperature resistance.* An air brake hose shall not show external or internal cracks, charring, or disintegration visible without magnification when straightened after being bent for 70 hours at 212 degrees Fahrenheit (100 degrees Celsius) over a small test cylinder having the radius specified in Table IV for the size of hose tested. (S8.1)

S7.3.3 *Low temperature resistance.* The inside and outside surfaces of an air brake hose shall not show cracks as a result of conditioning at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 70 hours when bent around a large test cylinder having the radius specified in Table IV for the size of hose tested (S8.2).

TABLE IV—AIR BRAKE HOSE DIAMETERS AND TEST CYLINDER RADII

Nominal hose inside diameter, inches [1]	3/16	1/4	5/16	3/8	13/32	7/16, 1/2	5/8
Nominal hose inside diameter, millimeters [1]	4, 5	6	8	.....	10	12	16
Small test cylinder, radius in inches (millimeters) [2]	1 (25)	1½ (38)	1¾ (45)	1¾ (45)	1⅞ (48)	2 (51)	2½ (64)
Large test cylinder, radius in inches (millimeters) [3]	2 (51)	2½ (64)	3 (76)	3½ (89)	3½ (89)	4 (102)	4½ (114)

Notes:
[1] These sizes are listed to provide test cylinder radii for brake hoses manufactured in these sizes. They do not represent conversions.
[2] Small test cylinders are used for the high temperature resistance test.
[3] Large test cylinders are used for the low temperature resistance, ozone resistance, and adhesion of wire-reinforced hose tests.

S7.3.4 *Oil resistance.* After immersion in ASTM No. 3 oil for 70 hours at 212 °F. the volume of a specimen prepared from the inner tube and cover of an air brake hose shall not increase more than 100 percent (S8.3).

S7.3.5 *Ozone resistance.* An air brake hose assembly shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours at 104 degrees Fahrenheit (40 degrees Celsius) when bent around a test cylinder of the radius specified in Table IV for the size of hose tested (S8.4).

S7.3.6 *Length change.* An air brake hose shall not contract in length more than 7 percent nor elongate more than 5 percent when subjected to air pressure of 200 psi (S8.5).

S7.3.7 *Adhesion.* (a) Except for hose reinforced by wire, an air brake hose shall withstand a tensile force of 8 pounds per inch of length before separation of adjacent layers (S8.6).

(b) An air brake hose reinforced by wire shall permit a steel ball to roll freely along the entire length of the inside of the hose when the hose is subjected to a vacuum of 25 inches of Hg and bent around a test cylinder (S8.13).

S7.3.8 *Flex strength and air pressure leakage.* An air brake hose assembly of the length specified in the table accompanying Figure 5, when subjected to a flex test and internal pressure cycling, shall be capable of having its internal pressure increased from zero to 140 psi within 2 minutes with pressurized air supplied through an orifice (S8.7).

S7.3.9 *Corrosion resistance and burst strength.* An air brake hose assembly exposed to salt spray shall not rupture when exposed to hydrostatic pressure of 900 psi (S8.8).

S7.3.10 *Tensile strength.* An air brake hose assembly designed for use between a frame and axle or between a towed and towing vehicle shall withstand, without separation of the hose from its end fittings, a pull of 250 pounds if it is ¼ inch, 6 mm, or less in nominal inside diameter, or a pull of 325 pounds if it is larger than ¼ inch or 6 mm in nominal inside diameter. An air brake hose assembly designed for use in any other application shall withstand, without separation of the hose from its end fittings, a pull of 50 pounds if it is ¼ inch, 6 mm, or less in nominal inside diameter, 150 pounds if it is larger than ¼ inch or 6 mm and equal to or smaller than ½ inch or 12 mm in nominal inside diameter, or 325 pounds if it is larger than ½ inch or 12 mm in nominal inside diameter (S8.9).

S7.3.11 *Water absorption and tensile strength.* After immersion in distilled water for 70 hours, an air brake hose assembly designed for use between a frame and axle or between a towed and a towing vehicle shall withstand, without separation of the hose from its end

fittings, a pull of 250 pounds if it is ¼ inch or less or 6 mm or less in nominal inside diameter, or a pull of 325 pounds if it is larger than ¼ inch or 6 mm in nominal inside diameter. After immersion in distilled water for 70 hours, an air brake hose assembly designed for use in any other application shall withstand, without separation of the hose from its end fittings, a pull of 50 pounds if it is ¼ inch or 6 mm or less in nominal inside diameter, 150 pounds if it is larger than ¼ inch or 6 mm and equal to or smaller than ½ inch or 12 mm in nominal inside diameter, or 325 pounds if it is larger than ½ inch or 12 mm in nominal inside diameter. (S8.10)

S7.3.12 *Zinc chloride resistance.* The outer cover of an air brake hose shall not show cracks visible under 7-power magnification after immersion in a 50 percent zinc chloride aqueous solution for 200 hours (S8.11).

S7.3.13 *End fitting corrosion resistance.* After 24 hours of exposure to salt spray, air brake hose end fittings shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information causes a displacement of the protective coating.

S8. *Test procedures—Air brake hose, brake hose assemblies, and brake hose end fittings.*

S8.1 *High temperature resistance test.*

(a) Utilize a small test cylinder with a radius specified in Table IV for the size of hose tested.

(b) Bind the hose around the cylinder and condition it in an air oven for 70 hours at 212 degrees Fahrenheit (100 degrees Celsius).

(c) Cool the hose to room temperature, remove it from the cylinder and straighten it.

(d) Without magnification, examine the hose externally and cut the hose lengthwise and examine the inner tube.

S8.2 *Low temperature resistance test.* (a) Utilize a large test cylinder with a radius specified in Table IV for the size of hose tested.

(b) Condition the cylinder and the brake hose, in a straight position, in a cold box at minus 40 °F. for 70 hours.

(c) With the hose and cylinder at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), bend the hose 180 degrees around the cylinder at a steady rate in a period of 3 to 5 seconds. Remove the hose from the test cylinder and visibly examine the exterior of the hose for cracks without magnification.

(d) Allow the hose to warm at room temperature for 2 hours. All reusable end fittings are removed from the hose. All permanently-attached end fittings are cut away from the hose. Cut through one wall of the hose longitudinally along its entire length. Unfold the hose to permit examination of the interior surface. Visibly examine the interior of the hose for cracks without magnification.

S8.3 *Oil resistance test.* Utilize three test specimens and average the results.

S8.3.1 *Preparation.* Fashion a test specimen by cutting a rectangular block 2 inches long and not less than one-third of an inch in width, having a thickness of not more than one-sixteenth inch, from the brake hose and buff the specimen on both faces to ensure smooth surfaces.

S8.3.2 *Measurement.* (a) Weigh each specimen to the nearest milligram in air (W1) and in distilled water (W2) at room temperature. If wetting is necessary to remove air bubbles, dip the specimen in acetone and thoroughly rinse it with distilled water.

(b) Immerse each specimen in ASTM IRM 903 oil for 70 hours at 212 degrees Fahrenheit (100 degrees Celsius) and then cool in ASTM IRM 903 oil at room temperature for 30 to 60 minutes.

(c) Dip the specimen quickly in acetone and blot it lightly with filter paper.

(d) Weigh each specimen in a tared weighing bottle (W3) and in distilled water (W4) within five minutes of removal from the cooling liquid.

(e) Calculate the percentage increase in volume follows:

$$\text{Percent of increase} = [(W_3 - W_4) - (W_1 - W_2)]/(W_1 - W_2) \times 100$$

S8.4 *Ozone resistance test.* Conduct the test specified in S6.8, using air brake hose, except use the large test cylinder specified in Table IV for the size of hose tested.

S8.5 *Length change test.* (a) Position a test hose in a straight, horizontal position, and apply air pressure of 10 psi thereto.

(b) Measure the hose to determine original free length.

(c) Without releasing the 10 psi, raise the air pressure to the test hose to 200 psi.

(d) Measure the hose under 200 psi to determine final free length. An elongation or contraction is an increase or decrease, respectively, in the final free length from the original free length of the hose.

S8.6 *Adhesion test for air brake hose not reinforced by wire.*

S8.6.1 *Apparatus.* A tension testing machine that is power-driven and that applies a constant rate of extension is used for measuring the force required to separate the layers of the test specimen. The apparatus is constructed so that:

(a) The recording head includes a freely rotating form with an outside diameter substantially the same as the inside diameter of the hose specimen to be placed on it.

(b) The freely rotating form is mounted so that its axis of rotation is in the plane of the ply being separated from the specimen and so that the applied force is perpendicular to the tangent of the specimen circumference at the line of separation.

(c) The rate of travel of the power-actuated grip is a uniform one inch per minute and the capacity of the machine is such that maximum applied tension during the test is not more than 85 percent nor less than 15 percent of the machine's rated capacity.

(d) The machine produces a chart with separation as one coordinate and applied tension as the other.

S8.6.2 *Preparation.* (a) Cut a test specimen of 1 inch or more in length from the hose to be tested and cut the layer to be tested of that test specimen longitudinally along its entire length to the level of contact with the adjacent layer.

(b) Peel the layer to be tested from the adjacent layer to create a flap large enough to permit attachment of the power-actuated clamp of the apparatus.

(c) Mount the test specimen on the freely rotating form with the separated layer attached to the power-actuated clamp.

S8.6.3 [Reserved]

S8.6.4 *Calculations.* (a) The adhesion value shall be the minimum force recorded on the chart excluding that portion of the chart which corresponds to the initial and final 20 percent portion along the displacement axis.

(b) Express the force in pounds per inch of length.

S8.7 *Flex strength and air pressure test.*

S8.7.1 *Apparatus.* A flex testing machine with a fixed hose assembly attachment point and a movable hose assembly attachment point, which meets the dimensional requirements of Figure 5 for the size of hose being tested. The attachment points connect to the end fittings on the hose assembly without leakage and, after the hose assembly has been installed for the flex test, are restrained from rotation. The movable end has a linear travel of 6 inches and a cycle rate of 100 cycles per minute. The machine is capable of increasing the air pressure in the hose assembly from zero to 150 psi within 2 seconds, and decreasing the air pressure in the hose assembly from 150 to zero psi within 2 seconds.

FIGURE 5. FLEX TEST APPARATUS

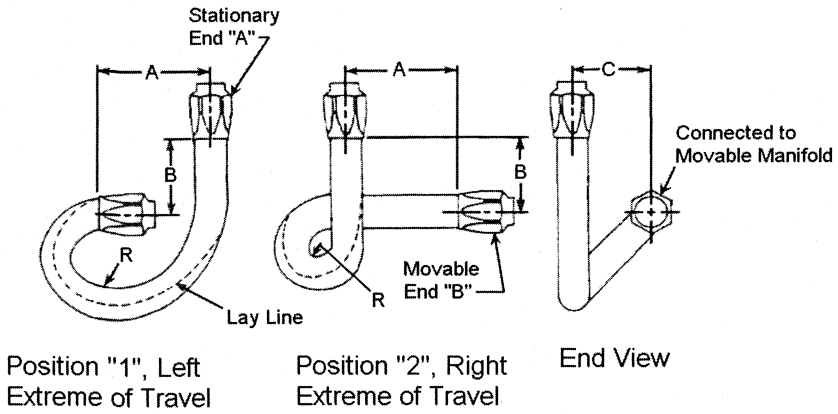


TABLE ACCOMPANYING FIGURE 5—DIMENSIONS IN INCHES (MILLIMETERS)

Free hose length	Nominal hose inside diameter	Dimensions							
		Position "1"				Position "2"			
		A	B	C	R(1)	A	B	C	R(1)
10.00 (254)	3/16, 1/4	3.00 (76)	2.75 (70)	3.75 (95)	1.40 (34)	3.00 (76)	2.75 (70)	3.75 (95)	1.20 (30)
11.00 (279)	5/16, 3/8, 13/32	3.00 (76)	3.50 (89)	4.50 (114)	1.70 (43)	3.00 (76)	3.50 (89)	4.50 (114)	1.30 (33)
14.00 (355)	7/16, 1/2, 5/8	3.00 (76)	4.00 (102)	5.00 (127)	2.20 (56)	3.00 (76)	4.00 (102)	5.00 (127)	1.80 (46)

Note (1): This is an approximate average radius.

S8.7.2 *Preparation.* (a) Lay the hose material on a flat surface in an unstressed condition. Apply a permanent marking line along the centerline of the hose on the uppermost surface.

(b) Prepare the hose assembly with a free length as shown in the table accompanying Figure 5. The end fittings shall be attached according to the end fitting manufacturer's instructions.

(c) Plug the ends of the hose assembly and conduct the salt spray test in S6.11 using an air brake hose assembly. Remove the plugs from the end fittings.

(d) Within 168 hours of completion of the salt spray test, expose the hose assembly to an air temperature of 212 degrees Fahrenheit (100 degrees Celsius) for 70 hours, with the hose in a straight position. Remove the hose and cool it at room temperature for 2 hours. Within 166 hours, subject the hose to the flexure test in S8.7.2(e).

(e) Install the hose assembly on the flex testing machine as follows. With the movable hose attachment point at the mid point of its travel, attach one end of the hose to the movable attachment point with the marked line on the hose in the uppermost position. Attach the other end of the hose to the fixed attachment point allowing the hose to follow its natural curvature.

(f) Cycle the air pressure in the hose by increasing the pressure in the hose

from zero psi to 150 psi and holding constant for one minute, then decreasing the pressure from 150 psi to zero psi and holding constant for one minute. Continue the pressure cycling for the duration of the flex testing. Begin the flex testing by cycling the movable attachment point through 6 inches of travel at a rate of 100 cycles per minute. Stop the flex testing and pressure cycling after one million flex cycles have been completed.

(g) Install an orifice with a hole diameter of 0.0625 inches and a thickness of 0.032 inches in the air pressure supply line to the hose assembly. Provide a gauge or other means to measure air pressure in the hose assembly. Regulate the supply air pressure to the orifice to 150 psi.

(h) Apply 150 psi air pressure to the orifice. After 2 minutes have elapsed, measure the air pressure in the brake hose assembly, while pressurized air continues to be supplied through the orifice.

S8.8 *Corrosion resistance and burst strength test.* (a) Conduct the test specified in S6.11 using an air brake hose assembly. Remove the plugs from the ends of the hose assembly.

(b) Fill the hose assembly with water, allowing all gases to escape. Apply water pressure at a uniform rate of increase of approximately 1,000 psi per minute until the hose ruptures.

S8.9 *Tensile strength test.* Utilize a tension testing machine conforming to the requirements of ASTM E4–03 (incorporated by reference, see § 571.5) and provided with a recording device to measure the force applied.

(a) Attach an air brake hose assembly to the testing machine to permit straight, even, machine pull on the hose. Use adapters to mount hose assemblies equipped with angled end fittings so that the hose is in a straight position when installed on the machine.

(b) Apply tension at a rate of 1 inch per minute travel of the moving head until separation occurs.

S8.10 *Water Absorption and tensile strength test.* Immerse an air brake hose assembly in distilled water at room temperature for 70 hours. Thirty minutes after removal from the water, conduct the test specified in S8.9.

S8.11 *Zinc chloride resistance test.* Immerse an air brake hose in a 50 percent zinc chloride aqueous solution at room temperature for 200 hours. Remove it from the solution and examine it under 7-power magnification for cracks.

S8.12 *End fitting corrosion resistance test.* Conduct the test specified in S6.11 using an air brake hose assembly.

S8.13 *Adhesion test for air brake hose reinforced by wire.* (a) Place a steel ball with a diameter equal to 73 percent of the nominal inside diameter of the hose being tested inside of the hose. Plug one end of the hose. Attach the other end of the hose to a source of vacuum.

(b) Subject the hose to a vacuum of 25 inches of Hg for five minutes. With the vacuum still applied to the hose, bend the hose 180 degrees around a large test cylinder with a radius specified in Table IV for the size of hose tested. At the location of this bend, bend the hose 180 degrees around the test cylinder in the opposite direction.

(c) With the vacuum still applied to the hose, return the hose to a straight position. Attempt to roll the ball inside the hose using gravity from one end of the hose to the other end.

S8.14 *Constriction test.* Perform the constriction test in S6.12 using an air brake hose, except that the spherical diameter ''A'' of the plug gauge in Figure 4, or the diameter of the rigid spherical ball in S6.12.3(a), shall be 66 percent of the nominal inside diameter of the air brake hose being tested.

S9. *Requirements—vacuum brake hose, brake hose assemblies, and brake hose end fittings.*

S9.1 *Labeling.*

S9.1.1 *Hose.* Each vacuum brake hose shall be labeled, or cut from bulk hose that is labeled, at intervals of not more than 6 inches, measured from the end of one legend to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on hose that is sold as part of a brake hose assembly or a motor vehicle. (a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics Division, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

(d) The nominal inside diameter of the hose expressed in inches or fractions of inches or in millimeters, or the nominal outside diameter of plastic tubing expressed in inches or fractions of inches or in millimeters followed by the letters OD. The abbreviation ''mm'' shall follow hose sizes that are expressed in millimeters. (Example of inside diameter: 7⁄32, ¼, 4 mm. Example of outside diameter: ¼ OD, 12 mm OD.)

(e) The letters ''VL'' or ''VH'' shall indicate that the component is a light-duty vacuum brake hose or heavy-duty vacuum brake hose, respectively.

S9.1.2 *End fittings.* Except for an end fitting that is attached by heat shrinking or by interference fit with plastic vacuum hose or that is attached by deformation of the fitting about a hose by crimping or swaging, at least one component of each vacuum brake hose fitting shall be etched, embossed, or stamped in block capital letters and numerals at least one-sixteenth of an inch high with the following information:

(a) The symbol DOT, constituting a certification by the manufacturer of that component that the component conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of that component of the fitting, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics Division, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

(c) The letters ''VL'' or ''VH'' shall indicate that the end fitting is intended for use in a light-duty or heavy-duty vacuum brake system, respectively.

(d) The nominal inside diameter of the hose to which the fitting is properly attached expressed in inches or fractions of inches or in millimeters, or the outside diameter of the plastic tubing to which the fitting is properly attached expressed in inches or fraction of inches or in millimeters followed by the letter OD (See examples in S9.1.1(d)). The abbreviation ''mm'' shall follow hose sizes that are expressed in millimeters.

S9.1.3 *Assemblies.* Each vacuum brake hose assembly made with end fittings that are attached by crimping or swaging and each plastic tube assembly made with end fittings that are attached by heat shrinking or dimensional interference fit, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake hose assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S9.1.3.1. The band may at the manufacturer's option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped in block capital letters, numerals or symbols at least one-eighth of an inch high, with the following information:

(a) The symbol DOT, constituting certification by the hose assembler that the hose assembly conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics Division, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

S9.1.3.1 At least one end fitting of a vacuum brake hose assembly made with end fittings that are attached by crimping or swaging, or of a plastic tubing assembly made with end fittings that are attached by heat shrinking or dimensional interference fit shall be etched, stamped or embossed with a designation at least one-sixteenth of an

inch high that identifies the manufacturer of the hose assembly and is filed in accordance with S9.1.3(b).

S9.2 *Test requirements.* Each vacuum brake hose assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S10. However, a particular hose assembly or appropriate part thereof need not meet further requirements after having met the constriction requirement (S9.2.1) and then having been subjected to any one of the requirements specified in S9.2.2 through S9.2.10.

S9.2.1 *Constriction.* Except for that part of an end fitting which does not contain hose, every inside diameter of any section of a vacuum brake hose assembly shall not be less than 75 percent of the nominal inside diameter of the hose if for heavy duty, or 70 percent of the nominal inside diameter of the hose if for light duty (S10.11).

S9.2.2 *High temperature resistance.* A vacuum brake hose tested under the conditions specified in S10.1:

(a) Shall not have collapse of the outside diameter exceeding 10 percent of the initial outside diameter for a heavy-duty vacuum brake hose, or exceeding 15 percent of the initial outside diameter for a light-duty vacuum brake hose;

(b) Shall not show external cracks, charring, or disintegration visible without magnification, and;

(c) Shall not leak when subjected to a hydrostatic pressure test.

S9.2.3 *Low temperature resistance.* A vacuum brake hose tested under the conditions specified in S10.2 shall:

(a) Not show cracks visible without magnification after conditioning at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 70 hours when bent around a cylinder having the radius specified in Table V for the size hose tested; and

(b) Not leak when subjected to a hydrostatic pressure test (S10.1(e)).

S9.2.4 *Ozone resistance.* A vacuum brake hose shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours (S10.3).

S9.2.5 *Burst strength.* A vacuum brake hose shall not rupture under hydrostatic pressure of 350 psi (S10.4).

S9.2.6 *Vacuum.* The collapse of the outside diameter of a vacuum brake hose under internal vacuum of 26 inches of Hg. for five minutes shall not exceed one-sixteenth of an inch (S10.5).

S9.2.7 *Bend.* The collapse of the outside diameter of a vacuum brake hose, other than a preformed vacuum brake hose, at the middle point of the test length when bent until the ends touch shall not exceed the values given in Table V for the size of hose tested (S10.6).

TABLE V—VACUUM BRAKE HOSE TEST REQUIREMENTS

Hose inside diameter*		High temperature resistance		Low temperature resistance		Bend		Deformation—collapsed inside diameter (dimension D), inches
Inches	Millimeters	Hose length, inches	Radius of cylinder, inches	Hose length, inches	Radius of cylinder, inches	Hose length, inches	Maximum collapse of outside diameter, inches	
7/32	5	8	1 1/2	17 1/2	3	7	11/64	3/64
1/4	6	9	1 1/2	17 1/2	3	8	3/32	1/16
9/32	.....	9	1 3/4	19	3 1/2	9	12/64	4/64
11/32	8	9	1 3/4	19	3 1/2	11	13/64	5/64
3/8	10	10	1 3/4	19	3 1/2	12	5/32	3/32
7/16	.....	11	2	20 1/2	4	14	17/64	5/64
15/32	.....	11	2	20 1/2	4	14	17/64	5/64
1/2	12	11	2	20 1/2	4	16	7/32	1/8
5/8	16	12	2 1/4	22	4 1/2	22	7/32	5/32
3/4	.....	14	2 1/2	24	5	28	7/32	3/16
1	.....	16	3 1/4	28 1/2	6 1/2	36	9/32	1/4

*These sizes are listed to provide test values for brake hoses manufactured in these sizes. They do not represent conversions.

S9.2.8 *Swell and adhesion.* Following exposure to Reference Fuel B (as described in ASTM D471–98 (incorporated by reference, see § 571.5)), every inside

diameter of any section of a vacuum brake hose shall not be less than 75 percent of the nominal inside diameter of the hose if for heavy duty, or 70 percent of the nominal inside diameter of the hose if for light duty. The vacuum brake hose shall show no leakage in a vacuum test of 26 inches of Hg for 10 minutes. A vacuum hose that is constructed of two or more layers shall withstand a force of 6 pounds per inch of length before separation of adjacent layers. (S10.7).

S9.2.9 *Deformation.* A vacuum brake hose shall return to 90 percent of its original outside diameter within 60 seconds after five applications of force as specified in S10.8, except that a wire-reinforced hose need only return to 85 percent of its original outside diameter. In the case of a heavy duty hose, the first application of force shall not exceed a peak value of 70 pounds, and the fifth application of force shall reach a peak value of at least 40 pounds. In the case of light duty hose the first application of force shall not exceed a peak value of 50 pounds, and the fifth application of force shall reach a peak value of at least 20 pounds (S10.9).

S9.2.10 *End fitting corrosion resistance.* After 24 hours of exposure to salt spray, vacuum brake hose end fittings shall show no base metal corrosion of the end fitting surface except where crimping or the application of labeling information has caused displacement of the protective coating. (S10.10).

S10. *Test procedures—Vacuum brake hose, brake hose assemblies, and brake hose end fittings.*

S10.1 *High temperature resistance test.* (a) Measure the initial outside diameter of the hose.

(b) Subject the hose to an internal vacuum of 26 inches of Hg at an ambient temperature of 257 degrees Fahrenheit (125 degrees Celsius) for a period of 96 hours. Remove the hose to room temperature and atmospheric pressure.

(c) Within 5 minutes of completion of the conditioning in S10.1(b), measure the outside diameter at the point of greatest collapse and calculate the percentage collapse based on the initial outside diameter.

(d) Cool the hose at room temperature for 5 hours. Bend the hose around a mandrel with a diameter equal to five times the initial outside diameter of the hose. Examine the exterior of the hose for cracks, charring, or disintegration visible without magnification. Remove the hose from the mandrel.

(e) Fill the hose assembly with water, allowing all gases to escape. Apply water pressure in the hose of 175 psi within 10 seconds. Maintain an internal hydrostatic pressure of 175 psi for one minute and examine the hose for visible leakage.

S10.2 *Low temperature resistance test.* (a) Conduct the test specified in S8.2(a) through (c) using vacuum brake hose with the cylinder radius specified in Table V for the size of hose tested.

(b) Remove the hose from the test cylinder, warm the hose at room temperature for 5 hours, and conduct the hydrostatic pressure test in S10.1(e).

S10.3 *Ozone resistance test.* Conduct the test specified in S6.8 using vacuum brake hose.

S10.4 *Burst strength test.* Conduct the test specified in S8.8 using vacuum brake hose.

S10.5 *Vacuum test.* Utilize a 12-inch vacuum brake hose assembly sealed at one end. (a) Measure the hose outside diameter.

(b) Attach the hose to a source of vacuum and subject it to a vacuum of 26 inches of Hg for 5 minutes.

(c) Measure the hose to determine the minimum outside diameter while the hose is still subject to vacuum.

S10.6 *Bend test.* (a) Bend a vacuum brake hose, of the length prescribed in Table V, in the direction of its normal curvature until the ends just touch as shown in Figure 6.

(b) Measure the outside diameter of the specimen at point A before and after bending.

(c) The difference between the two measurements is the collapse of the hose outside diameter on bending.

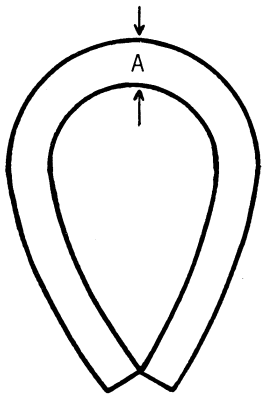


FIG. 6—BEND TEST OF VACUUM BRAKE HOSE.

S10.7 *Swell and adhesion test.* (a) Fill a specimen of vacuum brake hose 12 inches long with ASTM Reference Fuel B as described in ASTM D471–98 (incorporated by reference, see § 571.5).

(b) Maintain reference fuel in the hose under atmospheric pressure at room temperature for 48 hours.

(c) Remove fuel and conduct the constriction test in S10.11.

(d) Attach the hose to a source of vacuum and subject it to a vacuum of 26 inches of Hg for 10 minutes. Remove the hose from the vacuum source.

(e) For a vacuum brake hose constructed of two or more layers, conduct the test specified in S8.6 using the vacuum brake hose.

S10.8 [Reserved]

S10.9 *Deformation test.* Table VI specifies the test specimen dimensions.

S10.9.1 *Apparatus.* Utilize a compression device, equipped to measure force of at least 100 pounds, and feeler gages of sufficient length to be passed completely through the test specimen.

S10.9.2 *Operation.* (a) Position the test specimen longitudinally in the compression device with the fabric laps not in the line of the applied pressure.

TABLE VI—DIMENSIONS OF TEST SPECIMEN AND FEELER GAGE FOR DEFORMATION TEST

Hose inside diameter*		Specimen dimensions (see Fig. 7)		Feeler gage dimensions	
in.	mm	Depth (inch)	Length (inch)	Width (inch)	Thickness (inch)
7/32	5	3/64	1	1/8	3/64
1/4	6	1/16	1	1/8	1/16
9/32	.....	1/16	1	1/8	1/16
11/32	8	5/64	1	3/16	5/64
3/8	10	3/32	1	3/16	3/32
7/16	.....	5/64	1	1/4	5/64
15/32	.....	5/64	1	1/4	5/64
1/2	12	1/8	1	1/4	1/8
5/8	16	5/32	1	1/4	5/32
3/4	.....	3/16	1	1/4	3/16
1	.....	1/4	1	1/4	1/4

*These sizes are listed to provide test values for brake hoses manufactured in these sizes. They do not represent conversions.

(b) Apply gradually increasing force to the test specimen to compress its inside diameter to that specified in Table VI (dimension D of Figure 7) for the size of hose tested.

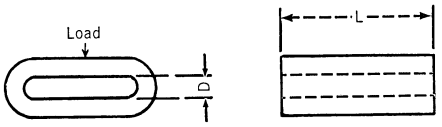


FIG. 7—DEFORMED SPECIMEN OF VACUUM BRAKE HOSE

(c) After 5 seconds release the force and record the peak load applied.

(d) Repeat the procedure four times permitting a 10-second recovery period between load applications.

S10.10 *End fitting corrosion resistance test.* Conduct the test specified in S6.11 using a vacuum brake hose assembly.

S10.11 *Constriction test.* Perform the constriction test in S6.12 using a vacuum brake hose, except that the spherical diameter ''A'' of the plug gauge in Figure 4, or the diameter of the rigid spherical ball in S6.12.3(a), shall be 75 percent of the nominal inside diameter of the vacuum brake hose if it is heavy duty, or 70 percent of the nominal inside diameter of the vacuum brake hose if it is light duty.

S11. *Requirements—Plastic air brake tubing, plastic air brake tubing assemblies, and plastic air brake tubing end fittings.*

11.1 *Construction.* Each plastic air brake tubing assembly shall be equipped with permanently attached

end fittings or reusable end fittings. Plastic air brake tubing shall conform to the dimensional requirements specified in Table VII. (S12.1)

TABLE VII—PLASTIC AIR BRAKE TUBING DIMENSIONS

Nominal tubing outside diameter	Maximum outside diameter		Minimum outside diameter		Nominal inside diameter		Nominal wall thickness		Wall thickness tolerance	
	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches
1/8 inch	3.25	0.128	3.10	0.122	2.01	0.079	0.58	0.023	0.08	0.003
5/32 inch	4.04	0.159	3.89	0.153	2.34	0.092	0.81	0.032	0.08	0.003
3/16 inch	4.83	0.190	4.67	0.184	2.97	0.117	0.89	0.035	0.08	0.003
1/4 inch	6.43	0.253	6.27	0.247	4.32	0.170	1.02	0.040	0.08	0.003
5/16 inch	8.03	0.316	7.82	0.308	5.89	0.232	1.02	0.040	0.10	0.004
3/8 inch	9.63	0.379	9.42	0.371	6.38	0.251	1.57	0.062	0.10	0.004
1/2 inch	12.83	0.505	12.57	0.495	9.55	0.376	1.57	0.062	0.10	0.004
5/8 inch	16.00	0.630	15.75	0.620	11.20	0.441	2.34	0.092	0.13	0.005
3/4 inch	19.18	0.755	18.92	0.745	14.38	0.566	2.34	0.092	0.13	0.005
6 mm	6.10	0.240	5.90	0.232	4.00	0.157	1.00	0.039	0.10	0.004
8 mm	8.10	0.319	7.90	0.311	6.00	0.236	1.00	0.039	0.10	0.004
10 mm	10.13	0.399	9.87	0.389	7.00	0.276	1.50	0.059	0.10	0.004
12 mm	12.13	0.478	11.87	0.467	9.00	0.354	1.50	0.059	0.10	0.004
16 mm	16.13	0.635	15.87	0.625	12.00	0.472	2.00	0.079	0.13	0.005

S11.2 *Labeling.*

S11.2.1 *Plastic air brake tubing.* Plastic air brake tubing shall be labeled, or cut from bulk tubing that is labeled, at intervals of not more than 6 inches, measured from the end of one legend to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on tubing that is sold as part of a motor vehicle.

(a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the tubing, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS–222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

(d) The nominal outside diameter expressed in inches or fractions of inches or in millimeters followed by the letters OD. The abbreviation ''mm'' shall follow tubing sizes that are expressed in millimeters. (Examples: 3/8 OD, 6 mm OD.)

(e) The letter ''A'' shall indicate intended use in air brake systems.

S11.2.2 *End fittings.* Except for an end fitting that is attached by deformation of the fitting about the tubing by crimping or swaging, at least one component of each plastic air brake tubing end fitting shall be etched, embossed, or stamped in block capital letters and numerals at least one-sixteenth of an inch high with the following information:

(a) The symbol DOT, constituting a certification by the manufacturer that the end fitting conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the end fitting, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS–222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The letter ''A'' shall indicate intended use in air brake systems.

(d) The nominal outside diameter of the plastic tubing to which the fitting is properly attached expressed in inches or fractions of inches or in millimeters followed by the letters OD. The abbreviation ''mm'' shall follow tubing sizes that are expressed in millimeters. (Examples: 3/8 OD, 6 mm OD)

S11.2.3. *Assemblies.* Each plastic air brake tubing assembly made with end fittings that are attached by crimping

or swaging, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake tubing assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S11.2.3.1. The band may at the manufacturer's option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped in block capital letters, numerals or symbols at least one-eighth of an inch high, with the following information:

(a) The symbol DOT, constituting certification by the tubing assembler that the tubing assembly conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS–222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

S11.2.3.1 At least one end fitting of a plastic air brake tubing assembly made with end fittings that are attached by crimping or swaging shall be etched, stamped, or embossed with a designation at least one-sixteenth of an inch high that identifies the manufacturer of the tubing assembly and is filed in accordance with S11.2.3(b).

S11.3 *Test requirements.* Each plastic air brake tubing assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S12. However, a particular tubing assembly or appropriate part thereof need not meet further requirements after having met the constriction requirement (S11.3.1) and then having been subjected to any one of the requirements specified in S11.3.2 through S11.3.24. Unless otherwise specified, testing is conducted on a sample of tubing 12 inches in length.

S11.3.1 *Constriction.* Every inside diameter of any section of a plastic air brake tubing assembly shall not be less than 66 percent of the nominal inside diameter of the brake tubing. (S12.2)

S11.3.2 *High temperature conditioning and dimensional stability.* Plastic air brake tubing shall conform to the dimensions in Table VII after conditioning in air at 230 degrees Fahrenheit (110 degrees Celsius) for four hours. (S12.3)

S11.3.3 *Boiling water conditioning and dimensional stability.* Plastic air brake tubing shall conform to the dimensions in Table VII after conditioning in boiling water for two hours. (S12.4)

S11.3.4 *Burst Strength.* Plastic air brake tubing shall not rupture when subjected to the burst strength pressure in Table VIII for the size of tubing being tested. (S12.5)

S11.3.5 *Moisture absorption and burst strength.* Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII, after the tubing has been dried in an oven and then conditioned in a 100 percent relative humidity atmosphere at 75 degrees Fahrenheit (24 degrees Celsius) for 100 hours. (S12.6)

TABLE VIII—PLASTIC AIR BRAKE TUBING MECHANICAL PROPERTIES

Nominal tubing OD	Burst strength pressure		Supported bend radius [1]		Unsupported bend radius [2]		Conditioned tensile load	
	kPa	Psi	Mm	inches	mm	inches	N	lbf
1/8 inch	6900	1000	9.4	0.37	9.4	0.37	156	35
5/32 inch	8300	1200	12.7	0.50	12.7	0.50	178	40
3/16 inch	8300	1200	19.1	0.75	19.1	0.75	222	50
1/4 inch	8300	1200	25.4	1.00	25.4	1.00	222	50
5/16 inch	6900	1000	31.8	1.25	38.1	1.50	334	75
3/8 inch	9700	1400	38.1	1.50	38.1	1.50	667	150
1/2 inch	6600	950	50.8	2.00	63.5	2.50	890	200
5/8 inch	6200	900	63.5	2.50	76.2	3.00	1446	325
3/4 inch	5500	800	76.2	3.00	88.9	3.50	1557	350
6 mm	7600	1100	20.0	0.75	25.4	1.00	222	50
8 mm	6200	900	31.8	1.25	38.1	1.50	334	75
10 mm	8200	1200	38.1	1.50	38.1	1.50	667	150
12 mm	6900	1000	44.5	1.75	63.5	2.50	890	200

TABLE VIII—PLASTIC AIR BRAKE TUBING MECHANICAL PROPERTIES—Continued

Nominal tubing OD	Burst strength pressure		Supported bend radius [1]		Unsupported bend radius [2]		Conditioned tensile load	
	kPa	Psi	Mm	inches	mm	inches	N	lbf
16 mm	6000	875	69.9	2.75	76.2	3.00	1446	325

NOTES: (1) Supported bend radius for tests specifying cylinders around which the tubing is bent. (2) Unsupported bend radius for the collapse resistance test in which the tubing is not supported by a cylinder during bending.

S11.3.6 *Ultraviolet light resistance.* Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after being exposed to ultraviolet light for 300 hours and then impacted with a one pound weight dropped from a height of 12 inches. (S12.7)

S11.3.7 *Low temperature flexibility.* The outer surface of plastic air brake tubing shall not show cracks visible without magnification as a result of conditioning in air at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours, and then conditioning in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for four hours, and then bending the tubing 180 degrees around a test cylinder having a radius equal to six times the nominal outside diameter of the tubing. (S12.8)

S11.3.8 *High temperature flexibility.* Plastic air brake tubing shall not rupture or burst when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been:

(a) Conditioned in air at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours while bent 180 degrees around a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested; and

(b) Cooled to room temperature while remaining on the cylinder, then straightened; and

(c) Bent 180 degrees around the cylinder in the opposite direction of the first bending. (S12.9)

S11.3.9 *High temperature resistance.* Plastic air brake tubing shall not rupture or burst when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in air at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. (S12.10)

S11.3.10 *High temperature conditioning, low temperature impact resistance.* Plastic air brake tubing shall not rupture or burst when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in air at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours, then conditioned in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours and impacted with a one pound weight dropped from a height of 12 inches. (S12.11)

S11.3.11 *Boiling water conditioning, low temperature impact resistance.* Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in boiling water for two hours, then conditioned in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours, and then impacted with a one pound weight dropped from a height of 12 inches. (S12.12)

S11.3.12 *Zinc chloride resistance.* The outer surface of plastic air brake tubing shall not show cracks visible under 7-power magnification after immersion in a 50 percent zinc chloride aqueous solution for 200 hours while bent around a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing tested. (S12.13)

S11.3.13 *Methyl alcohol resistance.* The outer surface of plastic air brake tubing shall not show cracks visible under 7-power magnification after immersion in a 95 percent methyl alcohol aqueous solution for 200 hours while bent around a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing tested. (S12.14)

S11.3.14 *High temperature conditioning and collapse resistance.* The collapse of the outside diameter of plastic air brake tubing shall not exceed twenty percent of the original outside diameter when bent 180 degrees on a holding fixture to the unsupported bend radius specified in Table VIII and conditioned in air at 200 degrees Fahrenheit (93 degrees Celsius) for 24 hours. (S12.15)

S11.3.15 *Ozone resistance.* The outer surface of plastic air brake tubing shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours at 104 degrees Fahrenheit (40 degrees Celsius). (S12.16)

S11.3.16 *Oil resistance.* Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in ASTM IRM 903 oil at 212 degrees Fahrenheit (100 degrees Celsius) for 70 hours. (S12.17)

S11.3.17 *Tensile strength.* A plastic air brake tubing assembly designed for use between frame and axle or between a towed and a towing vehicle shall withstand, without separation of the tubing from its end fittings, a pull of 250 pounds if it is ⅜ inch, 10 mm, or less in nominal outside diameter, or a pull of 325 pounds if it is larger than ⅜ inch or 10 mm in nominal outside diameter. A plastic air brake tubing assembly designed for use in any other application shall withstand, without separation of the hose from its end fittings, a pull of 35 pounds if it is ⅛ inch, 3 mm, or less in nominal outside diameter, 40 pounds if it is 5⁄32 inch or 4 mm in nominal outside diameter, 50 pounds if it is 3⁄16 to ⅜ inch or 5 mm to 10 mm in nominal outside diameter, 150 pounds if it is ½ to ⅝ inch or 11 mm to 16 mm in nominal outside diameter, or 325 pounds if it is larger than ⅝ inch or 16 mm in nominal outside diameter. (S12.18)

S11.3.18 *Boiling water conditioning and tensile strength.* A plastic air brake tubing assembly when subjected to a tensile pull test shall either elongate 50 percent or withstand the conditioned tensile load in Table VIII without separation from its end fittings, with one end of the assembly conditioned in boiling water for 5 minutes. (S12.19)

S11.3.19 *Thermal conditioning and tensile strength.* A plastic air brake tubing assembly when subjected to a tensile pull test shall either elongate 50 percent or withstand the conditioned tensile load in Table VIII without separation from its end fittings after the assembly has been subjected to four cycles of conditioning in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for thirty minutes, normalizing at room temperature, conditioning in boiling water for 15 minutes, and normalizing at room temperature. (S12.20)

S11.3.20 *Vibration resistance.* A plastic air brake tubing assembly with an internal air pressure of 120 psig shall not rupture or leak more than 50 cm^3 per minute at a temperature of minus 40 degrees Fahrenheit (minus 40 degrees Celsius) and 25 cm^3 per minute at a temperature of 75 degrees Fahrenheit (24 degrees Celsius), after the assembly has been subjected to 1,000,000 cycles of vibration testing with one end of the assembly fixed and the other end stroked ½-inch at 600 cycles per minute. In addition, end fittings that use a threaded retention nut shall retain at least 20 percent of the original retention nut tightening torque upon completion of the vibration testing. The vibration test shall be conducted in an environmental chamber and the air temperature shall be cycled between minus 40 degrees Fahrenheit (minus 40 degrees Celsius) and 220 degrees Fahrenheit (104 degrees Celsius) during the test. (S12.21)

S11.3.21 *End fitting retention.* The end fittings of a plastic air brake tubing assembly shall not rupture when the assembly is filled with water and pressurized to the burst strength pressure in Table VIII. (S12.22)

S11.3.22 *Thermal conditioning and end fitting retention.* The end fittings of a plastic air brake tubing assembly shall not rupture when the tubing assembly is filled with ASTM IRM 903 oil and:

(a) Conditioning in air at 200 degrees Fahrenheit (93 degrees Celsius) for 24 hours with atmospheric pressure inside the tubing assembly; and

(b) Increasing the pressure inside the tubing assembly to 450 psi, and holding

this pressure for five minutes while maintaining an air temperature of 200 degrees Fahrenheit (93 degrees Celsius); and

(c) Reducing the pressure inside the tubing assembly to atmospheric and permitting the tubing assembly to cool at 75 degrees Fahrenheit (24 degrees Celsius) for 1 hour; and

(d) Conditioning the tubing assembly in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 24 hours with atmospheric pressure inside the tubing assembly; and

(e) Increasing the pressure inside the tubing assembly to 450 psi, and holding this pressure for five minutes while maintaining an air temperature of minus 40 degrees Fahrenheit (minus 40 degrees Celsius). (S12.23)

S11.3.23 *End fitting serviceability.* A plastic air brake end fitting that uses a threaded retention nut shall not rupture or leak more than 25 cm^3 per minute when pressurized to 120 psi after five assembly cycles. (S12.24)

S11.3.24 *End fitting corrosion resistance.* After 24 hours of exposure to salt spray, air brake hose end fittings shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information causes a displacement of the protective coating. (S12.25)

S12. *Test procedures—Plastic air brake tubing, plastic air brake tubing assemblies, plastic air brake tubing end fittings.*

S12.1 *Air brake tubing dimensions.* Measure the tubing dimensions including wall thickness, inside diameter, and outside diameter, using appropriate metrology apparatus such as micrometers, dial indicators and gauges, or optical comparators. To account for slight out-of-round conditions, diameter measurements may be calculated using the average of the major and minor diameters.

S12.2 *Constriction test.* Perform the constriction test in S6.12 using an air brake tubing assembly, except that the spherical diameter ''A'' of the plug gauge in Figure 4, or the diameter of the rigid spherical ball in S6.12.3(a), shall be 66 percent of the nominal inside diameter of the tubing as specified in Table VII.

S12.3 *High temperature conditioning and dimensional stability test.* (a) Condition the tubing at 230 degrees Fahrenheit (110 degrees Celsius) for 4 hours in an air oven.

(b) Remove the tubing from the oven and allow to cool at room temperature for 30 minutes.

(c) Measure the dimensions of the tubing using the procedure in S12.1.

S12.4 *Boiling water conditioning and dimensional stability test.* (a) Utilize a container constructed of a non-reactive material large enough so that the tubing to be tested does not touch any surface of the container. Fill container with distilled water.

(b) Slip the tubing over a stainless steel wire for positioning it in the pot.

(c) Bring the water to a boil. Place the tubing in the water and position it so that it does not touch the container. Boil the tubing for two hours. Replenish the water as necessary, adding it slowly so that the water in the pot boils continuously.

(d) Remove the tubing from the water and allow to cool at room temperature for 30 minutes. Wipe off any water that remains on the tubing.

(e) Measure the dimensions of the tubing using the procedure in S12.1.

S12.5 *Burst strength test.* (a) Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions.

(b) Plug one end of the assembly, fill it with water, and connect the other end to a source of water pressure. Bleed any air from the assembly and water pressure system.

(c) Increase the water pressure inside the tubing assembly at a rate of 3,000 psi per minute to the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.6 *Moisture absorption and burst strength.* (a) Prepare a sample of tubing twelve inches in length.

(b) Condition the tubing at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours in an air oven. Remove the tubing from the oven and within 30 seconds, and weigh it to establish the initial weight. The weight shall be measured with a resolution of 0.01 gram; if the scale has a higher resolution, then values of 0.005 gram and above shall be rounded to the nearest 0.01 gram and

values below 0.005 gram shall be truncated.

(c) Place the tubing in an environmental chamber and condition it for 100 hours at 100 percent relative humidity and a temperature of 75 degrees Fahrenheit (24 degrees Celsius).

(d) Remove the tubing from the chamber and within a period of 5 minutes, remove all surface moisture from the tubing using cloth and weigh the tubing to establish the conditioned weight. Weight shall be measured to the nearest 0.01 gram as in S12.6(b).

(e) Calculate percentage of moisture absorption as follows:

([Conditioned Weight—Initial Weight] ÷ [Initial Weight]) × 100

(f) Install end fittings according to the end fitting manufacturers instructions.

(g) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.7 *Ultraviolet light resistance test.* (a) *Apparatus.* An accelerated weathering test machine for ultraviolet light conditioning of plastic air brake tubing. The machine shall be equipped with fluorescent UVA–340 light bulbs and automatic irradiance control. Also utilize an impact test apparatus as shown in Figure 8.

(b) *Test standards.* The testing is in accordance with ASTM G154–00, ASTM G151–97, and ASTM D4329–99 (all incorporated by reference, see § 571.5).

(c) *Preparation.* (1) Utilize a 12 inch length of plastic air brake tubing. Mask 1 inch of each end of the tubing where end fittings will be attached using opaque tape.

(2) Attach the tubing to the test rack of the machine, securing it at the ends along the masked sections. Wipe the outside surface of the tubing with acetone to remove any surface contaminants. Place the tubing and rack in the accelerated weathering test machine so that the center of the tubing assembly is approximately in the center of the UV light exposure area of the test machine. (If multiple plastic brake tubing assemblies are tested, then their position in the machine should be rotated according to ASTM D4329–99 S7.4.1, except the rotation shall be each 96 hours instead of weekly.) The distance from the light bulb to the tubing shall be approximately 2 inches. Set the UV irradiance to 0.85 watts per square meter at 340 nm and maintain this level during the testing. Maintain a temperature inside the test chamber of 113 degrees Fahrenheit (45 degrees Celsius), and use only atmospheric humidity. Expose the tubing at this UV irradiance level for 300 hours continuously. Remove the tubing from the test chamber.

(3) Place the tubing inside the impact test apparatus, and drop the impacter onto the tubing from a height of 12 inches.

(4) Remove the masking material from the ends of the tubing. Install end fittings according to the end fitting manufacturer's instructions. Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

FIGURE 8. IMPACT TEST APPARATUS

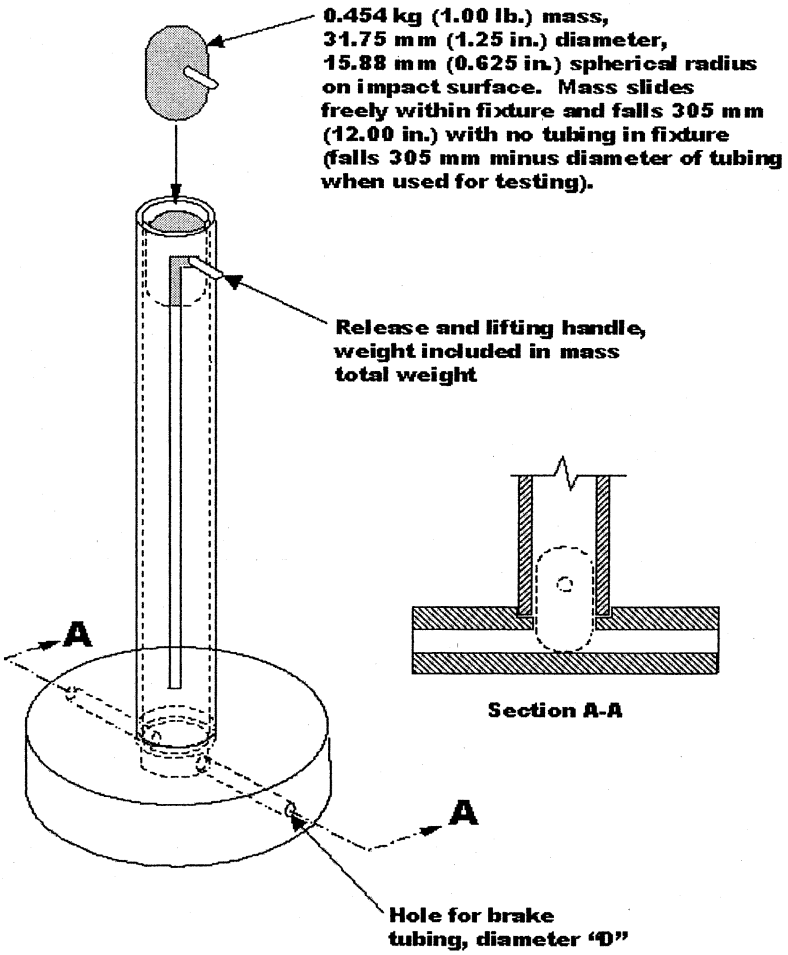


TABLE ACCOMPANYING FIGURE 8

Nominal tubing outside diameter	Hole diameter "D"	
	mm	Inches
1/8 inch	3.96	0.156
5/32 inch	4.75	0.187

TABLE ACCOMPANYING FIGURE 8—Continued

Nominal tubing outside diameter	Hole diameter "D"	
	mm	Inches
3/16 inch	5.54	0.218
1/4 inch	7.14	0.281

TABLE ACCOMPANYING FIGURE 8—Continued

Nominal tubing outside diameter	Hole diameter "D"	
	mm	Inches
5/16 inch	8.71	0.343
3/8 inch	10.31	0.406
1/2 inch	13.49	0.531
5/8 inch	16.66	0.656
3/4 inch	20.32	0.800
6 mm	6.80	0.268
8 mm	8.80	0.346
10 mm	10.80	0.425
12 mm	12.80	0.504
16 mm	16.80	0.661

S12.8 *Low temperature flexibility test.* (a) Utilize a cylinder having a radius of six times the nominal outside diameter of the tubing.

(b) Condition the tubing in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours. Remove from the oven and cool at room temperature for 30 minutes.

(c) Condition the cylinder and the tubing in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for four hours.

(d) With the tubing and test cylinder at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), bend the tubing 180 degrees around the cylinder at a steady rate in a period of 4 to 8 seconds.

S12.9 *High temperature flexibility test.* (a) Utilize a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested.

(b) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support, applying only enough force on the tubing to hold it in position.

(c) Condition the tubing and cylinder in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. Remove the tubing and cylinder from the oven and cool at room temperature for two hours.

(d) Remove the clamps or supports from the tubing and straighten the tubing at a steady rate in a period of 4 to 8 seconds.

(e) Rebend the tubing 180 degrees around the cylinder, at the same point but in the opposite direction of the bending in S12.9(b), at a steady rate in a period of 4 to 8 seconds.

(f) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.10 *High temperature resistance test.* Condition the tubing in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. Remove the tubing and allow to cool at room temperature for 30 minutes. Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.11 *High temperature conditioning, low temperature impact resistance test.* (a) *Apparatus.* Utilize an impact test apparatus as shown in Figure 8.

(b) Condition the tubing in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. Remove the tubing and allow to cool at room temperature for 30 minutes.

(c) Condition the tubing and the impact test apparatus in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours.

(d) With the tubing and impact test apparatus at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), place the tubing inside the apparatus and drop the impacter onto the tubing from a height of 12 inches. Remove the tubing from the chamber and allow to warm at room temperature for one hour.

(e) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.12 *Boiling water conditioning, low temperature impact resistance test.* (a) *Apparatus.* Utilize an impact test apparatus as shown in Figure 8.

(b) Condition the tubing in boiling water using the test in S12.4 (a) through (d), except that the length of tubing shall be 12 inches.

(c) Condition the tubing and the impact test apparatus in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours.

(d) With the tubing and impact test apparatus at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), place the tubing inside the apparatus and drop the impacter onto the tubing from a height of 12 inches. Remove the tubing from the chamber and allow to

warm at room temperature for one hour.

(e) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.13 *Zinc chloride resistance test.* (a) Utilize a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested. The cylinder is constructed of a non-reactive material or coated to prevent chemical reaction with zinc chloride. The length of the tubing sample is long enough so that its ends will not be submerged during the immersion in zinc chloride, or the ends of the tubing are plugged to keep the zinc chloride from entering the tubing.

(b) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support constructed of non-reactive materials, applying only enough force on the tubing to hold it in position.

(c) Immerse the tubing and cylinder in a 50 percent zinc chloride aqueous solution at room temperature for 200 hours.

(d) Remove the tubing and cylinder from the solution. While still on the test cylinder, inspect the tubing under 7-power magnification for cracks.

S12.14 *Methyl alcohol resistance.* (a) Utilize a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested. The cylinder is constructed of a non-reactive material or coated to prevent chemical reaction with methyl alcohol.

(b) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support constructed of non-reactive materials, applying only enough force on the tubing to hold it in position. The ends of the tubing may be shortened so that they will be fully submerged in the methyl alcohol.

(c) Immerse the tubing and cylinder in a 95 percent methyl alcohol aqueous solution at room temperature for 200 hours.

(d) Remove the tubing and cylinder from the solution. While still on the test cylinder, inspect the tubing under 7-power magnification for cracks.

S12.15 *High temperature conditioning and collapse resistance test.* (a) *Apparatus.* A holding device consisting of two vertical pins affixed to a flat, horizontal plate. Each pin projects 1 inch above the top surface of the plate. The diameter of each pin is approximately equal to the inside diameter of the tubing being tested. Using the unsupported bend radius for the size of tubing being tested from Table VIII, the distance between the pin centerlines is equal to:

[2 × unsupported bend radius] + [nominal OD of tubing]

(b) *Preparation.* (1) Use the unsupported bend radius for the size of tubing being tested from Table VIII and cut the tubing to the following length:

[3.14 × [unsupported bend radius]] + [10 × [nominal tubing OD]] + 2 inches

or

[3.14 × [unsupported bend radius]] + [10 × [nominal tubing OD]] + 50 mm

(2) Place a reference mark at the center of the sample. At this mark, measure the initial outside diameter of the tubing. If the tubing is slightly out-of-round, use the elliptical minor diameter as the initial outside diameter.

(3) Install the tubing completely over the pins of the holding device so that the tubing is bent 180 degrees. If the tubing has a natural curvature, the tubing shall be bent in the direction of the natural curvature.

(4) Condition the holding device and tubing in an air oven at 200 degrees Fahrenheit (93 degrees Celsius) for 24 hours. Remove the holding device and tubing and allow to cool at room temperature for thirty minutes.

(5) With the tubing still mounted to the holding device, measure the elliptical minor diameter of the tubing at the reference mark to determine the final outside diameter.

(c) *Calculation.* Calculate the percentage collapse of the outside diameter of the tubing as follows: ([Initial Outside Diameter—Final Outside Diameter] ÷ [Initial Outside Diameter]) × 100

S12.16 *Ozone resistance test.* Conduct the test specified in S6.8 using plastic air brake tubing.

S12.17 *Oil resistance test.* (a) Utilize a plastic air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the

end fitting manufacturer's instructions.

(b) Immerse the tubing in ASTM IRM 903 oil at 212 degrees Fahrenheit (100 degrees Celsius) for 70 hours. Remove and allow to cool at room temperature for 30 minutes. Wipe any excess oil from the tubing assembly.

(c) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII and, at the manufacturer's option, oil may be used as the test medium instead of water.

S12.18 *Tensile strength test.* Conduct the test in S8.9 using a plastic air brake tubing assembly or an assembly prepared from a 12 inch length of air brake tubing with end fittings installed according to the end fitting manufacturer's instructions.

S12.19 *Boiling water conditioning and tensile strength.* (a) *Apparatus.* Use a tension testing machine as specified in S8.9. The lower attachment point of the machine is equipped with a heated, open-top container that is water tight. The inside of the container (lower attachment point) and upper attachment point of the machine have provisions to quickly attach a brake hose assembly for tensile testing.

(b) *Preparation.* Prepare an air brake tubing assembly with a free length of 6 inches (six inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. If necessary install adapters on the end fittings to permit quick attachment to the machine, to keep water from entering the tubing assembly, and to ensure that the tubing assembly is in a straight position when installed on the machine. Fill the container with distilled water such that the lower 4 inches of exposed tubing will be submerged when the brake tubing assembly is installed on the machine. Heat the water until it boils. Then quickly install the plastic air brake tubing assembly on the machine with the lower end of the tubing assembly in the boiling water. After the water has boiled continuously for 5 minutes, apply tension to the tubing assembly at a rate of 1 inch per minute travel of the moving head until either the conditioned tensile load in Table VIII for the size of tubing being tested is reached or the free length of the tubing assembly reaches 9 inches, whichever occurs first.

S12.20 *Thermal conditioning and tensile strength*—(a) *Apparatus.* Use a tension testing machine as specified in S8.9.

(b) *Preparation.* Prepare an air brake tubing assembly with a free length of 6 inches (six inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. If necessary install adapters on the end fittings to permit attachment to the machine, to keep water from entering the tubing assembly, and/or to ensure that the tubing assembly is in a straight position when installed on the machine. Subject the tubing assembly to four complete cycles of the following sequence:

(1) Condition the tubing assembly in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 30 minutes. Remove from the chamber and allow to warm at room temperature for 30 minutes.

(2) Condition the tubing assembly by submerging it in boiling water for 15 minutes. Remove and allow to cool at room temperature for 30 minutes. Install the tubing assembly on the tension testing machine and apply tension to the tubing assembly at a rate of one inch per minute travel of the moving head until either the conditioned tensile load in Table VIII for the size of tubing being tested is reached or the free length of the tubing assembly reaches 9 inches, whichever occurs first.

S12.21 *Vibration resistance test.* (a) *Apparatus.* A vibration testing machine that supports a brake tubing assembly by its end fittings in approximately a straight line and includes the following features:

(1) One tubing assembly attachment point is fixed and the other moves in a plane perpendicular to a line projected between the attachment points. The movable attachment point moves in a linear direction and travels ½ inch total and at its midpoint of travel falls on a line projected between the attachment points. The movable attachment

point has a cycle rate of 600 cycles per minute.

(2) The distance between the attachment points is adjustable to compensate for varying lengths of brake tubing assemblies.

(3) The actuating mechanism for the movable attachment point is balanced to prevent introduction of machine vibration into the brake tubing assembly.

(4) The machine has a compressed air supply system that pressurizes the air brake tubing assembly through one fitting while the other fitting is plugged. The machine's compressed air supply system includes a pressure gauge or monitoring system and an air flow meter.

(5) The machine is constructed so that an air brake tubing assembly mounted on it can be conditioned in an environmental test chamber.

(b) *Preparation.* (1) Prepare an air brake tubing assembly with a free length of 18 inches (18 inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. Record the initial tightening torque for an end fitting that uses a threaded retaining nut.

(2) Install the air brake tubing assembly on the vibration testing machine and, with the movable attachment point at the midpoint of its travel, adjust the distance between the attachment points so that they are ½ inch closer together than the distance at which the tubing assembly is taut.

(3) With the tubing assembly inside the environmental chamber, apply compressed air to the tubing assembly at a regulated pressure of 120 psi and maintain the supply of air to the tubing assembly for the duration of the test. Set the temperature of the environmental chamber to 220 degrees Fahrenheit (104 degrees Celsius) and initiate cycling of the movable attachment point. After 250,000 cycles, set the temperature of the environmental chamber to minus 40 degrees Fahrenheit (minus 40 degrees Celsius). After 500,000 cycles, set the temperature of the environmental chamber to 220 degrees Fahrenheit (104 degrees Celsius). After 750,000 cycles, set the temperature of the environmental chamber to minus 40 degrees Fahrenheit (minus 40 degrees Celsius). Measure the air flow rate just prior to 1,000,000 cycles and if the compressed air flow rate supplied to the air brake tubing assembly exceeds 50 cubic centimeters per minute this constitutes failure of the test. Stop the cycling at 1,000,000 cycles and set the environmental chamber temperature to 75 degrees Fahrenheit (24 degrees Celsius), while air pressure is still supplied to the air brake tubing assembly. After one hour, measure the compressed air flow rate supplied to the air brake tubing assembly and if the rate exceeds 25 cubic centimeters per minute this constitutes failure of the test.

(4) For end fittings that use a threaded retaining nut, apply 20 percent of the original tightening torque as recorded in S12.21(b)(1). If the retention nut visibly moves, this constitutes a failure of the test.

S12.22 *End fitting retention test.* (a) Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions.

(b) Plug one end of the assembly, fill it with water, and connect the other end to a source of water pressure. Bleed any air from the assembly and water pressure system.

(c) Increase the pressure inside the tubing assembly at a rate of 3,000 psi per minute to 50 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII. Hold the pressure constant for 30 seconds.

(d) Increase the pressure inside the tubing assembly at a rate of 3,000 psi per minute to the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.23 *Thermal conditioning and end fitting retention test*—(a) *Apparatus.* A source of hydraulic pressure that includes a pressure gauge or monitoring system, uses ASTM IRM 903 oil, and is constructed so that an air brake tubing assembly mounted to it can be conditioned in an environmental test chamber.

(b) *Preparation.* Utilize an air brake tubing assembly or prepare a 12 inch

length of tubing and install end fittings according to the end fitting manufacturer's instructions. Attach one end of the assembly to the hydraulic pressure supply and plug the other end of the assembly, fill the assembly with ASTM IRM 903 oil and bleed any air from the assembly, and place the tubing assembly inside an environmental chamber. Conduct the following tests:

(1) With atmospheric pressure applied to the oil inside the tubing assembly, set the environmental chamber temperature to 200 degrees Fahrenheit (93 degrees Celsius) and condition the tubing assembly for 24 hours.

(2) With the temperature maintained at 200 degrees Fahrenheit (93 degrees Celsius), increase the oil pressure inside the tubing assembly at a rate of 3,000 psi per minute to 450 psi, and hold this pressure for 5 minutes.

(3) Decrease the oil pressure inside the tubing assembly at a rate of 3,000 psi per minute to atmospheric pressure and set the temperature of the environmental chamber to 75 degrees Fahrenheit (24 degrees Celsius). Condition the tubing assembly at this temperature for 1 hour.

(4) Set the temperature of the environmental chamber to minus 40 degrees Fahrenheit (minus 40 degrees Celsius) and condition the tubing assembly for 24 hours.

(5) With the temperature maintained at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), increase the hydraulic pressure inside the tubing assembly at a rate of 3,000 psi per minute to 450 psi, and hold this pressure for 5 minutes.

S12.24 *End fitting serviceability*—(a) *Apparatus.* A source of air pressure that includes a pressure gauge or monitoring system and is equipped with a mass air flow meter.

(b) *Preparation.* Prepare a 12-inch length of tubing and plug one end. Assemble the end fitting with the threaded retention nut on the other end of the tubing according to the end fitting manufacturer's instructions, then disassemble the fitting. Repeat the assembly and disassembly sequence three more times, and then reassemble the end fitting (five total assembly steps).

(c) Attach the end fitting with the threaded retention nut to the source of air pressure. Pressurize the tubing at a rate of 3,000 psi per minute to a pressure of 120 psi. If the end fitting leaks, measure and record the leakage rate using the mass air flow meter.

S12.25 *End fitting corrosion resistance.* Utilize an air brake tubing assembly or prepare a 12-inch length of tubing and install end fittings according to the end fitting manufacturer's instructions. Conduct the test specified in S6.11 using a plastic air brake tubing assembly.

S13. *Test Conditions.* Each hose assembly or appropriate part thereof shall be able to meet the requirements of S5, S7, S9, and S11, under the following conditions.

S13.1 The temperature of the testing room is 75 degrees Fahrenheit (24 degrees Celsius).

S13.2 The brake hoses and brake hose assemblies are at least 24 hours old, and unused.

S13.3 Specified test pressures are gauge pressures (psig).

[38 FR 31303, Nov. 13, 1973]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 571.106, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov.*

§ 571.107 [Reserved]

§ 571.108 Standard No. 108; Lamps, reflective devices, and associated equipment.

S1 *Scope.* This standard specifies requirements for original and replacement lamps, reflective devices, and associated equipment.

S2 *Purpose.* The purpose of this standard is to reduce traffic accidents and deaths and injuries resulting from traffic accidents, by providing adequate illumination of the roadway, and by enhancing the conspicuity of motor vehicles on the public roads so that their presence is perceived and their signals understood, both in daylight and in darkness or other conditions of reduced visibility.

S3 *Application.* This standard applies to:

S3.1 Passenger cars, multipurpose passenger vehicles, trucks, buses, trailers (except pole trailers and trailer converter dollies), and motorcycles;

S3.2 Retroreflective sheeting and reflex reflectors manufactured to conform to S8.2 of this standard; and

S3.3 Lamps, reflective devices, and associated equipment for replacement of like equipment on vehicles to which this standard applies.

S4 *Definitions.*

Adaptive driving beam means a long-range light beam for forward visibility, which automatically modifies portions of the projected light to reduce glare to traffic participants on an ongoing, dynamic basis.

Aiming plane means a plane defined by the surface of the three aiming pads on the lens.

Aiming reference plane means a plane which is perpendicular to the longitudinal axis of the vehicle and tangent to the forwardmost aiming pad on the headlamp.

Aiming screws are the horizontal and vertical adjusting screws with self-locking features used to aim and retain a headlamp unit in the proper position.

Axis of reference means the characteristic axis of the lamp for use as the direction of reference (H = 0°, V = 0°) for angles of field for photometric measurements and for installing the lamp on the vehicle.

Backup lamp means a lamp or lamps which illuminate the road to the rear of a vehicle and provide a warning signal to pedestrians and other drivers when the vehicle is backing up or is about to back up.

Beam contributor means an indivisible optical assembly including a lens, reflector, and light source, that is part of an integral beam headlighting system and contributes only a portion of a headlamp beam.

Cargo lamp is a lamp that is mounted on a multipurpose passenger vehicle, truck, or bus for the purpose of providing illumination to load or unload cargo.

Clearance lamps are lamps which show to the front or rear of the vehicle, mounted on the permanent structure of the vehicle as near as practicable to the upper left and right extreme edges to indicate the overall width and height of the vehicle.

Coated materials means a material which has a coating applied to the surface of the finished sample to impart some protective properties. Coating identification means a mark of the manufacturer's name, formulation designation number, and recommendations for application.

Color Fundamental definitions of color are expressed by Chromaticity Coordinates according to the CIE 1931 Standard Colorimetric System, as described in the CIE 1931 Chromaticity Diagram (incorporated by reference, see §571.5).

Color bleeding means the migration of color out of a plastic part onto the surrounding surface.

Combination clearance and side marker lamps are single lamps which simultaneously fulfill the requirements of clearance and side marker lamps.

Combination headlamp means a headlamp that is a combination of two different headlamp types chosen from a type F sealed beam headlamp, an integral beam headlamp, or a replaceable bulb headlamp.

Cracking means a separation of adjacent sections of a plastic material with penetration into the specimen.

Crazing means a network of apparent fine cracks on or beneath the surface of materials.

Cutoff means a generally horizontal, visual/optical aiming cue in the lower beam that marks a separation between areas of higher and lower luminance.

Daytime running lamps (DRLs) are steady burning lamps that are used to improve the conspicuity of a vehicle from the front and front sides when the regular headlamps are not required for driving.

Delamination means a separation of the layers of a material including coatings.

Design voltage means the voltage used for design purposes.

Direct reading indicator means a device that is mounted in its entirety on a headlamp or headlamp aiming or headlamp mounting equipment, is part of a VHAD, and provides information about headlamp aim in an analog or digital format.

Effective light-emitting surface means that portion of a lamp that directs light to the photometric test pattern, and does not include transparent lenses, mounting hole bosses, reflex reflector area, beads or rims that may

glow or produce small areas of increased intensity as a result of uncontrolled light from an area of ½° radius around a test point.

Effective projected luminous lens area means the area of the orthogonal projection of the effective light-emitting surface of a lamp on a plane perpendicular to a defined direction relative to the axis of reference. Unless otherwise specified, the direction is coincident with the axis of reference.

Exposed means material used in lenses or optical devices exposed to direct sunlight as installed on the vehicle.

Filament means that part of the light source or light emitting element(s), such as a resistive element, the excited portion of a specific mixture of gases under pressure, or any part of other energy conversion sources, that generates radiant energy which can be seen.

Flash means a cycle of activation and deactivation of a lamp by automatic means continuing until stopped either automatically or manually.

Fully opened means the position of the headlamp concealment device in which the headlamp is in the design open operating position.

H-V axis means the line from the center of the principal filament of a lamp to the intersection of the horizontal (H) and vertical (V) lines of a photometric test screen.

Haze means the cloudy or turbid appearance of an otherwise transparent specimen caused by light scattered from within the specimen or from its surface.

Headlamp means a lighting device providing an upper and/or a lower beam used for providing illumination forward of the vehicle.

Headlamp concealment device means a device, with its operating system and components, that provides concealment of the headlamp when it is not in use, including a movable headlamp cover and a headlamp that displaces for concealment purposes.

Headlamp mechanical axis means the line formed by the intersection of a horizontal and a vertical plane through the light source parallel to the longitudinal axis of the vehicle. If the mechanical axis of the headlamp is not at the geometric center of the lens, then the location will be indicated by the manufacturer on the headlamp.

Headlamp test fixture means a device designed to support a headlamp or headlamp assembly in the test position specified in the laboratory tests and whose mounting hardware and components are those necessary to operate the headlamp as installed in a motor vehicle.

Headlighting system midpoint means the intersection of a horizontal plane through the test vehicle's headlamp light sources, a vertical plane through the test vehicle's headlamp light sources and a vertical plane through the test vehicle's centerline.

High-mounted stop lamp means a lamp mounted high and possibly forward of the tail, stop, and rear turn signal lamps intended to give a steady stop warning through intervening vehicles to operators of following vehicles.

Identification lamps are lamps used in groups of three, in a horizontal row, which show to the front or rear or both, having lamp centers spaced not less than [6 in] 15.2 mm nor more than [12 in] 30.4 mm apart, mounted on the permanent structure as near as practicable to the vertical centerline and the top of the vehicle to identify certain types of vehicles.

Integral beam headlamp means a headlamp (other than a standardized sealed beam headlamp designed to conform to paragraph S10.13 or a replaceable bulb headlamp designed to conform to paragraph S10.15) comprising an integral and indivisible optical assembly including lens, reflector, and light source, except that a headlamp conforming to paragraph S10.18.8 or paragraph S10.18.9 may have a lens designed to be replaceable.

License plate lamp means a lamp used to illuminate the license plate on the rear of a vehicle.

Lower beam means a beam intended to illuminate the road and its environs ahead of the vehicle when meeting or closely following another vehicle.

Material means the type and grade of plastics, composition, and manufacturer's designation number and color.

Mechanically aimable headlamp means a headlamp having three pads on the lens, forming an aiming plane used for laboratory photometric testing and for

adjusting and inspecting the aim of the headlamp when installed on the vehicle.

Motor driven cycle means every motorcycle, including every motor scooter, with a motor which produces not more than 5 horsepower, and every bicycle with motor attached.

Motorcycle or motor driven cycle headlamp means a major lighting device used to produce general illumination ahead of the vehicle.

Mounting ring means the adjustable ring upon which a sealed beam unit is mounted.

Mounting ring (type F sealed beam) means the adjustable ring upon which a sealed beam unit is mounted and which forces the sealed beam unit to seat against the aiming ring when assembled into a sealed beam assembly.

Multiple compartment lamp means a device which gives its indication by two or more separately lighted areas which are joined by one or more common parts, such as a housing or lens.

Multiple lamp arrangement means an array of two or more separate lamps on each side of the vehicle which operate together to give a signal.

Optically combined means a lamp having a single or two filament light source or two or more separate light sources that operate in different ways, and has its optically functional lens area wholly or partially common to two or more lamp functions.

Overall width means the nominal design dimension of the widest part of the vehicle, exclusive of signal lamps, marker lamps, outside rearview mirrors, flexible fender extensions, mud flaps, and outside door handles determined with doors and windows closed, and the wheels in the straight-ahead position. Running boards may also be excluded from the determination of overall width if they do not extend beyond the width as determined by the other items excluded by this definition.

Parking lamps are lamps on both the left and right of the vehicle which show to the front and are intended to mark the vehicle when parked or serve as a reserve front position indicating system in the event of headlamp failure.

Protected means material used in inner lenses for optical devices where such lenses are protected from exposure to the sun by an outer lens made of materials meeting the requirements for exposed plastics.

Rated voltage means the nominal circuit or vehicle electrical system voltage classification.

Reflex reflectors are devices used on vehicles to give an indication to approaching drivers using reflected light from the lamps of the approaching vehicle.

Remote reading indicator means a device that is not mounted in its entirety on a headlamp or headlamp aiming or headlamp mounting equipment, but otherwise meets the definition of a direct reading indicator.

Replaceable bulb headlamp means a headlamp comprising a bonded lens and reflector assembly and one or two replaceable light sources, except that a headlamp conforming to paragraph S10.18.8 or paragraph S10.18.9 may have a lens designed to be replaceable.

Replaceable light source means an assembly of a capsule, base, and terminals that is designed to conform to the requirements of appendix A or appendix B of 49 CFR part 564 *Replaceable Light Source Information* of this Chapter.

Retaining ring means the clamping ring that holds a sealed beam unit against a mounting ring.

Retaining ring (type F sealed beam) means the clamping ring that holds a sealed beam unit against a mounting ring, and that provides an interface between the unit's aiming/seating pads and the headlamp aimer adapter (locating plate).

School bus signal lamps are alternately flashing lamps mounted horizontally both front and rear, intended to identify a vehicle as a school bus and to inform other users of the highway that such vehicle is stopped on the highway to take on or discharge school children.

Sealed beam headlamp means an integral and indivisible optical assembly including the light source with ''SEALED BEAM'' molded in the lens.

Sealed beam headlamp assembly means a major lighting assembly which includes one or more sealed beam units used to provide general illumination ahead of the vehicle.

Seasoning means the process of energizing the filament of a headlamp at design voltage for a period of time equal to 1% of design life, or other equivalent method.

Semiautomatic headlamp beam switching device is one which provides either automatic or manual control of beam switching at the option of the driver. When the control is automatic the headlamp beams switch automatically. When the control is manual, the driver may obtain either the lower beam or the upper beam manually regardless of the conditions ahead of the vehicle.

Side marker lamps are lamps which show to the side of the vehicle, mounted on the permanent structure of the vehicle as near as practicable to the front and rear edges to indicate the overall length of the vehicle. Additional lamps may also be mounted at intermediate locations on the sides of the vehicle.

Stop lamps are lamps giving a steady light to the rear of a vehicle to indicate a vehicle is stopping or diminishing speed by braking.

Taillamps are steady burning low intensity lamps used to designate the rear of a vehicle.

Test voltage means the specified voltage and tolerance to be used when conducting a test.

Transition zone means the portion of an adaptive driving beam that occurs between an area of reduced intensity and an area of unreduced intensity.

Turn signal lamps are the signaling element of a turn signal system which indicates the intention to turn or change direction by giving a flashing light on the side toward which the turn will be made.

Turn signal flasher means a device which causes a turn signal lamp to flash as long as it is turned on.

Turn signal operating unit means an operating unit that is part of a turn signal system by which the operator of a vehicle causes the signal units to function.

Upper beam means a beam intended primarily for distance illumination and for use when not meeting or closely following other vehicles.

Vehicle headlamp aiming device or VHAD means motor vehicle equipment, installed either on a vehicle or headlamp, which is used for determining the horizontal or vertical aim, or both the vertical and horizontal aim of the headlamp.

Vehicular hazard warning signal flasher means a device which, as long as it is turned on, causes all the required turn signal lamps to flash.

Vehicular hazard warning signal operating unit means a driver controlled device which causes all required turn signal lamps to flash simultaneously to indicate to approaching drivers the presence of a vehicular hazard.

Visually/optically aimable headlamp means a headlamp which is designed to be visually/optically aimable in accordance with the requirements of paragraph S10.18.9 of this standard.

S5 *References to SAE publications.* Each required lamp, reflective device, and item of associated equipment must be designed to conform to the requirements of applicable SAE publications as referenced and subreferenced in this standard. The words ''it is recommended that,'' ''recommendations,'' or ''should be'' appearing in any SAE publication referenced or subreferenced in this standard must be read as setting forth mandatory requirements.

S6 *Vehicle requirements.*

S6.1 *Required lamps, reflective devices, and associated equipment by vehicle type.*

S6.1.1 *Quantity.* Except as provided in succeeding paragraphs of this S6.1.1 each vehicle must be equipped with at least the number of lamps, reflective devices, and items of associated equipment specified for that vehicle type and size in Table I and Section 6.6, designed to conform to the requirements of this standard. Multiple license plate lamps and backup lamps may be used to fulfill photometric requirements for those functions.

S6.1.1.1 *Conspicuity systems.* Each trailer of 2032 mm or more in overall width, and with a GVWR over 10,000 lbs., except a trailer designed exclusively for living or office use, and each truck tractor must be equipped with retroreflective sheeting, reflex reflectors, or a combination of retroreflective sheeting and reflex reflectors as specified in S8.2.

S6.1.1.2 *High-mounted stop lamps.* Each multipurpose passenger vehicle,

truck, and bus required by this standard to be equipped with a high-mounted stop lamp, whose vertical centerline, when the vehicle is viewed from the rear, is not located on a fixed body panel but separates one or two moveable body sections, such as doors, which lacks sufficient space to install a single high-mounted stop lamp on the centerline above such body sections, must have two high-mounted stop lamps identical in size and shape.

S6.1.1.2.1 The two lamps must be located at the same height, with one vertical edge of each lamp on the vertical edge of the body section nearest the vehicle centerline.

S6.1.1.3 *Truck tractor rear turn signal lamps.* A truck tractor need not be equipped with turn signal lamps mounted on the rear if the turn signal lamps installed at or near the front are of double face construction and are located such that they meet the photometric requirements for double faced turn signal lamps specified in Footnote 6 of Table VII.

S6.1.1.3.1 The flashing signal from a double faced signal lamp must not be obliterated when subjected to external light rays from either in front or behind, at any and all angles.

S6.1.1.4 *Daytime running lamps.* Any pair of lamps on the front of a passenger car, multipurpose passenger vehicle, truck, or bus, whether or not required by this standard, other than parking lamps or fog lamps, may be wired to be automatically activated, as determined by the manufacturer of the vehicle, in a steady burning state as daytime running lamps (DRLs) in accordance with S7.10.5.

S6.1.2 *Color.* The color in all lamps and reflective devices to which this standard applies must be as specified in Table I. The color identified as amber is identical to the color identified as yellow.

S6.1.3 *Mounting location.*

S6.1.3.1 Each lamp, reflective device, and item of associated equipment must be securely mounted on a rigid part of the vehicle, other than glazing, that is not designed to be removed except for repair, within the mounting location and height limits as specified in Table I, and in a location where it complies with all applicable photometric requirements, effective projected luminous lens area requirements, and visibility requirements with all obstructions considered.

S6.1.3.2 When multiple lamp arrangements for rear turn signal lamps, stop lamps, or taillamps are used, with only a portion of the lamps installed on a fixed part of the vehicle, the lamp or lamps that are installed to the nonfixed part of the vehicle will be considered auxiliary lamps.

S6.1.3.3 *License plate lamp.* The license plate lamp or lamps installed on vehicles other than motorcycles and motor driven cycles must be mounted so as to illuminate the license plate without obstruction from any designed feature unless the lamp or lamps is (are) designed to comply with all the photometric requirements with these obstructions considered.

S6.1.3.4 *High-mounted stop lamps.*

S6.1.3.4.1 *Interior mounting.* A high-mounted stop lamp mounted inside the vehicle must have means provided to minimize reflections from the light of the lamp upon the rear window glazing that might be visible to the driver when viewed directly, or indirectly in the rearview mirror.

S6.1.3.4.2 *Accessibility.* Each high-mounted stop lamp must provide access for convenient replacement of bulbs without special tools.

S6.1.3.5 *Headlamp beam mounting.*

S6.1.3.5.1 *Vertical headlamp arrangement.*

S6.1.3.5.1.1 Where multiple headlamps with single light sources are installed in a vertical orientation the lower beam must be provided by the uppermost headlamp.

S6.1.3.5.1.2 Where headlamps with two vertically oriented light sources are installed the lower beam must be provided by the uppermost light source or by all light sources.

S6.1.3.5.2 *Horizontal headlamp arrangement.*

S6.1.3.5.2.1 Where multiple headlamps with single light sources are installed in a horizontal orientation the lower beam must be provided by the most outboard headlamp.

S6.1.3.5.2.2 Where headlamps with two horizontally oriented light sources are installed the lower beam must be

provided by the outboard light source or by all light sources.

S6.1.3.6 *Auxiliary lamps mounted near identification lamps.* Each auxiliary lamp must be located at least twice the distance from any required identification lamp as the distance between two adjacent required identification lamps.

S6.1.4 *Mounting height.* The mounting height of each lamp and reflective device must be measured from the center of the item, as mounted on the vehicle at curb weight, to the road surface.

S6.1.4.1 *High-mounted stop lamps.*

S6.1.4.1.1 A high-mounted stop lamp mounted below the rear window must have no lens portion lower than 153 mm [6 in] below the lower edge of the rear glazing on convertibles, or 77 mm [3 in] on other passenger cars.

S6.1.5 *Activation.* Each lamp must be activated as specified, in the combinations specified, and in response to the inputs specified in Table I and Table II.

S6.1.5.1 *Hazard warning signal.* In all passenger cars, multipurpose passenger vehicles, trucks, and buses, the activation of the vehicular hazard warning signal operating unit must cause to flash simultaneously sufficient turn signal lamps to meet, as a minimum, the turn signal photometric requirements of this standard.

S6.1.5.2 *Simultaneous beam activation.*

S6.1.5.2.1 On any vehicle to which this standard applies where the headlighting system is designed to conform to the photometric requirements of UB1 of Table XVIII and LB1M or LB1V of Table XIX–a, the lamps marked ''L'' or ''LF'' may remain permanently activated when the lamps marked ''U'' or ''UF'' are activated.

S6.1.5.2.2 On any vehicle to which this standard applies where an integral beam headlighting system is designed to conform to the photometric requirements of UB6 of Table XVIII and LB5M of Table XIX–b or LB4V of Table XIX–c, the lower beam headlamps must remain permanently activated when the upper beam headlamps are activated.

S6.1.5.2.3 On any vehicle to which this section applies where the headlighting system is designed to conform to the photometric requirements of UB2 of Table XVIII and LB2M or LB2V of Table XIX–a, a lower beam light source may remain permanently activated when an upper beam light source is activated if the lower beam light source contributes to the upper beam photometric compliance of the headlighting system.

S6.2 *Impairment.*

S6.2.1 No additional lamp, reflective device, or other motor vehicle equipment is permitted to be installed that impairs the effectiveness of lighting equipment required by this standard.

S6.2.2 If any required lamp or reflective device is obstructed by motor vehicle equipment (e.g., mirrors, snow plows, wrecker booms, backhoes, winches, etc.) including dealer installed equipment, and cannot meet the applicable photometry and visibility requirements, the vehicle must be equipped with an additional lamp or device of the same type which meet all applicable requirements of this standard, including photometry and visibility.

S6.2.3 *Headlamp obstructions.*

S6.2.3.1 When activated in the steady burning state, headlamps (excluding headlamps mounted on motorcycles) must not have any styling ornament or other feature, such as a translucent cover or grill, in front of the lens

S6.2.3.2 Headlamp wipers may be used in front of the lens provided that the headlamp system is designed to conform with all applicable photometric requirements with the wiper stopped in any position in front of the lens.

S6.3 *Equipment combinations.* Two or more lamps, reflective devices, or items of associated equipment may be combined if the requirements for each lamp, reflective device, and item of associated equipment are met with the following exceptions:

S6.3.1 No high-mounted stop lamp is permitted to be combined with any other lamp or reflective device, other than with a cargo lamp.

S6.3.2 No high-mounted stop lamp is permitted to be optically combined with any cargo lamp.

S6.3.3 No clearance lamp is permitted to be optically combined with any taillamp.

S6.4 *Lens area, visibility and school bus signal lamp aiming.*

S6.4.1 *Effective projected luminous lens area.* Each turn signal lamp, stop lamp, high-mounted stop lamp, and school bus signal lamp must meet the applicable effective projected luminous lens area requirement specified in Tables IV–a, IV–b, and IV–c.

S6.4.2 *Visibility.* Each backup lamp, single or combination of dual high-mounted stop lamp(s), and school bus signal lamp must meet the applicable visibility requirement specified in Table V-a.

S6.4.3 *Visibility options.* A manufacturer must certify compliance of each lamp function to one of the following visibility requirement options, and it may not thereafter choose a different option for that vehicle:

(a) *Lens area option.* When a vehicle is equipped with any lamp listed in Table V-b each such lamp must provide not less than 1250 sq mm of unobstructed effective projected luminous lens area in any direction throughout the pattern defined by the corner points specified in Table V-b for each such lamp; or

(b) *Luminous intensity option.* When a vehicle is equipped with any lamp listed in Table V-c each such lamp must provide a luminous intensity of not less than that specified in Table V-c in any direction throughout the pattern defined by the corner points specified in Table V-c for each such lamp when measured in accordance with the photometry test requirements of this standard.

S6.4.4 *Legacy visibility alternative.* As an alternative to S6.4.3, each passenger car and motorcycle, and each multipurpose passenger vehicle, truck, trailer, and bus that is of less than 2032 mm overall width, that is manufactured on or before September 1, 2011, and each multipurpose passenger vehicle, truck, trailer, and bus that is of 2032 mm or more overall width, that is manufactured on or before September 1, 2014, must have each lamp located so that it meets the visibility requirements specified in Table V–d.

S6.4.5 *School bus signal lamp aiming.* Each school bus signal lamp must be mounted on the vehicle with its aiming plane vertical and normal to the vehicle longitudinal axis. Aim tolerance must be no more than 5 in vertically and 10 in horizontally at 25 ft from the lamp. If the lamps are aimed or inspected by use of SAE Recommended Practice J602–1963 (incorporated by reference, see §571.5), the graduation settings for aim must be 2° D and 0° sideways for aiming and the limits must be 3° U to 7° D and from 10° R to 10° L for inspection.

S6.5 *Marking.* A summary of the marking requirements of this standard and their location in the standard is contained in Table III.

S6.5.1 *DOT marking.* The lens of each original equipment and replacement headlamp, and of each original equipment and replacement beam contributor, and each replacement headlamp lens for an integral beam or replaceable bulb headlamp, must be marked with the symbol ''DOT'' either horizontally or vertically to indicate certification under 49 U.S.C. 30115.

S6.5.1.1 The DOT marking requirements for conspicuity materials are specified in S8.2 of this standard.

S6.5.1.2 Each original equipment or replacement lamp or reflective device specified in Table I, except for a headlamp, or an item of associated equipment specified in S9 may be marked with the symbol ''DOT'' which constitutes a certification that it conforms to the requirements of this standard.

S6.5.2 *DRL marking.* Each original equipment and replacement lamp used as a daytime running lamp (DRL), unless optically combined with a headlamp, must be permanently marked ''DRL'' on its lens in letters not less than 3 mm high.

S6.5.3 *Headlamp markings.*

S6.5.3.1 *Trademark.* The lens of each original and replacement equipment headlamp, and of each original and replacement equipment beam contributor must be marked with the name and/or trademark registered with the U.S. Patent and Trademark Office of the manufacturer of such headlamp or beam contributor, of its importer, or any manufacturer of a vehicle equipped with such headlamp or beam contributor. Nothing in this standard authorizes the marking of any such name and/or trademark by one who is not the owner, unless the owner has consented to it.

S6.5.3.2 *Voltage and trade number.* Each original and replacement equipment headlamp, and each original and replacement equipment beam contributor must be marked with its voltage and with its part or trade number.

S6.5.3.3 *Sealed beam headlamp markings.*

S6.5.3.3.1 Each sealed beam headlamp lens must be molded with ''sealed beam'' and the appropriate designation code as shown in Table II in characters no less than 6.35 mm in size.

S6.5.3.3.2 The face of any character molded on the surface of the lens must not be raised more than 0.5 mm above the lens surface.

S6.5.3.3.3 Type 1C1, 2C1, and 2D1 headlamps must have no raised markings on the outside surface of the lens between the diameters of 40 mm and 90 mm about the lens center.

S6.5.3.3.4 Type 1A1, 2A1, 2B1, and 2E1 headlamps must have no raised markings on the outside surface of the lens within a diameter of 70 mm about the lens center.

S6.5.3.3.5 Type LF, UF, 1G1, 2G1, and 2H1 headlamps must have no raised markings on the outside surface of the lens within a diameter of 35 mm about the lens center.

S6.5.3.3.6 A Type 1C1 replacement headlamp may be marked ''1'' rather than ''1C1''. A Type 2C1 replacement headlamp may be marked ''2'' rather than ''2C1''. A Type 2D1 replacement headlamp may be marked ''TOP'' or ''2'' rather than ''2D1''.

S6.5.3.4 *Replaceable bulb headlamp markings.*

S6.5.3.4.1 The lens of each replaceable bulb headlamp must bear permanent marking in front of each replaceable light source with which it is equipped that states either: The HB Type, if the light source conforms to S11 of this standard for filament light sources, or the bulb marking/designation provided in compliance with Section VIII of appendix A of 49 CFR Part 564 (if the light source conforms to S11 of this standard for discharge light sources).

S6.5.3.4.1.1 No marking need be provided if the only replaceable light source in the headlamp is type HB1.

S6.5.3.5 *Additional headlamp markings.* Additional marking requirements for headlamps are found in, S10.14.4, S10.15.4, S10.17.2, S10.18.5, S10.18.7, and S10.18.9 of this standard.

S6.5.3.6 Each replacement headlamp lens must also be marked with the manufacturer and the part or trade number of the headlamp for which it is intended, and with the name and/or trademark of the lens manufacturer or importer that is registered with the U.S. Patent and Trademark Office. Nothing in this standard authorizes the marking of any such name and/or trademark by one who is not the owner, unless the owner has consented to it.

S6.6 *Associated equipment.*

S6.6.1 All vehicles to which this standard applies, except trailers, must be equipped with a turn signal operating unit, a turn signal flasher, a turn signal pilot indicator, a headlamp beam switching device, and an upper beam headlamp indicator meeting the requirements of S9.

S6.6.2 All vehicles to which this standard applies except trailers and motorcycles must be equipped with a vehicular hazard warning operating unit, a vehicular hazard warning signal flasher, and a vehicular hazard warning signal pilot indicator meeting the requirements of S9.

S6.6.3 *License plate holder.* Each rear license plate holder must be designed and constructed to provide a substantial plane surface on which to mount the plate.

S6.6.3.1 For motor vehicles on which the license plate is designed to be mounted on the vehicle such that the upper edge of the license plate is 1.2 m or less from the ground, the plane of the license plate mounting surface and the plane on which the vehicle stands must be perpendicular within 30° upward (an installed plate will face above the horizon) and 15° downward (an installed plate will face below the horizon).

S6.6.3.2 For motor vehicles on which the license plate is designed to be mounted on the vehicle such that the upper edge of the license plate is more than 1.2m from the ground, the plane of the license plate mounting surface and the plane on which the vehicle stands must be perpendicular within ±15°.

S6.7 *Replacement equipment.*

S6.7.1 *General.*

S6.7.1.1 Each replacement lamp, reflective device, or item of associated equipment, including a combination lamp, must:

(a) Be designed to conform to meet all requirements specified in this standard for that type of lamp, reflective device, or other item of equipment (in the case of a combination lamp, it must meet these requirements for each function); and

(b) Include all of the functions of the lamp, reflective device, or item of associated equipment, including a combination lamp, it is designed to replace or is capable of replacing (other than functions not required by this standard).

S6.7.1.2 Each replacement lamp, reflective device, or item of associated equipment, including a combination lamp, which is designed or recommended for particular vehicle models must be designed so that it does not take the vehicle out of compliance with this standard when the individual device is installed on the vehicle. Except as provided in S6.7.1.3, the determination of whether a vehicle would be taken out of compliance with this standard when an individual device is installed on the vehicle is made without regard to whether additional devices, including separate lamps or reflective devices sold together with the device, would also be installed.

S6.7.1.3 In the case of a lamp or other device that is used on each side of the vehicle in pairs, the determination (for the purposes of S6.7.1.2) of whether a vehicle would be taken out of compliance with this standard when an individual device is installed on the vehicle is made assuming that the other matched paired device would be installed on the other side of the vehicle, whether or not the matched paired devices are sold together. This provision does not limit the responsibilities of manufacturers, distributors, dealers or motor vehicle repair businesses under 49 U.S.C. 30122, *Making safety devices and elements inoperative.*

S6.7.2 *Version of this standard.* The requirements of S6.7.1 must be met, at the option of the manufacturer, using either the current version of this standard or the standard in effect at the time of manufacture of the original equipment being replaced.

S7 *Signal lamp requirements.*

S7.1 *Turn signal lamps.*

S7.1.1 *Front turn signal lamps.*

S7.1.1.1 *Number.* See Tables I–a and I–c.

S7.1.1.2 *Color of light.* See Tables I–a and I–c.

S7.1.1.3 *Mounting location.* See Tables I–a and I–c.

S7.1.1.4 *Mounting height.* See Tables I–a and I–c.

S7.1.1.5 *Activation.* See Tables I–a and I–c.

S7.1.1.6 *Effective projected luminous lens area.* See Table IV–a.

S7.1.1.7 *Visibility.* See S6.4.

S7.1.1.8 *Indicator.* See S9.3.

S7.1.1.9 *Markings.* See S6.5.1.2.

S7.1.1.10 *Spacing to other lamps.*

S7.1.1.10.1 Each front turn signal lamp must also be designed to comply with any additional photometry requirements based on its installed spacing to other lamps as specified by this section. Where more than one spacing relationship exists for a turn signal lamp the requirement must be the one that specifies the highest luminous intensity multiplier of Tables VI–a and VI–b.

S7.1.1.10.2 *Spacing measurement for non-reflector lamps.* For any front turn signal lamp that does not employ a reflector to meet photometric requirements, the spacing must be measured from the light source of the turn signal lamp to the lighted edge of any lower beam headlamp, or any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp.

S7.1.1.10.3 *Spacing measurement for lamps with reflectors.* For any front turn signal lamp which employs a reflector, such as a parabolic reflector, to meet photometric requirements, the spacing must be measured from the geometric centroid of the turn signal lamp effective projected luminous lens area to the lighted edge of any lower beam headlamp, or any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp.

S7.1.1.10.4 *Spacing based photometric multipliers.*

(a) where the spacing measurement of S7.1.1.10.2 or S7.1.1.10.3 between a turn signal lamp and the lighted edge of any lower beam headlamp is less than 100 mm the photometric multiplier must be 2.5.

(b) where the spacing measurement of S7.1.1.10.2 or S7.1.1.10.3 between a turn signal lamp and the lighted edge of any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp is at least 75 mm but less than 100 mm the photometric multiplier of Table VI must be 1.5.

(c) where the spacing measurement of S7.1.1.10.2 or S7.1.1.10.3 between a turn signal lamp and the lighted edge of any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp is at least 60 mm but less than 75 mm the photometric multiplier must be 2.0.

(d) where the spacing measurement of S7.1.1.10.2 or S7.1.1.10.3 between a turn signal lamp and the lighted edge of any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp is less than 60 mm the photometric multiplier must be 2.5.

S7.1.1.11 *Multiple compartment lamps and multiple lamps.*

S7.1.1.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric requirements of a front turn signal lamp provided the requirements of S6.1.3.2 are met.

S7.1.1.11.2 If a multiple compartment lamp or multiple lamps are used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between adjacent light sources does not exceed 560 mm for two compartment or lamp arrangements and does not exceed 410 mm for three compartments or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Tables VI–a or VI–b.

S7.1.1.11.3 If the distance between adjacent light sources exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Tables VI–a or VI–b

S7.1.1.11.4 *Lamps installed on vehicles 2032 mm or more in overall width.* Multiple compartment front turn signal lamps installed on multipurpose passenger vehicles, trucks, and buses 2032 mm or more in overall width require measurement of the photometrics for the entire lamp and not for individual compartments.

S7.1.1.12 *Ratio to parking lamps and clearance lamps.*

S7.1.1.12.1 When a parking lamp, or a clearance lamp on a multipurpose passenger vehicle, truck, trailer, or bus of 2032 mm or more in overall width, is combined with a front turn signal lamp, the luminous intensity of the front turn signal lamp at each identified test point must not be less than the luminous intensity of the parking lamp or clearance lamp at that same test point times the multiplier shown for that test point in Tables VI-a or VI-b.

S7.1.1.12.2 If a multiple compartment or multiple lamp arrangement is used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between the optical axes for both the parking lamp and turn signal lamp is within 560 mm for two compartment or lamp arrangements or 410 mm for three compartment or lamp arrangements, then the ratio must be computed with all compartments or lamps lighted.

S7.1.1.12.3 If a multiple compartment or multiple lamp arrangement is used and the distance between optical axes for one of the functions exceeds 560 mm for two compartment or lamp arrangements or 410 mm for three compartments or lamp arrangements, then the ratio must be computed for only those compartments or lamps where the parking lamp and turn signal lamp are optically combined.

S7.1.1.12.4 Where the clearance lamp is combined with the turn signal lamp, and the maximum luminous intensity of the clearance lamp is located below horizontal and within an area generated by a 1.0 degree radius around a test point, the ratio for the test point may be computed using the lowest

value of the clearance lamp luminous intensity within the generated area.

S7.1.1.13 *Photometry*.

S7.1.1.13.1 When tested according to the procedure of S14.2.1, each front turn signal lamp must be designed to conform to the base photometry requirements plus any applicable multipliers as shown in Tables VI–a and VI–b for the number of lamp compartments or individual lamps and the type of vehicle it is installed on.

S7.1.1.13.2 As an alternative to S7.1.1.13.1, a front turn signal lamp installed on a motorcycle may be designed to conform to the photometry requirements of Table XIII-a when tested according to the procedure of S14.2.1.

S7.1.1.14 *Physical tests*. Each front turn signal lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.1.2 *Rear turn signal lamps*.

S7.1.2.1 *Number*. See Tables I–a, I–b, and I–c.

S7.1.2.2 *Color of light*. See Tables I–a, I–b, and I–c.

S7.1.2.3 *Mounting location*. See Tables I–a, I–b, and I–c and S6.1.3.2.

S7.1.2.4 *Mounting height*. See Tables I–a, I–b, and I–c.

S7.1.2.5 *Activation*. See Tables I–a, I–b, and I–c.

S7.1.2.6 *Effective projected luminous lens area*. See Table IV–a.

S7.1.2.7 *Visibility*. See S6.4.

S7.1.2.8 *Indicator*. See S9.3.

S7.1.2.9 *Markings*. See S6.5.1.2.

S7.1.2.10 *Spacing to other lamps*. No requirement.

S7.1.2.11 *Multiple compartments and multiple lamps*.

S7.1.2.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric requirements of a rear turn signal lamp provided the requirements of S6.1.3.2 are met

S7.1.2.11.2 If a multiple compartment lamp or multiple lamps are used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between adjacent light sources does not exceed 560 mm for two compartment or lamp arrangements and does not exceed 410 mm for three compartment or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Table VII.

S7.1.2.11.3 If the distance between adjacent light sources exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Table VII.

S7.1.2.11.4 *Lamps installed on vehicles 2032 mm or more in overall width*. Multiple compartment rear turn signal lamps installed on multipurpose passenger vehicles, trucks, and buses 2032 mm or more in overall width require measurement of the photometrics for the entire lamp and not for individual compartments.

S7.1.2.12 *Ratio to taillamps and clearance lamps*.

S7.1.2.12.1 When a taillamp, or a clearance lamp on a multipurpose passenger vehicle, truck, trailer, or bus of 2032 mm or more in overall width, is combined with a rear turn signal lamp, the luminous intensity of the rear turn signal lamp at each identified test point must not be less than the luminous intensity of the taillamp or clearance lamp at that same test point times the multiplier shown for that test point in Table VII.

S7.1.2.12.2 If a multiple compartment or multiple lamp arrangement is used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between the optical axes for both the taillamp and turn signal lamp is within 560 mm for two compartment or lamp arrangement or 410 mm for three compartments or lamp arrangements, then the ratio must be computed with all compartments or lamps lighted.

S7.1.2.12.3 If a multiple compartment or multiple lamp arrangement is used and the distance between optical axes for one of the functions exceeds 560 mm for two compartment or lamp arrangements or 410 mm for three compartment or lamp arrangements, then the ratio must be computed for only those compartments or lamps where

the taillamp and turn signal lamp are optically combined.

S7.1.2.12.4 Where the taillamp or clearance lamp is combined with the turn signal lamp, and the maximum luminous intensity of the taillamp or clearance lamp is located below horizontal and within an area generated by a 0.5 ° radius around a test point for a taillamp on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, or by a 1.0 ° radius around a test point for a taillamp or clearance lamp on a vehicle 2032 mm or more in overall width, the ratio for the test point may be computed using the lowest value of the taillamp or clearance lamp luminous intensity within the generated area.

S7.1.2.13 *Photometry*.

S7.1.2.13.1 Each rear turn signal lamp must be designed to conform to the photometry requirements of Table VII, when tested according to the procedure of S14.2.1, for the number of lamp compartments or individual lamps, the type of vehicle it is installed on, and the lamp color as specified by this section.

S7.1.2.13.2 As an alternative to S7.1.2.13.1, a rear turn signal lamp installed on a motorcycle may be designed to conform to the photometry requirements of Table XIII-a when tested according to the procedure of S14.2.1.

S7.1.2.14 *Physical tests*. Each rear turn signal lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.1.3 *Combined lamp bulb indexing*.

S7.1.3.1 Each turn signal lamp optically combined with a taillamp or a parking lamp, or clearance lamp where installed on a vehicle 2032 mm or more in overall width, where a two-filament bulb is used must have a bulb with an indexing base and a socket designed so that bulbs with non-indexing bases cannot be used.

S7.1.3.2 Removable sockets must have an indexing feature so that they cannot be re-inserted into lamp housings in random positions, unless the lamp will perform its intended function with random light source orientation.

S7.2 *Taillamps*.

S7.2.1 *Number*. See Tables I-a, I-b, and I-c.

S7.2.2 *Color of light*. See Tables I-a, I-b, and I-c.

S7.2.3 *Mounting location*. See Tables I-a, I-b, and I-c and S6.1.3.2.

S7.2.4 *Mounting height*. See Tables I-a, I-b, and I-c.

S7.2.5 *Activation*. See Tables I-a, I-b, and I-c.

S7.2.6 *Effective projected luminous lens area*. No requirement.

S7.2.7 *Visibility*. See S6.4.

S7.2.8 *Indicator*. No requirement.

S7.2.9 *Markings*. See S6.5.1.2.

S7.2.10 *Spacing to other lamps*. No requirement.

S7.2.11 *Multiple compartments and multiple lamps*.

S7.2.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric requirements of a taillamp provided the requirements of S6.1.3.2 are met.

S7.2.11.2 If a multiple compartment lamp or multiple lamps are used and the distance between the optical axes does not exceed 560 mm for two compartment or lamp arrangements and does not exceed 410 mm for three compartment or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Table VIII.

S7.2.11.3 If the distance between optical axes exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Table VIII.

S7.2.11.4 *Taillamps installed on vehicles 2032 mm or more in overall width*. A maximum of two taillamps and/or two compartments per side may be mounted closer together than 560 mm providing that each compartment and/or lamp meets the single lighted section photometric requirements specified in Table VIII. Each lamp and/or compartment utilized in this manner must meet the single lighted section requirements for all functions for which it is designed.

S7.2.12 *Ratio*. See S7.1.2.12 for rear turn signal lamps and S7.3.12 for stop lamps.

S7.2.13 *Photometry*. Each taillamp must be designed to conform to the photometry requirements of Table VIII, when tested according to the procedure of S14.2.1, for the number of lamp compartments or individual lamps and the type of vehicle it is installed on.

S7.2.14 *Physical tests*. Each taillamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.3 *Stop lamps*.

S7.3.1 *Number*. See Tables I-a, I-b, and I-c.

S7.3.2 *Color of light*. See Tables I-a, I-b, and I-c.

S7.3.3 *Mounting location*. See Tables I-a, I-b, and I-c and S6.1.3.2.

S7.3.4 *Mounting height*. See Tables I-a, I-b, and I-c.

S7.3.5 *Activation*. See Tables I-a, I-b, and I-c.

S7.3.6 *Effective projected luminous lens area*. See Table IV-a.

S7.3.7 *Visibility*. See S6.4.

S7.3.8 *Indicator*. No requirement.

S7.3.9 *Markings*. See S6.5.1.2.

S7.3.10 *Spacing to other lamps*. No requirement.

S7.3.11 *Multiple compartments and multiple lamps*.

S7.3.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric requirements of a stop lamp provided the requirements of S6.1.3.2 are met.

S7.3.11.2 If a multiple compartment lamp or multiple lamps are used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between adjacent light sources does not exceed 560 mm for two compartment or lamp arrangements and does not exceed 410 mm for three compartment or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Table IX.

S7.3.11.3 If the distance between adjacent light sources exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Table IX.

S7.3.11.4 *Lamps installed on vehicles 2032 mm or more in overall width*. Multiple compartment stop lamps installed on multipurpose passenger vehicles, trucks, and buses 2032 mm or more in overall width require measurement of the photometrics for the entire lamp and not for individual compartments.

S7.3.12 *Ratio to taillamps*.

S7.3.12.1 When a taillamp is combined with a stop lamp, the luminous intensity of the stop lamp at each identified test point must not be less than the luminous intensity of the taillamp at that same test point times the multiplier shown for that test point in Table IX.

S7.3.12.2 If a multiple compartment or multiple lamp arrangement is used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between the optical axes for both the taillamp and stop lamp is within 560 mm for two compartment or lamp arrangements or 410 mm for three compartment or lamp arrangements, then the ratio must be computed with all compartments or lamps lighted.

S7.3.12.3 If a multiple compartment or multiple lamp arrangement is used and the distance between optical axes for one of the functions exceeds 560 mm for two compartment or lamp arrangements or 410 mm for three compartments or lamp arrangements, then the ratio must be computed for only those compartments or lamps where the taillamp and stop lamp are optically combined.

S7.3.12.4 Where the taillamp is combined with the stop lamp, and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5 ° radius around a test point for a taillamp on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, or by a 1.0 ° radius around a test point for a taillamp on a vehicle 2032 mm or more in overall

width, the ratio for the test point may be computed using the lowest value of the taillamp luminous intensity within the generated area.

S7.3.13 *Photometry.*

S7.3.13.1 Each stop lamp must be designed to conform to the photometry requirements of Table IX, when tested according to the procedure of S14.2.1, for the number of lamp compartments or individual lamps and the type of vehicle it is installed on.

S7.3.13.2 A stop lamp installed on a motor driven cycle may be designed to conform to the photometry requirements of Table XIII-b when tested according to the procedure of S14.2.1.

S7.3.14 *Physical tests.* Each stop lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.3.15 *Combined lamp bulb indexing.*

S7.3.15.1 Each stop lamp optically combined with a taillamp where a two-filament bulb is used must have a bulb with an indexing base and a socket designed so that bulbs with non-indexing bases cannot be used.

S7.3.15.2 Removable sockets must have an indexing feature so that they cannot be re-inserted into lamp housings in random positions, unless the lamp will perform its intended function with random light source orientation.

S7.4 *Side marker lamps.*

S7.4.1 *Number.* See Tables I–a, I–b, and I–c.

S7.4.2 *Color of light.* See Tables I–a, I–b, and I–c.

S7.4.3 *Mounting location.* See Tables I–a, I–b, and I–c.

S7.4.4 *Mounting height.* See Tables I–a, I–b, and I–c.

S7.4.5 *Activation.* See Tables I–a, I–b, and I–c.

S7.4.6 *Effective projected luminous lens area.* No requirement.

S7.4.7 *Visibility.* No requirement.

S7.4.8 *Indicator.* No requirement.

S7.4.9 *Markings.* See S6.5.1.2.

S7.4.10 *Spacing to other lamps.* No requirement.

S7.4.11 *Multiple compartments and multiple lamps.* No requirement.

S7.4.12 *Ratio.* No requirement.

S7.4.13 *Photometry.*

S7.4.13.1 Each side marker lamp must be designed to conform to the photometry requirements of Table X, when tested according to the procedure of S14.2.1, for the lamp color as specified by this section.

S7.4.13.2 *Inboard photometry.* For each motor vehicle less than 30 feet in overall length, the minimum photometric intensity requirements for a side marker lamp may be met for all inboard test points at a distance of 15 feet from the vehicle and on a vertical plane that is perpendicular to the longitudinal axis of the vehicle and located midway between the front and rear side marker lamps.

S7.4.14 *Physical tests.* Each side marker lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.5 *Clearance and identification lamps.*

S7.5.1 *Number.* See Tables I–a and I–b.

S7.5.2 *Color of light.* See Tables I–a and I–b.

S7.5.3 *Mounting location.* See Tables I–a and I–b.

S7.5.4 *Mounting height.* See Tables I–a and I–b.

S7.5.5 *Activation.* See Tables I–a and I–b.

S7.5.6 *Effective projected luminous lens area.* No requirement.

S7.5.7 *Visibility.* No requirement.

S7.5.8 *Indicator.* No requirement.

S7.5.9 *Markings.* See S6.5.1.2.

S7.5.10 *Spacing to other lamps.* No requirement.

S7.5.11 *Multiple compartments and multiple lamps.* No requirement.

S7.5.12 *Ratio.*

S7.5.12.1 *Clearance lamps.* See S7.1.1.12 for front turn signal lamps and S7.1.2.12 for rear turn signal lamps.

S7.5.12.2 *Identification lamps.* No requirement.

S7.5.13 *Photometry.* Each clearance or identification lamp must be designed to conform to the photometry requirements of Table XI, for the applicable lamp color, when tested according to the procedure of S14.2.1.

S7.5.14 *Physical tests.* Each clearance and identification must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.6 *Backup lamps.*

S7.6.1 *Number.* See Table I–a and S6.1.1.

S7.6.2 *Color of light.*

S7.6.2.1 See Table I–a.

S7.6.2.2 A backup lamp may project incidental red, yellow, or white light through reflectors or lenses that are adjacent, close to, or a part of the lamp assembly.

S7.6.3 *Mounting location.* See Table I–a.

S7.6.4 *Mounting height.* No requirement.

S7.6.5 *Activation.* See Table I–a.

S7.6.6 *Effective projected luminous lens area.* No requirement.

S7.6.7 *Visibility.* See Table V–a.

S7.6.8 *Indicator.* No requirement.

S7.6.9 *Markings.* See. S6.5.1.2.

S7.6.10 *Spacing to other lamps.* No requirement.

S7.6.11 *Multiple compartments and multiple lamps.* No requirement.

S7.6.12 *Ratio.* No requirement.

S7.6.13 *Photometry.* Each backup lamp must be designed to conform to the photometry requirements of Table XII, when tested according to the procedure of S14.2.1, as specified by this section.

S7.6.14 *Physical tests.* Each backup lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.7 *License plate lamps.*

S7.7.1 *Number.* See Tables I–a, I–b, and I–c and S6.1.1.

S7.7.2 *Color of light.* See Tables I–a, I–b, and I–c.

S7.7.3 *Mounting location.* See Tables I–a, I–b, and I–c.

S7.7.4 *Mounting height.* No requirement.

S7.7.5 *Activation.* See Tables I–a, I–b, and I–c.

S7.7.6 *Effective projected luminous lens area.* No requirement.

S7.7.7 *Visibility.* No requirement.

S7.7.8 *Indicator.* No requirement.

S7.7.9 *Markings.* See. S6.5.1.2.

S7.7.10 *Spacing to other lamps.* No requirement.

S7.7.11 *Multiple compartments and multiple lamps.* No requirement.

S7.7.12 *Ratio.* No requirement.

S7.7.13 *Photometry.*

S7.7.13.1 Each license plate lamp must be designed to conform to the photometry requirements of this section when tested according to the procedure of S14.2.2.

S7.7.13.2 An illumination value of no less than 8 lx [0.75 fc] must be met at each test station target location shown in Figure 19.

S7.7.13.3 The ratio of the average of the two highest illumination values divided by the average of the two lowest illumination values must not exceed 20:1 for vehicles other than motorcycles and motor driven cycles.

S7.7.13.4 The ratio of the highest illumination value divided by the average of the two lowest illumination values must not exceed 15:1 for motorcycles and motor driven cycles.

S7.7.14 *Physical tests.* Each license plate lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.7.15 *Installation.*

S7.7.15.1 Each license plate lamp installed on a vehicle other than a motorcycle or motor driven cycle must be of such size and design as to provide illumination on all parts of a 150 mm by 300 mm test plate.

S7.7.15.2 Each license plate lamp installed on a motorcycle or motor driven cycle must be of such size and design as to provide illumination on all parts of a 100 mm by 175 mm test plate.

S7.7.15.3 The light rays must reach all portions of an imaginary plate of the same size at least 25 mm ahead of the actual plate measured perpendicular to the plane of the plate.

S7.7.15.4 *Incident light from single lamp.* When a single lamp as shown in Figure 20 is used to illuminate the license plate, the lamp and license plate holder must bear such relation to each other that at no point on the plate must the incident light make an angle

of less than 8° to the plane of the plate, this angle being measured from the edge of the light emitting surface of the lamp farthest from the surface of the plate.

S7.7.15.5 *Incident light from multiple lamps.* When two or more lamps as shown in Figure 20 are used to illuminate the license plate, the minimum 8° incident light angle must apply only to that portion of the plate which the particular lamp is designed to illuminate. The angle must be measured in the same manner as S7.7.15.4.

S7.8 *Parking lamps.*

S7.8.1 *Number.* See Table I–a.

S7.8.2 *Color of light.* See Table I–a.

S7.8.3 *Mounting location.* See Table I–a.

S7.8.4 *Mounting height.* See Table I–a.

S7.8.5 *Activation.* See Table I–a.

S7.8.6 *Effective projected luminous lens area.* No requirement.

S7.8.7 *Visibility.* See S6.4.

S7.8.8 *Indicator.* No requirement.

S7.8.9 *Markings.* See. S6.5.1.2.

S7.8.10 *Spacing to other lamps.* No requirement.

S7.8.11 *Multiple compartments and multiple lamps.* No requirement.

S7.8.12 *Ratio.* See S7.1.1.12 for front turn signal lamps.

S7.8.13 *Photometry.* Each parking lamp must be designed to conform to the photometry requirements of Table XIV, when tested according to the procedure of S14.2.1, as specified by this section.

S7.8.14 *Physical tests.* Each parking lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.9 *High-mounted stop lamps.*

S7.9.1 *Number.* See Table I–a and S6.1.1.2.

S7.9.2 *Color of light.* See Table I–a.

S7.9.3 *Mounting location.* See Table I–a.

S7.9.4 *Mounting height.* See Table I–a and S6.1.4.1.

S7.9.5 *Activation.* See Table I–a.

S7.9.6 *Effective projected luminous lens area.* See Table IV–b.

S7.9.7 *Visibility.* See Table V–a.

S7.9.8 *Indicator.* No requirement.

S7.9.9 *Markings.* See. S6.5.1.2.

S7.9.10 *Spacing to other lamps.* No requirement.

S7.9.11 *Multiple compartments and multiple lamps.* No requirement.

S7.9.12 *Ratio.* No requirement.

S7.9.13 *Photometry.* Each high-mounted stop lamp must be designed to conform to the photometry requirements of Table XV, when tested according to the procedure of S14.2.1, as specified by this section.

S7.9.14 *Physical tests.*

S7.9.14.1 Each high-mounted stop lamp must be designed to conform to the performance requirements of the vibration test of S14.5, and the color test and plastic optical material test of S14.4.

S7.9.14.2 Each high-mounted stop lamp that is not mounted inside the vehicle must be designed to conform to the performance requirements of the moisture test, dust test, and corrosion test of S14.5.

S7.10 *Daytime running lamps (DRLs).*

S7.10.1 *Number.* See Table I–a.

S7.10.2 *Color of light.* See Table I–a.

S7.10.3 *Mounting location.* See Table I–a.

S7.10.4 *Mounting height.* See Table I–a. and S7.10.13(b).

S7.10.5 *Activation.* See Table I–a. and S7.10.10.1(c).

S7.10.6 *Effective projected luminous lens area.* No requirement.

S7.10.7 *Visibility.* No requirement.

S7.10.8 *Indicator.* No requirement.

S7.10.9 *Markings.* See S6.5.

S7.10.10 *Spacing to other lamps.*

S7.10.10.1 *Spacing to turn signal lamps.* Each DRL not optically combined with a turn signal lamp must be located on the vehicle so that the distance from its lighted edge to the optical center of the nearest turn signal lamp is not less than 100 mm unless,

(a) The luminous intensity of the DRL is not more than 2,600 cd at any location in the beam and the turn signal lamp meets 2.5 times the base front turn signal photometric requirements, or

(b) The DRL is optically combined with a lower beam headlamp and the turn signal lamp meets 2.5 times the base front turn signal photometric requirements, or

(c) The DRL is deactivated when the turn signal or hazard warning signal lamp is activated.

S7.10.11 *Multiple compartments and multiple lamps.* No requirement.

S7.10.12 *Ratio.* No requirement.

S7.10.13 *Photometry.* Each DRL must have a luminous intensity not less than 500 cd at test point H–V, nor more than 3,000 cd at any location in the beam when tested according to the procedure of S14.2.4 as specified by this section, unless it is:

(a) A lower beam headlamp intended to operate as a DRL at full voltage, or a voltage lower than used to operate it as a lower beam headlamp, or

(b) An upper beam headlamp intended to operate as a DRL, whose luminous intensity at test point H–V is not more than 7,000 cd, and whose mounting height is not higher than 864 mm.

S7.10.14 *Physical tests.* Each DRL that is not combined with another required lamp must be designed to conform to the performance requirements of the color test and plastic optical material test of S14.4.

S7.11 *School bus signal lamps.*

S7.11.1 *Number.* See Table I–a.

S7.11.2 *Color of light.* See Table I–a.

S7.11.3 *Mounting location.* See Table I–a.

S7.11.4 *Mounting height.* See Table I–a.

S7.11.5 *Activation.* See Table I–a.

S7.11.6 *Effective projected luminous lens area.* See Table IV–c.

S7.11.7 *Visibility.* See Table V–a.

S7.11.8 *Indicator.* No requirement.

S7.11.9 *Markings.* See. S6.5.1.2.

S7.11.10 *Spacing to other lamps.* No requirement.

S7.11.11 *Multiple compartments and multiple lamps.* No requirement.

S7.11.12 *Ratio.* No requirement.

S7.11.13 *Photometry.* Each school bus signal lamp must be designed to conform to the photometry requirements of Table XVII, when tested according to the procedure of S14.2.1, for the lamp color as specified by this section.

S7.11.14 *Physical tests.* Each school bus signal lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S8 *Reflective device requirements.*

S8.1 *Reflex reflectors.*

S8.1.1 *Number.* See Tables I–a, I–b, and I–c.

S8.1.2 *Color.* See Tables I–a, I–b, and I–c.

S8.1.3 *Mounting location.* See Tables I–a, I–b, and I–c.

S8.1.4 *Mounting height.* See Tables I–a, I–b, and I–c.

S8.1.5 *Activation.* No requirement.

S8.1.6 *Effective projected luminous lens area.* No requirement.

S8.1.7 *Visibility.* No requirement.

S8.1.8 *Indicator.* No requirement.

S8.1.9 *Markings.* See. S6.5.1.2.

S8.1.10 *Spacing to other lamps or reflective devices.* No requirement.

S8.1.11 *Photometry.* Each reflex reflector must be designed to conform to the photometry requirements of Table XVI–a when tested according to the procedure of S14.2.3 for the reflex reflector color as specified by this section.

S8.1.12 *Physical tests.* Each reflex reflector must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S8.1.1P3 *Alternative side reflex reflector material.* Reflective material conforming to GSA Federal Specification L–S–300 (incorporated by reference, see §571.5), may be used for side reflex reflectors if this material as used on the vehicle, meets the performance requirements of Table XVI–a.

S8.2 *Conspicuity systems.* The requirement for conspicuity systems may be met with retroreflective sheeting, conspicuity reflex reflectors, or a combination of retroreflective sheeting and conspicuity reflex reflectors.

S8.2.1 *Retroreflective sheeting.*

S8.2.1.1 Retroreflective sheeting must consist of a smooth, flat, transparent exterior film with retroreflective elements embedded or suspended beneath the film so as to form a non-exposed retroreflective optical system.

S8.2.1.2 *Retroreflective sheeting material.* Retroreflective sheeting must meet the requirements, except photometry, of ASTM D 4956–90 (incorporated by reference, see §571.5) for Type V

Sheeting. Sheeting of Grade DOT–C2 of no less than 50 mm wide, Grade DOT–C3 of no less than 75 mm wide, or Grade DOT–C4 of no less than 100 mm wide may be used.

S8.2.1.3 *Certification marking.* The letters DOT–C2, DOT–C3, or DOT–C4, as appropriate, constituting a certification that the retroreflective sheeting conforms to the requirements of this standard, must appear at least once on the exposed surface of each white or red segment of retroreflective sheeting, and at least once every 300 mm on retroreflective sheeting that is white only. The characters must be not less than 3 mm high, and must be permanently stamped, etched, molded, or printed in indelible ink.

S8.2.1.4 *Application pattern.*

S8.2.1.4.1 *Alternating red and white materials.*

S8.2.1.4.1.1 As shown in Figures 12–1 and 12–2, where alternating material is installed, except for a segment that is trimmed to clear obstructions, or lengthened to provide red sheeting near red lamps, alternating material must be installed with each white and red segment having a length of 300 ±150 mm.

S8.2.1.4.1.2 Neither white nor red sheeting must represent more than two thirds the aggregate of any continuous strip marking the width of a trailer, or any continuous or broken strip marking its length.

S8.2.1.5 *Application location.* Conspicuity systems need not be installed, as illustrated in Figure 12–2, on discontinuous surfaces such as outside ribs, stake post pickets on platform trailers, and external protruding beams, or to items of equipment such as door hinges and lamp bodies on trailers and body joints, stiffening beads, drip rails, and rolled surfaces on truck tractors.

S8.2.1.6 *Application spacing.* As illustrated in Figure 12–2, the edge of any white sheeting must not be located closer than 75 mm to the edge of the luminous lens area of any red or amber lamp that is required by this standard. The edge of any red sheeting must not be located closer than 75 mm to the edge of the luminous lens area of any amber lamp that is required by this standard.

S8.2.1.7 *Photometry.* Each retroreflective sheeting must be designed to conform to the photometry requirements of Table XVI–c when tested according to the procedure of S14.2.3 for the color and grade as specified by this section.

S8.2.2 *Conspicuity reflex reflectors.*

S8.2.2.1 *Certification marking.* The exposed surface of each conspicuity reflex reflector must be marked with the letters DOT–C which constitutes a certification that the reflector conforms to the conspicuity reflex reflector requirements of this standard. The certification must be not less than 3 mm high, and must be permanently stamped, etched, molded, or printed in indelible ink.

S8.2.2.2 *Application pattern.*

S8.2.2.2.1 *Alternating red and white materials.* Conspicuity reflex reflectors must be installed in a repetitive pattern of two or three white reflectors alternating with two or three red reflectors, with the center of each reflector not more than 100 mm from the center of each adjacent reflector.

S8.2.2.2.2 *White material.* White conspicuity reflex reflectors must be installed with the center of each reflector not more than 100 mm from the center of each adjacent reflector.

S8.2.2.3 *Photometry.*

S8.2.2.3.1 Each red conspicuity reflex reflector must be designed to conform to the photometry requirements of Table XVI–a for a red reflex reflector and Table XVI–b for a red conspicuity reflex reflector when tested according to the procedure of S14.2.3 as specified by this section.

S8.2.2.3.2 Each white conspicuity reflex reflector installed in only a horizontal orientation must be designed to conform to the photometry requirements of Table XVI–a for a white reflex reflector and Table XVI–b for a white horizontal conspicuity reflex reflector when tested according to the procedure of S14.2.3 as specified by this section.

S8.2.2.3.3 Each white conspicuity reflex reflector installed in a vertical orientation must be designed to conform to the photometry requirements of Table XVI–a for a white reflex reflector, and Table XVI–b for a white horizontal conspicuity reflex reflector and

a white vertical conspicuity reflex reflector when tested according to the procedure of S14.2.3 as specified by this section.

S8.2.3 *Conspicuity system installation on trailers.*

S8.2.3.1 *Trailer rear.*

S8.2.3.1.1 *Element 1—alternating red and white materials.* As shown in Figure 11, a strip of sheeting or conspicuity reflex reflectors, as horizontal as practicable, must be applied across the full width of the trailer, as close to the extreme edges as practicable, and as close as practicable to not less than 375 mm and not more than 1525 mm above the road surface at the strip centerline with the trailer at curb weight.

S8.2.3.1.2 *Element 2—white.* (not required for container chassis or for platform trailers without bulkheads).

S8.2.3.1.2.1 As shown in Figure 11, two pairs of strips of sheeting or conspicuity reflex reflectors, each pair consisting of strips 300 mm long of Grade DOT–C2, DOT–C3, or DOT–C4, must be applied horizontally and vertically to the right and left upper contours of the body, as viewed from the rear, as close to the top of the trailer and as far apart as practicable.

S8.2.3.1.2.2 If the perimeter of the body, as viewed from the rear, is other than rectangular, the strips may be applied along the perimeter, as close as practicable to the uppermost and outermost areas of the rear of the body on the left and right sides.

S8.2.3.1.3 *Element 3—alternating red and white materials.* (not required for trailers without underride protection devices).

S8.2.3.1.3.1 As shown in Figure 11, a strip of Grade DOT–C2 sheeting no less than 38 mm wide or reflectors must be applied across the full width of the horizontal member of the rear underride protection device.

S8.2.3.2 *Trailer side—alternating red and white materials.*

S8.2.3.2.1 As shown in Figure 11, a strip of sheeting or conspicuity reflex reflectors must be applied to each side, as horizontal as practicable, originating and terminating as close to the front and rear as practicable, as close as practicable to not less than 375 mm and not more than 1525 mm above the road surface at the strip centerline at curb weight, except that at the location chosen the strip must not be obscured in whole or in part by other motor vehicle equipment or trailer cargo.

S8.2.3.2.2 The strip need not be continuous as long as not less than half the length of the trailer is covered and the spaces are distributed as evenly as practicable.

S8.2.3.2.3 If necessary to clear rivet heads or other similar obstructions, Grade DOT–C2 sheeting may be separated into two 25 mm wide strips of the same length and color, separated by a space of not more than 25 mm and used in place of the retroreflective sheeting that would otherwise be applied.

S8.2.4 *Conspicuity system installation on truck tractors.*

S8.2.4.1 *Element 1—alternating red and white materials.* As shown in Figure 13, two strips of sheeting or conspicuity reflex reflectors, each not less than 600 mm long, located as close as practicable to the edges of the rear fenders, mudflaps, or the mudflap support brackets, must be applied to mark the width of the truck tractor.

S8.2.4.1.1 The strips must be mounted as horizontal as practicable, in a vertical plane facing the rear, on the rear fenders, on the mudflap support brackets, on plates attached to the mudflap support brackets, or on the mudflaps.

S8.2.4.1.2 Strips on mudflaps must be mounted not lower than 300 mm below the upper horizontal edge of the mudflap. If the vehicle is certified with temporary mudflap support brackets, the strips must be mounted on the mudflaps or on plates transferable to permanent mudflap support brackets.

S8.2.4.1.3 For a truck tractor without mudflaps, the strips may be mounted outboard of the frame on brackets behind the rear axle or on brackets ahead of the rear axle and above the top of the rear tires at unladen vehicle height, or they may be mounted directly or indirectly to the back of the cab as close to the outer edges as practicable, above the top of the tires, and not more than 1525 mm above the road surface at unladen vehicle height.

S8.2.4.1.4 If the strips are mounted on the back of the cab, no more than 25% of their cumulative area may be

obscured by vehicle equipment as determined in a rear orthogonal view.

S8.2.4.2 *Element 2—white.* As shown in Figure 13, two pairs of strips of sheeting or conspicuity reflex reflectors, each pair consisting of strips 300 mm long, must be applied horizontally and vertically as practicable to the right and left upper contours of the cab, as close to the top of the cab and as far apart as practicable.

S8.2.4.2.1 No more than 25% of their cumulative area may be obscured by vehicle equipment as determined in a rear orthogonal view.

S8.2.4.2.2 If one pair must be relocated to avoid obscuration by vehicle equipment, the other pair may be relocated in order to be mounted symmetrically.

S8.2.4.2.3 If the rear window is so large as to occupy all the practicable space, the material may be attached to the edge of the window itself.

S9 *Associated equipment requirements.*

S9.1 *Turn signal operating unit.*

S9.1.1 The turn signal operating unit installed on passenger cars, multipurpose passenger vehicles, trucks, and buses less than 2032 mm in overall width must be self-canceling by steering wheel rotation and capable of cancellation by a manually operated control.

S9.1.2 *Physical tests.* Each turn signal operating unit must be designed to conform to all applicable performance requirements of S14.9.

S9.2 *Turn signal flasher.*

S9.2.1 The means of producing the turn signal pilot indicator signal may be incorporated in the flasher. A means of producing an audible signal may be incorporated in the flasher.

S9.2.2 *Physical tests.* Each turn signal flasher must be designed to conform to all applicable performance requirements of S14.9.

S9.3 *Turn signal pilot indicator.*

S9.3.1 Each vehicle equipped with a turn signal operating unit where any turn signal lamp is not visible to the driver must also have an illuminated pilot indicator to provide a clear and unmistakable indication that the turn signal system is activated.

S9.3.2 The indicator must consist of one or more lights flashing at the same frequency as the turn signal lamps.

S9.3.3 The indicator must function satisfactorily under all test conditions imposed on the turn signal flasher in S14.9.

S9.3.4 *Indicator size and color.*

S9.3.4.1 If the indicator is located inside the vehicle it must emit a green colored light and have a minimum area equivalent to a 3/16 in diameter circle.

S9.3.4.2 If the indicator is located outside of the vehicle it must emit a yellow light and have a minimum projected illuminated area of 0.1 sq in.

S9.3.5 The minimum required illuminated area of the indicator must be visible to any tangent on the 95th eyellipse as defined in SAE Recommended Practice J941b (1969) (incorporated by reference, see § 571.5), with the steering wheel turned to a straight ahead driving position and in the design location for an adjustable wheel or column.

S9.3.6 *Turn signal lamp failure.* Failure of one or more turn signal lamps such that the minimum photometric performance specified in Tables VI or VII is not being met must be indicated by the turn signal pilot indicator by a ''steady on'', ''steady off'', or by a significant change in the flashing rate, except when a variable-load turn signal flasher is used on a multipurpose passenger vehicle, truck, or bus 2032 mm or more in overall width, on a truck that is capable of accommodating a slide in camper, or on any vehicle equipped to tow trailers.

S9.4 *Headlamp beam switching device.* Each vehicle must have a means of switching between lower and upper beams designed and located so that it may be operated conveniently by a simple movement of the driver's hand or foot. The switch must have no dead point and, except as provided by S6.1.5.2, the lower and upper beams must not be energized simultaneously except momentarily for temporary signaling purposes or during switching between beams.

S9.4.1 *Semiautomatic headlamp beam switching devices.* As an alternative to S9.4, a vehicle may also be equipped with a semiautomatic means of switching beams that complies with 9.4.1.1 though S9.4.1.4 and either 9.4.1.5 (Option 1) or 9.4.1.6 (Option 2).

S9.4.1.1 *Operating instructions.* Each semiautomatic headlamp switching device must include operating instructions to permit a driver to operate the device correctly, including: How to turn the automatic control on and off; how to adjust the sensitivity control (for Option 1 and if provided for Option 2); and any other specific instructions applicable to the device.

S9.4.1.2 *Manual override.* The device must include a means convenient to the driver for switching the beam from the one provided.

S9.4.1.3 *Fail safe operation.* A failure of the automatic control portion of the device must not result in the loss of manual operation and control of the upper and lower beams.

S9.4.1.4 *Automatic dimming indicator.* There must be a convenient means of informing the driver when the device is controlling the headlamps automatically. For headlighting systems certified to Option 1, the device shall not affect the function of the upper beam indicator light.

S9.4.1.5—*Option 1 (Semiautomatic headlamp beam switching devices other than Adaptive Driving Beam systems).*

S9.4.1.5.1 *Lens accessibility.* The device lens must be accessible for cleaning while the device is installed on a vehicle.

S9.4.1.5.2 *Mounting height.* The center of the device lens must be mounted no less than 24 inches above the road surface.

S9.4.1.5.3 *Physical tests.* Each semiautomatic headlamp beam switching device must be designed to conform to all applicable performance requirements of S14.9.3.11.

S9.4.1.6—*Option 2 (Adaptive Driving Beam systems).*

S9.4.1.6.1 The system must be capable of detecting system malfunctions (including but not limited to sensor obstruction).

S9.4.1.6.2 If the system detects a malfunction that prevents the system from operating in automatic mode safely and in conformance with these requirements, the headlighting system must operate in manual mode until the malfunction is corrected and must provide the driver with a visible warning that the malfunction exists.

S9.4.1.6.3 When operating in manual mode, the system must provide only switching between lower and upper beams as provided in S9.4.

S9.4.1.6.4 When operating in automatic mode, the system must only switch between lower, upper, and adaptive driving beams. The adaptive driving beams must be designed to conform to the requirements of this section.

S9.4.1.6.4.1 The adaptive driving beams must consist only of area(s) of reduced intensity, area(s) of unreduced intensity, and transition zone(s).

S9.4.1.6.4.2 The adaptive driving beams must be designed to conform to the photometry requirements of Table XXI when tested according to S14.9.3.12, and, for replaceable bulb headlighting systems, when using any replaceable light source designated for use in the system.

S9.4.1.6.4.3 In an area of reduced intensity, the adaptive driving beams must be designed to conform to the photometric intensity requirements of Table XIX as specified in Table II for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5, and, for replaceable bulb headlighting systems, when using any replaceable light source designated for use in the system.

S9.4.1.6.4.4 In an area of unreduced intensity, the adaptive driving beams must be designed to conform to the photometric intensity requirements of Table XVIII as specified in Table II for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5, and, for replaceable bulb headlighting systems, when using any replaceable light source designated for use in the system.

S9.4.1.6.4.5 A transition zone not to exceed 1.0 degree in either the horizontal or vertical direction is permitted between an area of reduced intensity and an area of unreduced intensity. The Table XVIII and Table XIX photometric intensity requirements do not apply in a transition zone, except that the maximum at H–V in Table XVIII as specified in Table II for the specific headlamp unit and aiming method may not be exceeded at any point in a transition zone.

S9.4.1.6.4.6 For vehicle speeds below 32 kph (20 mph), the system must provide only lower beams (unless manually overridden according to S9.4.1.2).

S9.4.1.6.4.7 The adaptive driving beams must not be energized simultaneously with the lower or upper beams except as provided in Table II.

S9.4.1.6.5 The adaptive driving beams may be provided by any combination of headlamps or light sources, provided parking lamps are installed. If parking lamps meeting the requirements of this standard are not required according to Table I and are not installed, the adaptive driving beams may be provided using any combination of headlamps but must include the outermost installed headlamps to show the overall width of the vehicle.

S9.5 *Upper beam headlamp indicator.* Each vehicle must have a means for indicating to the driver when the upper beams of the headlighting system are activated. The upper beam headlamp indicator is not required to be activated when an Adaptive Driving Beam system is operating in automatic mode.

S9.5.1 *Indicator size and location.* The upper beam headlamp indicator must have a minimum area equivalent to that of a 3/16 in diameter circle, and be plainly visible to drivers of all heights under normal driving conditions when headlamps are required.

S9.6 *Vehicular hazard warning signal operating unit.*

S9.6.1 The unit may be an independent device or it may be combined with the turn signal operating unit. If combined with the turn signal operating unit, the actuating motion of the hazard function must differ from the actuating motion of the turn signal function.

S9.6.2 *Operating unit switch.* The unit must operate independently of the ignition or equivalent switch. If the actuation of the hazard function requires the operation of more than one switch, a means must be provided for actuating all switches simultaneously by a single driver action.

S9.6.3 *Physical tests.* Each vehicular hazard warning signal operating unit must be designed to conform to all applicable performance requirements of S14.9.

S9.7 *Vehicular hazard warning signal flasher.*

S9.7.1 The means of producing the hazard warning signal pilot indicator signal may be incorporated in the flasher. A means of producing an audible signal may be incorporated in the flasher.

S9.7.2 *Physical tests.* Each vehicular hazard warning signal flasher must be designed to conform to all applicable performance requirements of S14.9.

S9.8 *Vehicular hazard warning signal pilot indicator.*

S9.8.1 In vehicles equipped with right hand and left hand turn signal pilot indicators, both pilot indicators and /or a separate pilot indicator must flash simultaneously while the vehicle hazard warning signal operating unit is turned on.

S9.8.2 In vehicles equipped with a single turn signal pilot indicator, a separate vehicular hazard warning signal pilot indicator must flash and the turn signal pilot indicator may flash while the vehicle hazard warning signal operating unit is turned on.

S9.8.3 The indicator must function satisfactorily under all test conditions imposed on the vehicular hazard warning signal flasher in S14.9.

S9.8.4 *Indicator size and color.* If the vehicular hazard warning signal pilot indicator is not combined with the turn signal pilot indicator, it must emit a red color and have a minimum area equivalent to a 0.5 in diameter circle.

S10 *Headlighting system requirements.*

S10.1 *Vehicle headlighting systems.*

S10.1.1 Each passenger car, multipurpose passenger vehicle, truck and bus must be equipped with a headlighting system conforming to the requirements of Table II and this standard.

S10.1.2 Each motorcycle must be equipped with a headlighting system conforming to S10.17 of this standard.

S10.2 [Reserved]

S10.3 *Number. See Tables I–a and I–c.*

S10.4 *Color of light.* See Tables I–a and I–c.

S10.5 *Mounting location.* See Tables I–a and I–c and S6.1.3.5.

S10.6 *Mounting height.* See Tables I–a and I–c.

S10.7 *Activation*. See Tables I–a and I–c, Table II, and S6.1.5.

S10.8 *Effective projected luminous lens area*. No requirement.

S10.9 *Visibility*. No requirement.

S10.10 *Indicator*. See S9.5.

S10.11 *Markings*. See S6.5.

S10.12 *Spacing to other lamps*. See S6.1.3.5.

S10.13 *Sealed beam headlighting systems*. All sealed beam headlighting systems must be of a type designated in Table II-a. Each sealed beam headlamp must be designed to conform to the specifications furnished with respect to it pursuant to appendix C of part 564 of this chapter and Table II-a of this standard. The dimensions applicable to the design of a specific type are those identified with an ''I'' for interchangeability specified on the applicable drawing(s) filed in Docket No. NHTSA 98–3397.

S10.13.1 *Installation*. A sealed beam headlighting system must consist of the correct number of designated headlamp units as specified for the applicable system in Table II-a. The units must have their beams activated as specified in Table II-a. A system must provide in total not more than two upper beams and two lower beams.

S10.13.2 *Simultaneous aim*. Type F sealed beam headlamps may be mounted on common or parallel seating and aiming planes to permit simultaneous aiming of both headlamps provided that there is no provision for adjustment between the common or parallel aiming and seating planes of the two lamps. When tested with any conforming Type UF and LF headlamps in accordance with S14.2.5, the assembly (consisting of the Type UF and LF headlamps, mounting rings, the aiming/seating rings, and aim adjustment mechanism) must be designed to conform to the applicable photometric requirements.

S10.13.3 *Photometry*. Each sealed beam headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-a for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5.

S10.13.4 *Physical tests*.

S10.13.4.1 Each sealed beam headlamp must be designed to conform to the performance requirements of the corrosion test, vibration test, inward force test (for lamps which are externally aimed only), torque deflection test (for lamps which are externally aimed only), headlamp connector test, headlamp wattage test, and aiming adjustment tests of S14.6.

S10.13.4.2 Each sealed beam headlamp except a Type G or Type H must be designed to conform to the performance requirements of the retaining ring test of S14.6.

S10.13.4.3 Each sealed beam headlamp must be designed to conform to the performance requirements of the color test of S14.4. Each sealed beam headlamp that does not incorporate a glass lens must be designed to conform to the plastic optical materials test of S14.4.

S10.14 *Integral beam headlighting systems*. All integral beam headlighting systems must be of a type designated in Table II-c.

S10.14.1 Installation. An integral beam headlighting system must consist of the correct number of designated headlamp units as specified for the applicable system in Table II–c. The units must have their upper and lower beams activated as specified in Table II–c, and their adaptive driving beams (if so equipped) activated as specified in S9.4.1.6.5. A system must provide in total not more than two upper beams, two lower beams, and, optionally, two adaptive driving beams.

S10.14.2 *Aimability*.

S10.14.2.1 A system that incorporates any headlamp or beam contributor that does not have a VHAD as an integral and indivisible part of the headlamp or beam contributor must be designed so that the applicable photometric requirements are met when any correctly aimed and photometrically conforming headlamp or beam contributor is removed from its mounting and aiming mechanism, and is replaced without reaim by any conforming headlamp or beam contributor of the same type.

S10.14.2.2 A system that incorporates more than one beam contributor providing a lower beam, and/or

more than one beam contributor providing an upper beam, shall be designed to conform to the on-vehicle aiming requirements specified in S10.18.8.

S10.14.3 *Simultaneous aim.* An integral beam headlighting system consisting of four individual headlamps or beam contributors may have the headlamp units mounted in an assembly to permit simultaneous aiming of the beam(s) contributors, providing that with any complying contributor the assembly complete with all lamps meets the applicable photometric requirements when tested in accordance with S14.2.5.

S10.14.4 *Markings.* An integral beam headlamp with a single light source providing the lower beam must have its lens permanently marked with ''L''. An integral beam headlamp with a single light source providing the upper beam must have its lens permanently marked with ''U''.

S10.14.5 *Additional light sources.* An integral beam headlamp may incorporate light sources that are used for purposes other than headlighting and are capable of being replaced.

S10.14.6 *Photometry.* Each integral beam headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-c for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5.

S10.14.7 *Physical tests.*

S10.14.7.1 Each integral beam headlamp must be designed to conform to the performance requirements of the corrosion test, temperature cycle test, vibration test, inward force test (for lamps which are externally aimed only), headlamp connector test, and aiming adjustment tests of S14.6.

S10.14.7.2 Each integral beam headlamp that is not designed to conform to the performance requirements of the sealing test of S14.6 must be designed to conform to the performance requirements of the connector-corrosion test, dust test, and humidity test of S14.6.

S10.14.7.3 Each integral beam headlamp except those with a glass lens must be designed to conform to the performance requirements of the abrasion test of S14.6.

S10.14.7.4 Each integral beam headlamp except those with a non-replaceable glass lens must be designed to conform to the performance requirements of the chemical resistance test of S14.6.

S10.14.7.5 Each integral beam headlamp except those with a glass lens and a non-plastic reflector must be designed to conform to the performance requirements of the internal heat test of S14.6.

S10.14.7.6 Each integral beam headlamp incorporating a replaceable lens must be designed to conform to the performance requirements of the chemical resistance of reflectors of replaceable lens headlamps test and the corrosion resistance of reflectors of replaceable lens headlamps test of S14.6.

S10.14.7.7 Each integral beam headlamp capable of being mechanically aimed by externally applied headlamp aiming devices specified in SAE Recommended Practice J602–1980 (incorporated by reference, see § 571.5), must be designed to conform to the performance requirements of the torque deflection test of S14.6.

S10.14.7.8 Each integral beam headlamp must be designed to conform to the performance requirements of the color test of S14.4. Each integral beam headlamp that does not incorporate a glass lens must be designed to conform to the performance requirements of the plastic optical materials test of S14.4.

S10.15 *Replaceable bulb headlighting systems.* All replaceable bulb headlighting systems must be of a type designated in Table II-d.

S10.15.1 *Installation.* A replaceable bulb headlighting system must consist of either two or four headlamps as specified for the applicable system in Table II–d. The headlamps must have their upper and lower beams activated as specified in Table II–d, and their adaptive driving beams (if so equipped) activated as specified in S9.4.1.6.5. A system must provide in total not more than two upper beams, two lower beams, and, optionally, two adaptive driving beams, and must incorporate not more than two replaceable light sources in each headlamp.

S10.15.2 *Aiming restrictions.* Each replaceable bulb headlamp designed to conform to the external aiming requirements of S10.18.7 must have no mechanism that allows adjustment of an individual light source, or if there are two light sources, independent adjustments of each reflector.

S10.15.3 *Replacement lens reflector units.* Each lens reflector unit manufactured as replacement equipment must be designed to conform to applicable photometry requirements when any replaceable light source designated for such a unit is inserted in it.

S10.15.4 *Markings.*

S10.15.4.1 A replaceable bulb headlamp in a four headlamp system providing lower beam must have its lens permanently marked with ''L''. A replaceable bulb headlamp in a four headlamp system providing upper beam must have its lens permanently marked with ''U''.

S10.15.4.1.1 No such markings are required if the light sources in the headlamp are any combination of dual filament light sources other than HB2.

S10.15.5 *Additional light sources.* A replaceable bulb headlamp may incorporate replaceable light sources that are used for purposes other than headlighting.

S10.15.6 *Photometry.* Each replaceable bulb headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-d for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5 using any replaceable light source designated for use in the system under test.

S10.15.7 *Physical tests.*

S10.15.7.1 Each replaceable bulb headlamp must be designed to conform to the performance requirements of the corrosion test, corrosion-connector test, dust test, temperature cycle test, humidity test, vibration test, inward force test (for lamps which are externally aimed only), headlamp connector test, and aiming adjustment tests of S14.6.

S10.15.7.2 Each replaceable bulb headlamp except those with a glass lens must be designed to conform to the performance requirements of the abrasion test of S14.6.

S10.15.7.3 Each replaceable bulb headlamp except those with a non-replaceable glass lens must be designed to conform to the performance requirements of the chemical resistance test of S14.6.

S10.15.7.4 Each replaceable bulb headlamp except those with a glass lens and a non-plastic reflector must be designed to conform to the performance requirements of the internal heat test of S14.6.

S10.15.7.5 Each replaceable bulb headlamp incorporating a replaceable lens must be designed to conform to the performance requirements of the chemical resistance of reflectors of replaceable lens headlamps test and the corrosion resistance of reflectors of replaceable lens headlamps test of S14.6.

S10.15.7.6 Each replaceable bulb headlamp capable of being mechanically aimed by externally applied headlamp aiming devices specified in SAE Recommended Practice J602–1980 (incorporated by reference, see §571.5), must be designed to conform to the performance requirements of the torque deflection test of S14.6.

S10.15.7.7 Each replaceable bulb headlamp must be designed to conform to the performance requirements of the color test of S14.4. Each replaceable bulb headlamp that does not incorporate a glass lens must be designed to conform to the performance requirements of the plastic optical materials test of S14.4.

S10.16 *Combination headlighting systems.* All combination headlighting systems must be of a type designated in Table II–b.

S10.16.1 *Installation.* A combination headlighting system must consist of the correct number of designated headlamp units as specified for the applicable system in Table II–b. The units must have their upper and lower beams activated as specified in Table II–b, and their adaptive driving beams (if so equipped) activated as specified in S9.4.1.6.5. A system must provide in total not more than two upper beams, two lower beams, and, optionally, two adaptive driving beams. When installed on a motor vehicle, the headlamps (or parts thereof) that provide the lower

beam must be of the same type and provide a symmetrical effective projected luminous lens area when illuminated.

S10.16.2 *Photometry.* Each combination headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-b for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5.

S10.16.3 *Physical tests.*

S10.16.3.1 Any component headlamp of a combination headlighting system that is a Type F sealed beam headlamp must be designed to conform to the performance requirements of S10.13.4.

S10.16.3.2 Any component headlamp of a combination headlighting system that is an integral beam headlamp must be designed to conform to the performance requirements of S10.14.7.

S10.16.3.3 Any component headlamp of a combination headlighting system that is a replaceable bulb headlamp must be designed to conform to the performance requirements of S10.15.7.

S10.17 *Motorcycle headlighting systems.* A motorcycle headlighting system may consist of:

(a) One half of any headlighting system of Table II which provides both a full upper beam and full lower beam, and is designed to conform to the requirements for that headlamp type. Where more than one lamp must be used, the lamps shall be mounted vertically, with the lower beam as high as practicable, or

(b) A headlighting system designed to conform to the requirements of paragraphs S10.17.1 through S10.17.5.

S10.17.1 *Installation.* The headlighting system installed on a motorcycle must consist of one of the system types specified in this paragraph, and must be located on the front.

S10.17.1.1 *Single headlamp.*

S10.17.1.1.1 If the system consists of a single headlamp, it must be mounted on the vertical centerline of the motorcycle.

S10.17.1.1.2 If the headlamp contains more than one light source, each light source must be mounted on the vertical centerline with the upper beam no higher than the lower beam, or horizontally disposed about the vertical centerline and mounted at the same height.

S10.17.1.1.3 If the light sources are horizontally disposed about the vertical centerline, the distance between the closest edges of the effective projected luminous lens area in front of the light sources must not be greater than 200 mm.

S10.17.1.2 *Two headlamps with both beams.*

S10.17.1.2.1 If the system consists of two headlamps, each of which provides both an upper and lower beam, the headlamps must be mounted either at the same height and symmetrically disposed about the vertical centerline or mounted on the vertical centerline.

S10.17.1.2.2 If the headlamps are horizontally disposed about the vertical centerline, the distance between the closest edges of their effective projected luminous lens areas must not be greater than 200 mm.

S10.17.1.3 *Two headlamps, upper beam and lower beam.*

S10.17.1.3.1 If the system consists of two headlamps, one of which provides an upper beam and one of which provides the lower beam, the headlamps must be located on the vertical centerline with the upper beam no higher than the lower beam, or horizontally disposed about the vertical centerline and mounted at the same height.

S10.17.1.3.2 If the headlamps are horizontally disposed about the vertical centerline, the distance between the closest edges of their effective projected luminous lens areas must not be greater than 200 mm.

S10.17.2 *Motorcycle replaceable bulb headlamp marking.* Each replaceable bulb headlamp that is designed to conform to S10.17(b) and that is equipped with a light source other than a replaceable light source meeting the requirements of S11, must have the word ''motorcycle'' permanently marked on the lens in characters not less than 3 mm in height.

S10.17.3 *Photometry.* Each motorcycle headlamp that is not designed to conform to S10.17(a), must be designed to conform to the photometry requirements of Table XX when tested according to the procedure of S14.2.5.

S10.17.4 *Physical tests.* Each motorcycle headlamp that is not designed to

conform to S10.17(a) must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, the out of focus test of S14.3, the color test of S14.4, and each motorcycle headlamp that does not incorporate a glass lens must be designed to conform to the performance requirements of the plastic optical materials test of S14.4.

S10.17.5 *Motorcycle headlamp modulation system.* A headlamp on a motorcycle may be activated to modulate either the upper beam or the lower beam from its maximum intensity to a lesser intensity, provided that:

S10.17.5.1 *Modulation.*

(a) The rate of modulation must be 240 ±40 cycles per minute.

(b) The headlamp must be operated at maximum power for 50 to 70 percent of each cycle.

(c) The lowest intensity at any test point must be not less than 17 percent of the maximum intensity measured at the same point.

(d) The modulator switch must be wired in the power lead of the beam filament being modulated and not in the ground side of the circuit.

(e) Means must be provided so that both the lower beam and upper beam remain operable in the event of a modulator failure.

(f) The system must include a sensor mounted with the axis of its sensing element perpendicular to a horizontal plane. Headlamp modulation must cease whenever the level of light emitted by a tungsten filament light operating at 3000° Kelvin is either less than 270 lux of direct light for upward pointing sensors or less than 60 lux of reflected light for downward pointing sensors. The light is measured by a silicon cell type light meter that is located at the sensor and pointing in the same direction as the sensor. A Kodak Gray Card (Kodak R–27) is placed at ground level to simulate the road surface in testing downward pointing sensors.

(g) When tested in accordance with the test profile shown in Figure 9, the voltage drop across the modulator when the lamp is on at all test conditions for 12 volt systems and 6 volt systems must not be greater than 0.45 volt. The modulator must meet all the provisions of the standard after completion of the test profile shown in Figure 9.

(h) Means must be provided so that both the lower and upper beam function at design voltage when the headlamp control switch is in either the lower or upper beam position when the modulator is off.

S10.17.5.2 *Replacement modulators.* Each modulator not intended as original equipment, or its container, must be labeled with the maximum wattage, and the minimum wattage appropriate for its use.

S10.17.5.2.1 *Replacement performance.* Each modulator, not intended as original equipment, must comply with S10.17.5.1 (a) through (g) when connected to a headlamp of the maximum rated power and a headlamp of the minimum rated power, and must provide means so that the modulated beam functions at design voltage when the modulator is off.

S10.17.5.2.2 *Replacement instructions.* Instructions, with a diagram, must be provided for mounting the light sensor including location on the motorcycle, distance above the road surface, and orientation with respect to the light.

S10.18 *Headlamp aimability performance requirements* (*except for motorcycles*)

S10.18.1 *Headlamp mounting and aiming.* Except as provided in this paragraph, each headlamp must be installed on a motor vehicle with a mounting and aiming mechanism that permits aim inspection and adjustment of both vertical and horizontal aim, and is accessible for those purposes without removal of any vehicle parts, except for protective covers removable without the use of tools.

S10.18.1.1 The axis of the light beams must be adjustable to the left, right, up, or down from the designed setting, the amount of adjustability to be determined by practical operating conditions and the type of equipment.

S10.18.1.2 The adjustments must be conveniently made by one person with tools ordinarily available. When the headlamps are secured, the aim will not be disturbed under ordinary conditions of service.

S10.18.2 *Headlamp aiming systems.* When a headlamp system is installed on a motor vehicle, it must be aimable

with at least one of the following: An externally applied aiming device, as specified in S10.18.7; an on-vehicle headlamp aiming device installed by the vehicle or lamp manufacturer, as specified in S10.18.8; or by visual/optical means, as specified in S10.18.9.

S10.18.3 *Aim adjustment interaction.* When installed on the vehicle, adjustment of one aim axis through its full on-vehicle range must not cause the aim of the other axis to deviate more than ±0.76°. If the performance specified is not achievable, the requirements of S10.18.3.1 apply, except that if the aiming mechanism is not a VHAD, the requirements specific to VHADs are not applicable, and the instruction must be specific to the aiming mechanism installed.

S10.18.3.1 Should the mechanism not meet the requirements of S10.18.3, a cautionary label must be placed adjacent to the mechanism stating the caution and including either the reason for the caution or the corrective action necessary. Each such label must also refer the reader to the vehicle operator's manual for complete instructions. Each such vehicle must be equipped with an operator's manual containing the complete instructions appropriate for the mechanism installed.

S10.18.4 *Horizontal adjustment-visually aimed headlamp.* A visually/optically aimable headlamp that has a lower beam must not have a horizontal adjustment mechanism unless such mechanism meets the requirements of this standard for on vehicle aiming as specified in S10.18.8.

S10.18.5 *Optical axis marking.*

S10.18.5.1 *Optical axis marking-vehicle.* Each motor vehicle must be equipped with headlamps or beam contributors which have a mark or markings that are visible from the front of the headlamp when installed on the vehicle to identify the optical axis of the headlamp to assure proper horizontal and vertical alignment of the aiming screen or optical aiming equipment. The manufacturer is free to choose the design of the mark or markings. The mark or markings may be on the interior or exterior of the lens or indicated by a mark or central structure on the interior or exterior of the headlamp.

S10.18.5.2 *Optical axis marking-lamp.* Each headlamp or beam contributor that is not visually/optically aimable in accordance with S10.18.9 of this standard must be equipped with fiducial marks, aiming pads, or similar references of sufficient detail and accuracy, for determination of an appropriate vehicle plane to be used with the photometric procedures of S14.2.5 for correct alignment with the photometer axis when being tested for photometric compliance, and to serve for the aiming reference when the headlamp or beam contributor is installed on a motor vehicle. The fiducial marks, aiming pads, or similar references are protrusions, bubble vials, holes, indentations, ridges, scribed lines, or other readily identifiable marks established and described by the vehicle or headlamp manufacturer.

S10.18.5.3 *Optical axis marking-visual/optical aim headlamp.* There must be a mark or markings identifying the optical axis of the headlamp visible from the front of the headlamp when installed on the vehicle, to assure proper horizontal and vertical alignment of the aiming screen or optical aiming equipment with the headlamp being aimed. The manufacturer is free to choose the design of the mark or markings. The mark or markings may be on the interior or exterior of the lens or indicated by a mark or central structure on the interior or exterior of the headlamp.

S10.18.6 *Moveable reflectors.* Each headlamp aimed by moving the reflector relative to the lens and headlamp housing, or vice versa, must conform with the photometric requirements applicable to it when tested according to the procedure of S14.2.5 with the lens at any position relative to the reflector within the full range of vertical pitch on the vehicle on which the headlamp system is installed and a horizontal range of ±2.5°. Additionally it must comply with the aiming adjustment requirements of S14.6.

S10.18.7 *External aiming.* Each headlighting system that is capable of being mechanically aimed by externally applied headlamp aiming devices must be mechanically aimable using

the equipment specified in SAE Recommended Practice J602–1980 (incorporated by reference, see §571.5), without the removal of any ornamental trim rings, covers, wipers or other vehicle parts.

S10.18.7.1 *Headlamp aiming device locating plates.* Each headlighting system which is designed to use the Headlamp Aiming Device Locating Plates with adjustable legs for the 100 × 165 mm unit and the 142 × 200 mm unit, and which has adjustable length legs, must meet the following requirements:

S10.18.7.1.1 The lens must have three aiming pads which meet the requirements of Figure 4, *Dimensional Specifications for Location of Aiming Pads on Replaceable Bulb Headlamp Units.* The aiming pads need not be centered at the geometric center of the lens, or on the optical axis. Except as provided in S10.18.7.1.2, a whole number, which represents the distance in tenths of an inch (i.e. 0.3 inch = 3) from the aiming reference plane to the respective aiming pads which are not in contact with that plane, must be inscribed adjacent to each respective aiming pad on the lens. The height of these numbers must be not less than .157 inch (4 mm). If there is interference between the plane and the area of the lens between the aiming pads, the whole number represents the distance to a secondary plane. The secondary plane must be located parallel to the aiming reference plane and as close to the lens as possible without causing interference.

S10.18.7.1.2 If the most forward aiming pad is the lower inboard aiming pad, then the dimensions may be placed anywhere on the lens. The dimension for the outboard aiming pad (Dimension F in Figure 4) must be followed by the letter ''H'' and the dimension for the center aiming pad must be followed by the letter ''V.'' The dimensions must be expressed in tenths of an inch.

S10.18.7.2 *Nonadjustable headlamp aiming device locating plates.* Each headlamp may be designed to use the nonadjustable Headlamp Aiming Device Locating Plate for the 100 × 165 mm unit, the 142 × 200 mm unit, the 146 mm diameter unit, or the 178 mm diameter unit of SAE Recommended Practice J602–1980 (incorporated by reference, see §571.5), or the 92 × 150 mm Type F unit, and incorporate lens-mounted aiming pads as specified for those units pursuant to Appendix C of part 564 of this chapter. If so designed, no additional lens marking is necessary to designate the type of plate or dimensions.

S10.18.8 *On-vehicle aiming.* Each headlighting system that is capable of being aimed by equipment installed on the vehicle must include a Vehicle Headlamp Aiming Device (VHAD) that conforms to the following requirements:

S10.18.8.1 *Aim.* The VHAD must provide for headlamp aim inspection and adjustment in both the vertical and horizontal axes.

S10.18.8.1.1 *Vertical aim.* The VHAD must include the necessary references and scales relative to the horizontal plane to assure correct vertical aim for photometry and aiming purposes. An off vehicle measurement of the angle of the plane of the ground is permitted. In addition, an equal number of graduations from the ''0'' position representing angular changes in the axis in the upward and downward directions must be provided.

S10.18.8.1.1.1 Each graduation must represent a change in the vertical position of the mechanical axis not larger than 0.19° (1 in at 25 ft) to provide for variations in aim at least 1.2° above and below the horizontal, and have an accuracy relative to the zero mark of less than 0.1°.

S10.18.8.1.1.2 The VHAD must be marked to indicate headlamp aim movement in the upward and downward directions.

S10.18.8.1.1.3 Each graduation must indicate a linear movement of the scale indicator of not less than 0.05 in (1.27 mm) if a direct reading analog indicator is used. If a remote reading indicator is provided, it must represent the actual aim movement in a clear, understandable format.

S10.18.8.1.1.4 The vertical indicator must perform through a minimum range of ±1.2°.

S10.18.8.1.1.5 Means must be provided in the VHAD for compensating for deviations in floor slope less than

1.2° from the horizontal that would affect the correct positioning of the headlamp for vertical aim.

S10.18.8.1.1.6 The graduations must be legible under an illumination level not greater than 30 foot candles, measured at the top of the graduation, by an observer having 20/20 vision (Snellen), and must permit aim adjustment to within 0.19° (1 in at 25 ft).

S10.18.8.1.2 *Horizontal aim.* The VHAD must include references and scales relative to the longitudinal axis of the vehicle necessary to assure correct horizontal aim for photometry and aiming purposes. A ''0'' mark must be used to indicate alignment of the headlamps relative to the longitudinal axis of the vehicle. In addition, an equal number of graduations from the ''0'' position representing equal angular changes in the axis relative to the vehicle axis must be provided. If the horizontal VHAD is part of an adaptive driving beam system, S10.18.8.1.2.1 through S10.18.8.1.2.4 are not required.

S10.18.8.1.2.1 Each graduation must represent a change in the horizontal position of the mechanical axis not greater than 0.38° (2 in at 25 ft) to provide for variations in aim at least 0.76° (4 in at 25 ft) to the left and right of the longitudinal axis of the vehicle, and must have an accuracy relative to the zero mark of less than 0.1°.

S10.18.8.1.2.2 The VHAD must be marked to indicate headlamp aim movement in the left and right directions.

S10.18.8.1.2.3 The graduations must be legible under an illumination level not greater than 30 foot candles, measured at the top of the graduation, by an observer having 20/20 vision (Snellen), and must permit aim adjustment to within 0.38° (2 in at 25 ft).

S10.18.8.1.2.4 The horizontal indicator must perform through a minimum range of ±0.76° (4 in at 25 ft); however, the indicator itself must be capable of recalibration over a movement of ±2.5° relative to the longitudinal axis of the vehicle to accommodate any adjustment necessary for recalibrating the indicator after vehicle repair from accident damage.

S10.18.8.2 *Aiming instructions.*

S10.18.8.2.1 Instructions must be provided either on a label permanently affixed to the vehicle adjacent to the VHAD, or in the operator's manual, advising the vehicle owner what to do if the headlighting system requires aiming using the VHAD.

S10.18.8.2.2 Should a remote indicator or a remote indicator and adjuster be provided, the instructions must be placed in the operator's manual, and may also be placed on a label adjacent to the VHAD.

S10.18.8.3 *Permanent calibration.* Each headlamp equipped with a VHAD must be manufactured with its calibration permanently fixed by its manufacturer. Calibration in this case means the process of accurately aligning the geometry of the VHAD devices with the beam pattern for the purposes of compliance with the standard.

S10.18.8.4 *Replacement units.* When tested according to the procedure of S14.2.5 with any replacement headlamp unit(s) or light sources intended for use in the system under test, the VHAD and headlighting system must be designed to conform to the photometric performance requirements applicable for the system under test.

S10.18.8.5 *Physical tests.* Each VHAD must be designed to conform with the performance requirements of S14.8.

S10.18.9 *Visual/optical aiming.* Each visually/optically aimable headlamp must be designed to conform to the following requirements:

S10.18.9.1 *Vertical aim, lower beam.* Each lower beam headlamp must have a cutoff in the beam pattern. It may be either on the left side or the right side of the optical axis, but once chosen for a particular headlamp system's design, the side chosen for the cutoff must not be changed for any headlamps intended to be used as replacements for those system's headlamps.

S10.18.9.1.1 *Vertical position of the cutoff.* The headlamp must be aimed vertically so that the cutoff is on the left side, at 0.4° down from the H–H line, or on the right side, at the H–H line.

S10.18.9.1.2 *Vertical gradient.* The gradient of the cutoff measured at either 2.5° L or 2.0° R must be not less than 0.13 based on the procedure of S10.18.9.1.5.

S10.18.9.1.3 *Horizontal position of the cutoff.* The width must be not less than

2°, with not less than 2° of its actual width centered at either 2.5° L, or 2.0° R.

S10.18.9.1.4 *Maximum inclination of the cutoff.* The vertical location of the highest gradient at the ends of the minimum width must be within ±0.2° of the vertical location of the maximum gradient measured at the appropriate vertical line (at either 2.5° L for a left side cutoff, or 2.0° R for a right side cutoff).

S10.18.9.1.5 *Measuring the cutoff parameter.*

S10.18.9.1.5.1 The headlamp is mounted on a headlamp test fixture which simulates its actual design location on any vehicle for which the headlamp is intended. The fixture, with the headlamp installed, is attached to the goniometer table in such a way that the fixture alignment axes are coincident with the goniometer axes. The headlamp is energized at the specified test voltage. The cutoff parameter must be measured at a distance of 10 m from a photosensor with a 10 mm diameter.

S10.18.9.1.5.2 The headlamp beam pattern is aimed with the cutoff at the H–H axis. There is no adjustment, shimming, or modification of the horizontal axis of the headlamp or test fixture, unless the headlamp is equipped with a VHAD. In this case the VHAD is adjusted to zero.

S10.18.9.1.5.3 A vertical scan of the beam pattern is conducted for a headlamp with a left side gradient by aligning the goniometer on a vertical line at 2.5° L and scanning from 1.5° U to 1.5° D. For a headlamp with a right side gradient, a vertical scan of the beam pattern is conducted by aligning the goniometer on a vertical line at 2.0° R and scanning from 1.5° U to 1.5° D.

S10.18.9.1.5.4 Determine the maximum gradient within the range of the scan by using the formula: G = log E(a) − logE(a + 0.1), where ''G'' is the gradient, ''E'' is illumination and ''a'' is vertical angular position. The maximum value of the gradient ''G'' determines the vertical angular location of the cutoff. Perform vertical scans at 1.0° L and R of the measurement point of the maximum gradient to determine the inclination.

S10.18.9.2 *Horizontal aim, lower beam.* There is no adjustment of horizontal aim unless the headlamp is equipped with a horizontal VHAD. If the headlamp has a VHAD, it is set to zero.

S10.18.9.3 *Vertical aim, upper beam.*

S10.18.9.3.1 If the upper beam is combined in a headlamp with a lower beam, the vertical aim of the upper beam must not be changed from the aim set using the procedures of S10.18.9.1 and S10.18.9.2 used for the lower beam.

S10.18.9.3.2 If the upper beam is not combined in a headlamp with a lower beam, the vertical aim of the upper beam is adjusted so that the maximum beam intensity is located on the H–H axis.

S10.18.9.4 *Horizontal aim, upper beam.*

S10.18.9.4.1 If the upper beam is combined in a headlamp with a lower beam, the horizontal aim of the upper beam must not be changed from the aim set using the procedures of S10.18.9.1 and S10.18.9.2 used for the lower beam.

S10.18.9.4.2 If the upper beam is not combined in a headlamp with the lower beam and has fixed horizontal aim or has a horizontal VHAD, then the headlamp is mounted on a headlamp test fixture which simulates its actual design location on any vehicle for which the headlamp is intended. The fixture, with the headlamp installed, is attached to the goniometer table in such a way that the fixture alignment axes are coincident with the goniometer axes. The headlamp must be energized at 12.8 ±0.20 mV. There is no adjustment, shimming, or modification of the horizontal axis of the headlamp or test fixture, unless the headlamp is equipped with a VHAD. In this case the VHAD is adjusted to zero.

S10.18.9.4.3 If the upper beam is not combined in a headlamp with a lower beam, and it does not have a VHAD, the horizontal aim of the upper beam is adjusted so that the maximum beam intensity is located on the V–V axis.

S10.18.9.5 *Photometry.* When tested according to the procedure of S14.2.5, a visually/optically aimable headlamp must be designed to conform to the lower beam requirements of columns; LB1V or LB2V of Table XIX–a, or LB3V

of Table XIX–b, or LB4V of Table XIX–c.

S10.18.9.6 *Visual/optical aiming identification marking.* Each letter used in marking according to this paragraph must be not less than 3 mm high.

S10.18.9.6.1 The lens of a lower beam headlamp must be marked ''VOL'' if the headlamp is intended to be visually/optically aimed using the left side of the lower beam pattern. The lens of a lower beam headlamp must be marked ''VOR'' if the headlamp is intended to be visually/optically aimed using the right side of the lower beam pattern. The lens of a headlamp that is solely an upper beam headlamp and intended to be visually/optically aimed using the upper beam must be marked ''VO''.

S10.18.9.6.2 The lens of each sealed beam or integral beam headlamp must be marked ''VOR'' if the headlamp is of a type that was manufactured before May 1, 1997, and if such headlamp type has been redesigned since then to be visually/optically aimable.

S11 *Replaceable light source requirements.* Each replaceable light source must be designed to conform to the dimensions and electrical specifications furnished with respect to it pursuant to part 564 of this chapter, on file in Docket No. NHTSA 98–3397, and must conform to the following requirements:

S11.1 *Markings.* If other than an HB Type, the light source must be marked with the bulb marking designation specified for it in compliance with appendix A or appendix B of part 564 of this chapter. The base of each HB Type must be marked with its HB Type designation. Each replaceable light source must also be marked with the symbol DOT and with a name or trademark in accordance with S6.5.

S11.2 *Ballast markings.* If a ballast is required for operation, each ballast must bear the following permanent markings:

(a) Name or logo of ballast manufacturer;

(b) Ballast part number or unique identification;

(c) Part number or other unique identification of the light source for which the ballast is designed;

(d) Rated laboratory life of the light source/ballast combination, if the information for the light source has been filed in appendix B of part 564 of this chapter;

(e) A warning that ballast output voltage presents the potential for severe electrical shock that could lead to permanent injury or death;

(f) Ballast output power in watts and output voltage in rms volts AC or DC; and

(g) The symbol 'DOT'.

S11.3 *Gas discharge laboratory life.* For light sources that use excited gas mixtures as a filament or discharge arc, the ''rated laboratory life'' is determined in accordance with sections 4.3 and 4.9 of SAE Recommended Practice J2009 FEB93, Forward Discharge Lighting Systems (incorporated by reference, see 571.108 S5.2 of this title).

S11.4 *Physical tests.*

S11.4.1 Each replaceable light source must be designed to conform with the performance requirements of the deflection test and pressure test requirements of S14.7.

S11.4.2 Replaceable light sources must be designed to conform with the requirements of section VII of appendix A of part 564 of this chapter, or section IV of appendix B of part 564 of this chapter, for maximum power and luminous flux when test by the procedure of S14.7.3.

S12 *Headlamp concealment device requirements.*

S12.1 While the headlamp is illuminated, its fully opened headlamp concealment device must remain fully opened should any loss of power to or within the headlamp concealment device occur.

S12.2 Whenever any malfunction occurs in a component that controls or conducts power for the actuation of the concealment device, each closed headlamp concealment device must be capable of being fully opened by a means not requiring the use of any tools. Thereafter, the headlamp concealment device must remain fully opened until intentionally closed.

S12.3 Except for malfunctions covered by S12.2, each headlamp concealment device must be capable of being fully opened and the headlamps illuminated by actuation of a single switch, lever, or similar mechanism, including

a mechanism that is automatically actuated by a change in ambient light conditions.

S12.4 Each headlamp concealment device must be installed so that the headlamp may be mounted, aimed, and adjusted without removing any component of the device, other than components of the headlamp assembly.

S12.5 Except for cases of malfunction covered by S12.2, each headlamp concealment device must, within an ambient temperature range of −20 °F to + 120 °F, be capable of being fully opened in not more than 3 seconds after the actuation of a driver-operated control.

S12.6 As an alternative to complying with the requirements of S12.1 through S12.5, a vehicle with headlamps incorporating VHAD or visual/optical aiming in accordance with this standard may meet the requirements for *Concealable lamps* in paragraph 5.14 of UNECE Regulation 48 page 17 (incorporated by reference, see §571.5), in the English language version.

S12.7 *Certification election.* Manufacturers of vehicles with headlamps incorporating VHAD or visual/optical aiming must elect to certify to S12.1 through S12.5 or to S12.6 prior to, or at the time of certification of the vehicle, pursuant to 49 CFR Part 567. The selection is irrevocable.

S13 *Replaceable headlamp lens requirements.*

S13.1 A replacement lens for a replaceable bulb headlamp or integral beam headlamp that is not required to have a bonded lens must be provided with a replacement seal in a package that includes instructions for the removal and replacement of the lens, the cleaning of the reflector, and the sealing of the replacement lens to the reflector assembly.

S13.2 Each replacement headlamp lens with seal, when installed according to the lens manufacturer's instructions on an integral beam or replaceable bulb headlamp, must not cause the headlamp to fail to comply with any of the requirements of this standard.

S14 *Physical and photometry test procedures and performance requirements.*

S14.1 *General test procedures and performance requirements.*

S14.1.1 Each lamp, reflective device, item of conspicuity treatment, and item of associated equipment required or permitted by this standard must be designed to conform to all applicable physical test performance requirements specified for it.

S14.1.2 *Plastic optical materials.* All plastic materials used for optical parts such as lenses and reflectors on lamps or reflective devices required or allowed by this standard must conform to the material test requirements of S14.4.2.

S14.1.3 All coatings used on optical materials must have added to their formulations an optical brightener, whose presence is detectable by ultraviolet light, to aid in testing for their presence. Other equivalent industry accepted methods may be used as an alternative.

S14.1.4 *Samples.*

S14.1.4.1 Samples submitted for laboratory test must be new, unused, manufactured from production tooling and assembled by production processes, and representative of the devices as regularly manufactured and marketed.

S14.1.4.2 Each test sample must include not only the device but also accessory equipment necessary to operate in its intended manner. Where necessary a mounting bracket shall be provided so that the device may be rigidly bolted in its operating position on the various test equipment.

S14.1.4.3 Dust and photometric tests may be made on a second set of mounted samples, if desired, to expedite completion of the tests.

S14.1.5 *Laboratory facilities.* The laboratory must be equipped to test the sample in accordance with the requirements of the specific device.

S14.2 *Photometric test procedures.* Each lamp and reflective device required or permitted by this standard must be designed to conform to the applicable photometric requirements.

S14.2.1 *Photometry measurements for all lamps except license plate lamps, headlamps, and DRLs.*

S14.2.1.1 *Mounting.* Photometry measurements are made with the sample lamp mounted in its normal operating position.

S14.2.1.2 *School bus signal lamp aiming.* A school bus signal lamp must be

aimed with its aiming plane normal to the photometer axis and may be reaimed for photometry by ±½° vertically and ±1° horizontally.

S14.2.1.3 *Measurement distance.* Photometric measurements are made at a distance between the light source and the point of measurement of at least 1.2 m for side marker lamps, clearance lamps, identification lamps, and parking lamps, and at least 3 m for turn signal lamps, stop lamps, taillamps, backup lamps, and school bus signal lamps.

S14.2.1.4 *Location of test points.* Test point location must comply with the following nomenclature:

(a) The line formed by the intersection of a vertical plane through the light source of the lamp and normal to the test screen is designated ''V''.

(b) The line formed by the intersection of a horizontal plane through the light source and normal to the test screen is designated ''H''.

(c) The point of intersection of these two lines is designated ''H-V''.

(d) Other test points on the test screen are measured in terms of angles from the H and V lines.

(e) Angles to the right (R) and to the left (L) are regarded as being to the right and left of the V line when the observer stands behind the lamp and looks in the direction of its light beam when it is properly aimed for photometry. Similarly, the upward angles designated as U and the downward angles designated as D, refer to light directed at angles above and below the H line, respectively.

S14.2.1.5 *Multiple compartment and multiple lamp photometry of turn signal lamps, stop lamps, and taillamps.*

S14.2.1.5.1 When compartments of lamps or arrangements of multiple lamps are photometered together, the H–V axis intersects the midpoint between the optical axes.

S14.2.1.5.2 Luminous intensity measurements of multiple compartment lamps or multiple lamp arrangements are made either by:

(a) Measuring all compartments together, provided that a line from the optical axis of each compartment or lamp to the center of the photometer sensing device does not make an angle more than 0.6° with the H–V axis, or

(b) Measuring each compartment or lamp separately by aligning its optical axis with the photometer and adding the value at each test point.

S14.2.1.5.3 Multiple compartment turn signal lamps or stop lamps or multiple lamp arrangements of these lamps installed on multipurpose passenger vehicles, trucks, trailers, or buses 2032 mm or more in overall width must use the method of S14.2.1.5.2(b) only.

S14.2.1.6 *Bulbs.* Except for a lamp having a sealed-in bulb, a lamp must meet the applicable requirements of this standard when tested with a bulb whose filament is positioned within ±.010 in of the nominal design position specified in SAE Recommended Practice J573d (1968) (incorporated by reference, see §571.5) or specified by the bulb manufacturer and operated at the bulb's rated mean spherical candela.

S14.2.1.6.1 Each lamp designed to use a type of bulb that has not been assigned a mean spherical candela rating by its manufacturer and is not listed in SAE Recommended Practice J573d (1968) (incorporated by reference, see §571.5), must meet the applicable requirements of this standard when used with any bulb of the type specified by the lamp manufacturer, operated at the bulb's design voltage. A lamp that contains a sealed-in bulb must meet these requirements with the bulb operated at the bulb's design voltage.

S14.2.1.6.2 A bulb that is not listed in SAE Recommended Practice J573d (1968) (incorporated by reference, see §571.5) is not required to use a socket that conforms to the requirements of SAE Recommended Practice J567b (1964) (incorporated by reference, see §571.5).

S14.2.2 *License plate lamp photometry.* Photometry compliance of license plate lamps is determined by measurement of the illumination falling upon test stations located on a test plate.

S14.2.2.1 *Illumination surface.* All illumination measurements are made on a rectangular test plate of clean, white blotting paper mounted on the license plate holder in the position normally taken by the license plate. The face of the test plate must be 1.5 mm from the face of the license plate holder.

S14.2.2.2 *Test stations.* Test stations must be located on the face of the test plate as shown in Figure 19 according to the type of vehicle on which the license plate lamps are installed.

S14.2.2.3 Bulb requirements of S14.2.1.6 apply to license plate lamp photometry.

S14.2.3 *Reflex reflector and retroreflective sheeting photometry.*

S14.2.3.1 *Mounting.* Each reflex reflector is mounted for photometry with the center of the reflex area at the center of goniometer rotation and at the same horizontal level as the source of illumination.

S14.2.3.2 *Illumination source.* The source of illumination is a lamp with a 50 mm effective diameter and with a filament operating at 2856 °K.

S14.2.3.3 *Measurement distance.* The test distance is 30.5 m [100ft].

S14.2.3.4 *Test setup* The observation point is located directly above the source of illumination. The H–V axis of reflex reflectors is taken as parallel to the longitudinal axis of the vehicle for rear reflectors and perpendicular to a vertical plane passing through the longitudinal axis of the vehicle for side reflectors.

S14.2.3.5 *Photodetector.* The photodetector has an opening of not more than 13 mm vertically and 25 mm horizontally.

S14.2.3.6 *Photometry surface.* Reflex reflectors may have any linear or area dimensions but must have no more than 7740 sq mm projected area contained within a 254 mm diameter circle exposed for photometry.

S14.2.3.7 *Procedure.* Photometric measurements of reflex reflectors and retroreflective sheeting must be made at various observation and entrance angles as shown in Table XVI.

S14.2.3.7.1 The observation angle is the angle formed by a line from the observation point to the center of the reflector and a second line from the center of the reflector to the source of illumination.

S14.2.3.7.2 The entrance angle is the angle between the axis of the reflex reflector and a line from the center of the reflector to the source of illumination.

S14.2.3.7.3 The entrance angle is designated left, right, up, and down in accordance with the position of the source of illumination with respect to the axis of the reflex reflector as viewed from behind the reflector.

S14.2.3.7.4 Measurements are made of the luminous intensity which the reflex reflector is projecting toward the observation point and the illumination on the reflex reflector from the source of illumination.

S14.2.3.8 *Measurements.*

S14.2.3.8.1 *Reflex reflectors.* The required measurement for reflex reflectors at each test point as shown in Table XVI is the quotient of the projected luminous intensity divided by the illumination expressed as millicandela per lux or candela per footcandle.

S14.2.3.8.2 *Retroreflective sheeting.* The required measurement for retroreflective sheeting reflectors at each test point as shown in Table XVI is candela per lux per square meter of area.

S14.2.3.8.3 *Reflex reflector photometry measurement adjustments.*

S14.2.3.8.3.1 Reflex reflectors, which do not have a fixed rotational position on the vehicle, are rotated about their axis through 360° to find the minimum photometric value which must be reported for each test point. If the output falls below the minimum requirement at any test point, the reflector is rotated ±5° about its axis from the angle where the minimum output occurred, and the maximum value within this angle is reported as a tolerance value.

S14.2.3.8.3.2 Reflex reflectors, which by their design or construction, permit mounting on a vehicle in a fixed rotational position, are tested in this position. A visual locator, such as the word TOP is not considered adequate to establish a fixed rotational position on the vehicle.

S14.2.3.8.3.3 If uncolored reflections from the front surface interfere with photometric readings at any test point, additional readings are taken 1° above, below, right, and left of the test point, and the lowest of these readings and its location is reported provided the minimum test point requirement for the test point is met.

S14.2.4 *Daytime running lamp (DRL) photometry measurements.*

S14.2.4.1 Each DRL is tested to the procedure of S14.2.5 when a test voltage of 12.8 v ±20 mv is applied to the input terminals of the lamp switch module or voltage-reducing equipment, whichever is closer to the electrical source on the vehicle.

S14.2.4.2 The test distance from the lamp to the photometer is not less than 18.3 m if the lamp is optically combined with a headlamp, or is a separate lamp, and not less than 3 m if the lamp is optically combined with a lamp, other than a headlamp, that is required by this standard.

S14.2.4.3 Except for a lamp having a sealed-in bulb, a lamp must meet the applicable requirements of this standard when tested with a bulb whose filament is positioned within ±.010 in. of the nominal design position specified in SAE J573d, Lamp bulbs and Sealed Units, December 1968, (incorporated by reference, paragraph S5.2 of this section) or specified by the bulb manufacturer.

S14.2.5 *Headlamp photometry measurements.*

S14.2.5.1 *Mounting.* Photometry measurements at the applicable test points are made with the sample headlamp mounted in its normal operating position.

S14.2.5.2 Test points in the area from 10° U to 90° U must be measured from the normally exposed surface of the lens face.

S14.2.5.3 *Measurement distance.* Photometric measurements are made at a distance between the light source and the photometer sensor of at least 18.3 m.

S14.2.5.4 *Seasoning and test voltage.* All sealed beam headlamps, integral beam headlamps, beam contributors, and replaceable light sources are seasoned at design voltage for 1% of its average design life or 10 hours, whichever is less prior to a photometry test. A headlamp is tested at 12.8 v. ±20 mv, D.C. as measured at the terminals of the lamp.

S14.2.5.5 *Aiming.* Each headlamp is aimed prior to a photometry test in accordance with the procedure appropriate to its aiming system. A ¼° reaim is permitted in any direction at any test point to allow for variations in readings between laboratories for all headlamps except a Type F upper beam unit not equipped with a VHAD.

S14.2.5.5.1 *Mechanically aimable headlamps using an external aimer.* The headlamp is aimed mechanically with the aiming plane at the design angle(s) to the photometer axis and the mechanical axis of the headlamp on the photometer axis.

S14.2.5.5.2 *Mechanically aimable headlamps equipped with a VHAD.* The headlamp is aimed mechanically using the VHAD in accordance with the manufacturer's instructions as provided with the vehicle on which the headlamp is intended to be used.

S14.2.5.5.3 *Visually aimable lower beam headlamps-vertical aim.*

S14.2.5.5.3.1 A VOL cutoff headlamp must have the location of the cutoff maximum gradient, as determined by the method of this standard, positioned at 0.4° down from the H–H line.

S14.2.5.5.3.2 A VOR cutoff headlamp must have the location of the cutoff maximum gradient, as determined by the method of this standard, positioned at the H–H line.

S14.2.5.5.4 *Visually aimable lower beam headlamps-horizontal aim.* There must be no adjustment of horizontal aim unless the headlamp is equipped with a horizontal VHAD. If the headlamp has a VHAD, it must be set to zero.

S14.2.5.5.5 *Visually aimable upper beam headlamps-vertical aim.*

S14.2.5.5.5.1 A headlamp whose upper beam is combined with a lower beam must not have its vertical aim changed from that set for the lower beam.

S14.2.5.5.5.2 A headlamp whose upper beam is not combined with a lower beam must have its maximum beam intensity positioned on the H–H axis.

S14.2.5.5.6 *Visually aimable upper beam headlamps-horizontal aim.*

S14.2.5.5.6.1 A headlamp whose upper beam is combined with a lower beam must not have its horizontal aim changed from that set for the lower beam.

S14.2.5.5.6.2 A headlamp whose upper beam is not combined with a lower beam and has a fixed horizontal aim or has a horizontal VHAD must be mounted in its normal operating position on a goniometer such that the mounting fixture alignment axes are coincident

with the goniometer axes and must be energized at 12.8 v ±20 mv. There must be no adjustment, shimming, or modification of the horizontal axis of the headlamp or test fixture, unless the headlamp is equipped with a VHAD, in which case the VHAD must be adjusted to zero.

S14.2.5.5.6.3 A headlamp whose upper beam is not combined with a lower beam and is not equipped with a horizontal VHAD, the horizontal aim must be adjusted so that the maximum beam intensity is positioned on the V–V axis.

S14.2.5.5.7 *Simultaneous aim Type F sealed beam headlamps and beam contributor integral beam headlamps.*

S14.2.5.5.7.1 A headlamp system permitted to use simultaneous aim of lower beams and upper beams must be aimed mechanically for lower beam photometry by centering the lower beam unit or the geometric center of all lower beam contributors on the photometer axis and aligning the aiming plane, aiming reference plane, or other appropriate vertical plane defined by the manufacturer perpendicular to the photometer axis.

S14.2.5.5.7.2 The headlamp must be aimed for upper beam photometry by moving the assembly in a plane parallel to the established lower beam aiming plane until the upper beam unit or the geometric center of all upper beam contributors is centered in the photometric axis.

S14.2.5.5.8 *Motorcycle headlamp-upper beam headlamps designed to comply with Table XX.* The upper beam of a multiple beam headlamp designed to comply with the requirements of Table XX must be aimed photoelectrically so that the center of the zone of highest intensity falls 0.4° vertically below the lamp axis and is centered laterally. The center of the zone of highest intensity must be established by the intersection of a horizontal plane passing through the point of maximum intensity, and the vertical plane established by balancing the photometric values at 3°L and 3°R.

S14.2.5.5.9 *Motorcycle headlamp-lower beam headlamps designed to comply with Table XX.* The beam from a single beam headlamp designed to comply with the requirements of Table XX must be aimed straight ahead with the top of the beam aimed vertically to obtain 2000 cd at H–V.

S14.2.5.6 *Positioner.* The goniometer configuration, used to position the sample headlamp when making photometric measurements at specific angular test points, is horizontal rotation over elevation. The vertical axis of the goniometer must correspond to the design position vertical axis of the sample headlamp which is vertical and perpendicular to the longitudinal axis of the vehicle.

S14.2.5.7 *Photometer.*

S14.2.5.7.1 The photometer must be capable of measuring the luminous intensity of the sample headlamp throughout its illumination range.

S14.2.5.7.2 *Sensor.*

S14.2.5.7.2.1 The maximum effective area of the photometric sensor must fit within a circle whose diameter is equal to 0.009 times the actual test distance from the light source of the sample headlamp to the sensor.

S14.2.5.7.2.2 The sensor effective area is defined as the actual area of intercepted light striking the detector surface of the photometer. Sensor systems incorporating lens(es) that change the diameter of the intercepted light beam before it reaches the actual detector surface, the maximum size requirements must apply to the total area of the light actually intercepted by the lens surface.

S14.2.5.7.2.3 The sensor must be capable of intercepting all direct illumination from the largest illuminated dimension of the sample lamp at the test distance.

S14.2.5.7.3 The color response of the photometer must be corrected to that of the 1931 CIE Standard Observer (2-degree) Photopic Response Curve, as shown in the CIE 1931 Chromaticity Diagram (incorporated by reference, see §571.5).

S14.2.5.8 *Location of test points.*

S14.2.5.8.1 Test point positions are defined by the positioner. The following nomenclature applies:

S14.2.5.8.1.1 The letters ''V'' and ''H'' designate the vertical and horizontal planes intersecting both the headlamp light source and the photometer axis. ''H–V'' designates the zero test point angle at the intersection of the H and

V planes. This intersection is parallel to the longitudinal axis of the vehicle.

S14.2.5.8.1.2 The letters ''U'', ''D'', ''L'', and ''R'', indicating up, down, left and right, respectively, designate the angular position from the H and V planes to the photometer as viewed from the headlamp.

S14.2.5.8.1.3 Horizontal angles designated L and R are defined as the plan view angle between the vertical plane and the projection of the light ray from the headlamp onto the horizontal plane.

S14.2.5.8.1.4 Vertical angles designated U and D are defined as the true angle between the horizontal plane and the light ray from the headlamp.

S14.2.5.9 *Beam contributor photometry measurements.* In a headlighting system where there is more than one beam contributor providing a lower beam, and/or more than one beam contributor providing an upper beam, each beam contributor must be designed to meet only the applicable photometric performance requirements based upon the following mathematical expression: conforming test point value = 2(test point value)/total number of lower or upper beam contributors for the vehicle, as appropriate.

S14.2.5.10 *Moveable reflector aimed headlamp photometry measurements.*

S14.2.5.10.1 A headlamp aimed by moving the reflector relative to the lens and headlamp housing, or vice versa, must conform to the photometry requirements applicable to it with the lens at any position relative to the reflector.

S14.2.5.10.2 These positions include not less than the full range of vertical pitch of the vehicle on which the headlamp is installed and not less than ±2.5° from the nominal horizontal aim position for the vehicle on which the headlamp is installed unless the headlamp is visually/optically aimed with a fixed horizontal aim.

S14.3 *Motorcycle headlamp out of focus test procedure and performance requirements.*

S14.3.1 *Procedure.* The sample device must be tested for photometry using bulbs having each of four out-of-focus filament positions. Where conventional bulbs with two pin bayonet bases are used, tests must be made with the light source 0.060 in. above, below, ahead, and behind the designated position. If prefocused bulbs are used, the limiting positions at which tests are made must be 0.020 in. above, below, ahead, and behind the designated position. The sample device may be reaimed for each of the out-of-focus positions of the light source.

S14.3.2 *Performance requirements.* The minimum photometric values for the out-of-design position must be 80% of the in-design position.

S14.4 *General test procedures and performance requirements.*

S14.4.1 *Color test.* The requirement applies to the overall effective color of light emitted by the device and not to the color of the light from a small area of the lens. It does not apply to any pilot, indicator, or tell-tale lights. The color of the sample device must comply when tested by either the Visual Method or the Tristimulus Method.

S14.4.1.1 *Samples.* A test sample for a reflex reflector may be either the reflex reflector or a disc of the same material, technique of fabrication, and dye formulation as the reflex reflector. If a disc is used, the thickness must be twice the thickness of the reflector as measured from the face of the lens to the apexes of the reflecting elements.

S14.4.1.2 *General procedure.*

S14.4.1.2.1 The device must be operated at design voltage.

S14.4.1.2.2 Components (bulbs, caps, lenses, and the like) must be tested in a fixture or manner simulating the intended application.

S14.4.1.2.3 The lamp shall be allowed to reach operating temperature before measurements are made.

S14.4.1.2.4 The entire light emitting surface of the sample must be visible from any point on the entrance window of the test instrument.

S14.4.1.2.5 The distance between the test instrument and the sample must be large enough so that further increases in distance will not affect the results.

S14.4.1.3 *Visual method.*

S14.4.1.3.1 *Visual method procedure.* The color of light from the sample device must be compared visually with the color of the light from a standard. The standard may consist of a filter or limit glass. In the case of white, CIE

Source A is used only as a color reference. The chromaticity coordinates of the color standards must be as close as possible to the limits listed. The color of the standard filters is determined spectro-photometrically.

S14.4.1.3.2 *Visual method performance requirements.* The color must comply with the applicable requirement.

S14.4.1.3.2.1 *Red.* Red is not acceptable if it is less saturated (paler), yellower, or bluer than the limit standards.

S14.4.1.3.2.2 *Yellow (Amber).* Yellow is not acceptable if it is less saturated (paler), greener, or redder than the limit standards.

S14.4.1.3.2.3 *White.* White is not acceptable if its color differs materially from that of CIE Source A.

S14.4.1.3.2.4 Green. Green is not acceptable if it is less saturated (paler), yellower, or bluer than the limit standards.

S14.4.1.3.2.5 Blue. Blue is not acceptable if it is less saturated (paler), greener, or redder than the limit standards.

S14.4.1.4 *Tristimulus method.*

S14.4.1.4.1 *Tristimulus method procedure.*

S14.4.1.4.1.1 The color of light from the H–V point of a sample device must be measured by photoelectric receivers with spectral responses that approximate CIE standard spectral tristimulus valves.

S14.4.1.4.1.2 A sphere may be used to integrate light from a colored source provided that the color shift that results from the spectral selectivity of the sphere paint be corrected by the use of a filter, correction factor, or an appropriate calibration.

S14.4.1.4.1.3 Where the sample device does not have uniform spectral characteristics in all useful directions, color measurements must be made at as many directions of view as are required to evaluate the color for those directions that apply to the end use of the device.

S14.4.1.4.2 *Tristimulus method performance requirements.* The color must comply with the applicable requirement.

S14.4.1.4.2.1 *Red.* The color of light emitted must fall within the following boundaries:

y = 0.33 (yellow boundary)
y = 0.98 − x (purple boundary)

S14.4.1.4.2.2 *Yellow (Amber).* The color of light emitted must fall within the following boundaries:

y = 0.39 (red boundary)
y = 0.79 − 0.67x (white boundary)
y = x − 0.12 (green boundary)

S14.4.1.4.2.3 *White (achromatic).* The color of light emitted must fall within the following boundaries:

x = 0.31 (blue boundary)
y = 0.44 (green boundary)
x = 0.50 (yellow boundary)
y = 0.15 + 0.64x (green boundary)
y = 0.38 (red boundary)
y = 0.05 + 0.75x (purple boundary)

S14.4.1.4.2.4 Green. The color of light emitted must fall within the following boundaries:

y = 0.73 − 0.73x (yellow boundary)
x = 0.63y − 0.04 (white boundary)
y = 0.50 − 0.50x (blue boundary)

S14.4.1.4.2.5 Restricted Blue. The color of light emitted must fall within the following boundaries:

y = 0.07 + 0.81x (green boundary)
x = 0.40 − y (white boundary)
x = 0.13 + 0.60y (violet boundary)

S14.4.1.4.2.6 Signal Blue. The color of light emitted must fall within the following boundaries:

y = 0.32 (green boundary)
x = 0.16 (white boundary)
x = 0.40 − y (white boundary)
x = 0.13 + 0.60y (violet boundary)

S14.4.2 *Plastic optical materials tests.* Accelerated weathering procedures are not permitted.

S14.4.2.1 *Samples.*

S14.4.2.1.1 Samples of materials shall be injection molded into polished metal molds to produce test specimens with two flat and parallel faces. Alternative techniques may be used to produce equivalent specimens.

S14.4.2.1.2 Test specimens shape may vary, but each exposed surface must contain a minimum uninterrupted area of 32 sq cm.

S14.4.2.1.3 Samples must be furnished in thicknesses of 1.6 ±0.25 mm, 2.3 ±0.25 mm, 3.2 ±0.25 mm, and 6.4 ±0.25 mm.

S14.4.2.1.4 All samples must conform to the applicable color test requirement of this standard prior to testing.

S14.4.2.1.5 A control sample, kept properly protected from influences which may change its appearance and properties of each thickness, must be retained.

S14.4.2.2 *Outdoor exposure test.*

S14.4.2.2.1 Outdoor exposure tests of 3 years in duration must be made on samples of all materials, including coated and uncoated versions, used for optical parts of devices covered by this standard. Tests are to be conducted in Florida and Arizona.

S14.4.2.2.2 Concentrations of polymer components and additives used in plastic materials may be changed without outdoor exposure testing provided the changes are within the limits of composition represented by higher and lower concentrations of these polymer components and additives previously tested to this section and found to meet its requirements.

S14.4.2.2.3 *Procedure.*

S14.4.2.2.3.1 One sample of each thickness of each material must be mounted at each exposure site so that at least a minimum uninterrupted area of 32 sq cm of the exposed upper surface of the sample is at an angle of 45° to the horizontal facing south. The sample must be mounted in the open no closer than 30 cm (11.8 in) to its background.

S14.4.2.2.3.2 During the exposure time the samples must be cleaned once every three months by washing with mild soap or detergent and water, and then rinsing with distilled water. Rubbing must be avoided.

S14.4.2.2.4 *Performance requirements.* Plastic lenses, other than those incorporating reflex reflectors, used for inner lenses or those covered by another material and not exposed directly to sunlight must meet the optical material test requirements when covered by the outer lens or other material.

S14.4.2.2.4.1 After completion of the outdoor exposure test the haze and loss of surface luster as measured by ASTM D1003–92 (incorporated by reference, see § 571.5) must not be greater than:

(a) 30% for materials used for outer lenses, other than those incorporating reflex reflectors;

(b) 7% for materials used for reflex reflectors and lenses used in front of reflex reflectors.

S14.4.2.2.4.2 After completion of the outdoor exposure test materials used for headlamp lenses must show no deterioration.

S14.4.2.2.4.3 After completion of the outdoor exposure test all materials, when compared with the unexposed control samples, must not show physical changes affecting performance such as color bleeding, delamination, crazing, or cracking. Additionally materials used for reflex reflectors and lenses used in front of reflex reflectors must not show surface deterioration or dimensional changes.

S14.4.2.2.4.4 After completion of the outdoor exposure test all materials, when compared with the unexposed control samples, must not have their luminous transmittance changed by more than 25% when tested in accordance with ASTM E308–66 (incorporated by reference, see § 571.5) using CIE Illuminant A (2856K).

S14.4.2.2.4.5 After completion of the outdoor exposure test all materials must conform to the color test of this standard in the range of thickness stated by the material manufacturer.

S14.4.2.3 *Heat test.*

S14.4.2.3.1 *Procedure.* Two samples of each thickness of each material must be supported at the bottom, with at least 51 mm of the sample above the support, in the vertical position in such a manner that, on each side, the minimum uninterrupted area of exposed surface is not less than 3225 sq mm. The samples are placed in a circulating air oven at 79 ±3 °C for two hours.

S14.4.2.3.2 *Performance requirements.* After completion of the heat exposure and cooling to room ambient temperature, a test specimen must show no change in shape and general appearance discernable to the naked eye when compared with an unexposed specimen and continue to conform to the applicable color test requirement of this standard.

S14.5 *Signal lamp and reflective device physical test procedures and performance requirements.*

S14.5.1 *Vibration test.*

S14.5.1.1 *Procedure.* The sample device, as mounted on the support supplied, must be bolted to the anvil end of the table of the vibration test machine of Figure 21 and vibrated approximately 750 cpm through a distance of ⅛ in. The table must be spring mounted at one end and fitted with steel calks on the underside of the other end. The calks are to make contact with the steel anvil once during each cycle at the completion of the fall. The rack must be operated under a spring tension of 60 to 70 lb. The test must be continued for 1 hour.

S14.5.1.2 *Performance requirements.* After completion of the vibration test a device showing evidence of material physical weakness, lens or reflector rotation, displacement or rupture of parts except bulb failures, must be considered to have failed, providing that the rotation of lens or reflector must not be considered as a failure when tests show compliance with specifications despite such rotation.

S14.5.2 *Moisture test.*

S14.5.2.1 *Procedure.* The sample device must be mounted in its normal operating position with all drain holes open and subjected to a precipitation of 0.1 in of water per minute, delivered at an angle of 45° from a nozzle with a solid cone spray. During the test the device must revolve about its vertical axis at a rate of 4 rpm for a period of 12 hours followed by a one hour drain period where the device does not rotate and the spray stops. After completion of the moisture test the device must be examined for moisture accumulation.

S14.5.2.2 *Performance requirements.* Accumulation of moisture in excess of 2 cc or any visible moisture in a sealed reflex unit must constitute a failure.

S14.5.3 *Dust test.*

S14.5.3.1 *Samples.* A sealed unit is not required to meet the requirements of this test.

S14.5.3.2 *Procedure.* The sample device with any drain hole closed must be mounted in its normal operating position, at least 6 in from the wall in a cubical box with inside measurements of 3 ft on each side containing 10 lb of fine powered cement in accordance with ASTM C150–56 (incorporated by reference, see §571.5). At intervals of 15 minutes during a test period of 5 hours, the dust must be agitated by compressed air or fan blower by projecting blasts of air for a 2 second period in a downward direction into the dust in such a way that the dust is completely and uniformly diffused throughout the entire cube and allowed to settle. After the completion of the dust test the exterior surface of the device must be cleaned.

S14.5.3.3 *Performance requirements.* If after a photometry test the maximum photometric intensity of the device is not more than 10% less than the maximum photometric intensity of the same device after being cleaned both inside and outside, the device is considered to have met the requirements of the dust test.

S14.5.4 *Corrosion test.*

S14.5.4.1 *Procedure.* The sample device must be subjected to a salt spray (fog) test in accordance with the latest version of ASTM B117–73 (Reapproved 1979) (incorporated by reference, see §571.5), for a period of 50 hours, consisting of two periods of 24 hour exposure followed by a 1 hr drying time.

S14.5.4.2 *Performance requirements.* After the completion of the corrosion test there must be no evidence of excessive corrosion which would affect the proper function of the device.

S14.6 *Headlamp physical test procedures and performance requirements.*

S14.6.1 *Abrasion test.*

S14.6.1.1 *Procedure.*

S14.6.1.1.1 *Abrading pad.* A new, unused abrading pad constructed of 0000 steel wool not less than 2.5 ±.1 cm wide, rubber cemented to a rigid base shaped to the same vertical contour of the lens, is used for each test. The abrading pad support is equal in size to the pad and the center of the support surface is within ±2 mm of parallel to the lens surface. The ''grain'' of the pad is oriented perpendicular to the direction of motion. The density of the pad is such that when the pad is resting unweighted on the lens, the base of the pad is no closer than 3.2 mm to the lens at its closest point.

S14.6.1.1.2 *Abrading pad alignment.* A sample headlamp is mounted in the abrasion test fixture of Figure 5 with the lens facing upward. When mounted on its support and resting on the lens of the test headlamp, the abrading pad is

then weighted such that a pad pressure of 14 ±1 KPa. exists at the center and perpendicular to the face of the lens.

S14.6.1.1.3 *Abrasion test procedure.* The pad is cycled back and forth (1 cycle) for 11 cycles at 4 ±0.8 in (10 ±2 cm) per second over at least 80% of the lens surface, including all the area between the upper and lower aiming pads, but not including lens trim rings and edges. A pivot must be used if it is required to follow the contour of the lens.

S14.6.1.2 *Performance requirements.* After completion of the abrasion test the sample headlamp must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A ¼° reaim is permitted in any direction at any test point.

S14.6.2 *Chemical resistance test.*

S14.6.2.1 *Procedure.*

S14.6.2.1.1 *Test fluids.* The five test fluids used in the chemical resistance test include:

(a) ASTM Reference Fuel C, which is composed of Isooctane 50% volume and Toluene 50% volume. Isooctane must conform to A2.7 in the ASTM Motor Fuels section (incorporated by reference, see §571.5), and Toluene must conform to ASTM D362–84 (incorporated by reference, see §571.5). ASTM Reference Fuel C must be used as specified in: Paragraph A2.3.2 and A2.3.3 of the ASTM Motor Fuels section (incorporated by reference, see §571.5); and OSHA Standard 29 CFR 1910.106—Handling Storage and Use of Flammable Combustible Liquids;

(b) Tar remover (consisting by volume of 45% xylene and 55% petroleum base mineral spirits);

(c) Power steering fluid (as specified by the vehicle manufacturer for use in the motor vehicle on which the headlamp is intended to be installed);

(d) Windshield washer fluid consisting of 0.5% monoethanolamine with the remainder 50% concentration of methanol/distilled water by volume; and

(e) Antifreeze (50% concentration of ethylene glycol/distilled water by volume).

S14.6.2.1.2 *Fluid application.* The entire exterior lens surface of the sample headlamp mounted in the headlamp test fixture and top surface of the lens-reflector joint is wiped once to the left and once to the right with a 6 inch square soft cotton cloth (with pressure equally applied) which has been saturated once in a container with 2 ounces of five different test fluids listed above. The lamp is wiped within 5 seconds after removal of the cloth from the test fluid. A new lamp sample may be used with each fluid.

S14.6.2.1.3 *Test duration.* After the headlamp sample has been wiped with the test fluid, it must be stored in its designed operating attitude for 48 hours at a temperature of 23 °C ±4 °C and a relative humidity of 30% ±10%. At the end of the 48-hour period, the headlamp is wiped clean with a soft dry cotton cloth and visually inspected.

S14.6.2.2 *Performance requirements.* After completion of the chemical resistance test, the sample headlamp must have no surface deterioration, coating delamination, fractures, deterioration of bonding or sealing materials, color bleeding, or color pickup visible without magnification and the headlamp must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A ¼° reaim is permitted in any direction at any test point.

S14.6.3 *Corrosion test.*

S14.6.3.1 *Procedure.* A sample headlamp, mounted on a headlamp test fixture in designed operating position and including all accessory equipment necessary to operate in its normal manner, is subjected to a salt spray (fog) test in accordance with ASTM B117–73 (incorporated by reference, see §571.5), for 50 total hours, consisting of two periods of 24 hours exposure followed by a 1 hour drying period. If a portion of the device is completely protected in service, that portion is covered to prevent salt fog entry during exposure. After removal from the salt spray and the final 1 hour drying period the sample headlamp is examined for corrosion that affects any other applicable tests contained in S14.6. If such corrosion is found, the affected test(s) must be performed on the corrosion sample and the results recorded.

S14.6.3.2 *Performance requirements.* After completion of the corrosion test, the sample headlamp must not have

any observed corrosion which would result in the failure of any other applicable tests contained in S14.6 and no corrosion of the headlamp mounting and aiming mechanism that would result in the failure of the aiming adjustment tests, inward force test, or torque deflection test of S14.6.

S14.6.4 *Corrosion-connector test.*

S14.6.4.1 *Procedure.*

S14.6.4.1.1 A headlamp connector test must be performed on each filament circuit of the sample headlamp prior to the test in S14.6.4.1.2 according to Figure 4 and S14.6.15. The power source is set to provide 12.8 volts and the resistance must be set to produce 10 amperes.

S14.6.4.1.2 The headlamp, with connector attached to the terminals, unfixtured and in its designed operating attitude with all drain holes, breathing devices or other designed openings in their normal operating positions, is subjected to a salt spray (fog) test in accordance with ASTM B117–73 (incorporated by reference, see §571.5), for 240 hours, consisting of ten successive 24-hour periods.

S14.6.4.1.3 During each period, the headlamp is mounted in the middle of the chamber and exposed for 23 hours to the salt spray. The spray is not activated during the 24th hour. The bulb is removed from the headlamp and from the test chamber during the one hour of salt spray deactivation and reinserted for the start of the next test period, at the end of the first and last three 23-hour periods of salt spray exposure, and at the end of any two of the fourth through seventh 23-hour periods of salt-spray exposure.

S14.6.4.1.4 The test chamber is closed at all times except for a maximum of 2 minutes which is allowed for removal or replacement of a bulb during each period.

S14.6.4.1.5 After the ten periods, the lens-reflector unit without the bulb must be immersed in deionized water for 5 minutes, then secured and allowed to dry by natural convection only.

S14.6.4.1.6 Using the voltage, resistance and pre-test set up of S14.6.4.1.1 the current in each filament circuit must be measured after the test conducted in S14.6.4.1.2.

S14.6.4.2 *Performance requirements.*

S14.6.4.2.1 After the completion of the corrosion-connector test, the sample headlamp must show no evidence of external or internal corrosion or rust visible without magnification.

S14.6.4.2.2 Loss of adhesion of any applied coating must not occur more than 3.2 mm from any sharp edge on the inside or out.

S14.6.4.2.3 Corrosion may occur on terminals only if the test current produced during the test of S14.6.4.1.6 is not less than 9.7 amperes.

S14.6.5 *Dust test.*

S14.6.5.1 *Procedure.*

S14.6.5.1.1 A sample headlamp, mounted on a headlamp test fixture, with all drain holes, breathing devices or other designed openings in their normal operating positions, is positioned within a cubical box, with inside measurements of 900 mm on each side or larger if required for adequate wall clearance (*i.e.*, a distance of at least 150 mm between the headlamp and any wall of the box).

S14.6.5.1.2 The box contains 4.5 kg of fine powdered cement which conforms to the ASTM C150–77 (incorporated by reference, see §571.5). Every 15 minutes, the cement is agitated by compressed air or fan blower(s) by projecting blasts of air for a two-second period in a downward direction so that the cement is diffused as uniformly as possible throughout the entire box.

S14.6.5.1.3 This test is continued for five hours after which the exterior surfaces of the headlamp are wiped clean.

S14.6.5.2 *Performance requirements.* After completion of the dust test, the sample headlamp must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A ¼° reaim is permitted in any direction at any test point.

S14.6.6 *Temperature cycle test and internal heat test.*

S14.6.6.1 *Samples.* A sample headlamp with one or more replaceable light sources is tested according to the procedures of this section for a temperature cycle test and an internal heat test. The same sample headlamp is used in the temperature cycle test and then in the internal heat test.

S14.6.6.2 *General procedure.*

S14.6.6.2.1 Tests are made with all filaments lighted at design voltage

that are intended to be used simultaneously in the headlamp and which in combination draw the highest total wattage. These include but are not limited to filaments used for turn signal lamps, fog lamps, parking lamps, and headlamp lower beams lighted with upper beams when the wiring harness is so connected on the vehicle.

S14.6.6.2.2 If a turn signal is included in the headlamp assembly, it is operated at 90 flashes a minute with a 75% ±2% current ''on time.''

S14.6.6.2.3 If the lamp produces both the upper and lower beam, it is tested in both the upper beam mode and the lower beam mode under the conditions above described, except for a headlamp with a single type HB1 or type HB2 light source.

S14.6.6.3 *Temperature cycle test.*

S14.6.6.3.1 *Procedure.*

S14.6.6.3.1.1 A sample headlamp, mounted on a headlamp test fixture, is subjected to 10 complete consecutive cycles having the thermal cycle profile shown in Figure 6.

S14.6.6.3.1.2 During the hot cycle, the lamp, is energized commencing at point ''A'' of Figure 6 and de-energized at point ''B.''

S14.6.6.3.1.3 Separate or single test chambers may be used to generate the environment of Figure 6.

S14.6.6.3.1.4 All drain holes, breathing devices or other openings or vents of the headlamps are set in their normal operating positions.

S14.6.6.3.2 *Performance requirements.* After completion of the temperature cycle test, the sample headlamp must:

(a) show no evidence of delamination, fractures, entry of moisture, or deterioration of bonding material, color bleeding, warp or deformation visible without magnification;

(b) show no lens warpage greater than 3 mm when measured parallel to the optical axis at the point of intersection of the axis of each light source with the exterior surface of the lens; and

(c) meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A ¼° reaim is permitted in any direction at any test point.

S14.6.6.4 *Internal heat test.*

S14.6.6.4.1 *Procedure.*

S14.6.6.4.1.1 A sample headlamp lens surface that would normally be exposed to road dirt is uniformly sprayed with any appropriate mixture of dust and water or other materials to reduce the photometric output at the H–V test point of the upper beam (or the ½°D–1½°R test point of the lower beam as applicable) to 25% ±2% of the output originally measured in the applicable photometric compliance test.

S14.6.6.4.1.2 A headlamp with a single type HB1 or type HB2 light source is tested on the upper beam only.

S14.6.6.4.1.3 Such reduction is determined under the same conditions as that of the original photometric measurement.

S14.6.6.4.1.4 After the photometric output of the lamp has been reduced as specified above, the sample lamp and its mounting hardware must be mounted in an environmental chamber in a manner similar to that indicated in Figure 7 ''Dirt/Ambient Test Setup.''

S14.6.6.4.1.5 The headlamp is soaked for one hour at a temperature of 35° + 4° − 0 °C) and then the lamp is energized according to the procedure of this section for one hour in a still air condition, allowing the temperature to rise from the soak temperature.

S14.6.6.4.1.6 At the end of one hour the sample lamp is returned to a room ambient temperature of 23° + 4° − 0 °C and a relative humidity of 30% ±10% and allowed to stabilize to the room ambient temperature. The lens is then cleaned.

S14.6.6.4.2 *Performance requirements.* After completion of the temperature cycle test and meeting its requirements, and completion of the internal heat test, the sample headlamp must:

(a) have no lens warpage greater than 3 mm when measured parallel to the optical axis at the point of intersection of the axis of each light source with the exterior surface of the lens, and

(b) meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A ¼° reaim is permitted in any direction at any test point.

S14.6.7 *Humidity test.*

S14.6.7.1 *Procedure.*

S14.6.7.1.1 The test fixture consists of a horizontal steel plate to which three threaded steel or aluminum rods

of ½ inch diameter are screwed vertically behind the headlamp.

S14.6.7.1.2 The sample headlamp assembly is clamped to the vertical rods, which are behind the headlamp. All attachments to the headlamp assembly are made behind the lens and vents or openings, and are not within 2 inches laterally of a vent inlet or outlet.

S14.6.7.1.3 The mounted headlamp assembly is oriented in its design operating position, and is placed in a controlled environment at a temperature of 100° + 7° − 0 °F (38° + 4° − 0 °C) with a relative humidity of not less than 90%. All drain holes, breathing devices, and other openings are set in their normal operation positions for all phases of the humidity test.

S14.6.7.1.4 The headlamp is subjected to 24 consecutive 3-hour test cycles. In each cycle, the headlamp is energized for 1 hour at design voltage with the highest combination of filament wattages that are intended to be used, and then de-energized for 2 hours. If the headlamp incorporates a turn signal then the turn signal flashes at 90 flashes per minute with a 75% ±2% current ''on-time.''

S14.6.7.1.5 Within 3 minutes after the completion of the 24th cycle, the air flow test will begin. The following procedure shall occur: the mounted assembly is removed, placed in an insulating box and covered with foam material so that there is no visible air space around the assembly; the box is closed, taken to the air flow test chamber, and placed within it. Inside the chamber, the assembly with respect to the air flow, is oriented in its design operating position. The assembly is positioned in the chamber so that the center of the lens is in the center of the opening of the air flow entry duct during the test. The headlamp has at least 3 inches clearance on all sides, and at least 4 inches to the entry and exit ducts at the closest points. If vent tubes are used which extend below the lamp body, the 3 inches are measured from the bottom of the vent tube or its protection. The temperature of the chamber is 73° + 7° − 0 °F (23° + 4° − 0 °C) with a relative humidity of 30% + 10% − 0%. The headlamp is not energized.

S14.6.7.1.6 Before the test specified in paragraph S14.6.7.1.7 of this section, the uniformity of the air flow in the empty test chamber at a plane 4 inches downstream of the air entry duct is measured over a 4 inch square grid. The uniformity of air flow at each grid point is ±10% of the average air flow specified in paragraph S14.6.7.1.7 of this section.

S14.6.7.1.7 The mounted assembly in the chamber is exposed, for one hour, to an average air flow of 330 + 0 −30 ft/min as measured with an air velocity measuring probe having an accuracy of ±3% in the 330 ft/min range. The average air flow is the average of the velocity recorded at six points around the perimeter of the lens. The six points are determined as follows: At the center of the lens, construct a horizontal plane. The first two points are located in the plane, 1 inch outward from the intersection of the plane and each edge of the lens. Then, trisect the distance between these two points and construct longitudinal vertical planes at the two intermediate locations formed by the trisection. The four remaining points are located in the vertical planes, one inch above the top edge of the lens, and one inch below the bottom edge of the lens.

S14.6.7.1.8 After one hour, the headlamp is removed and inspected for moisture.

S14.6.7.2 *Performance requirements.* After completion of the humidity test, the sample headlamp must show no evidence of interior delamination or moisture, fogging or condensation visible without magnification.

S14.6.8 *Vibration test.*

S14.6.8.1 *Samples.* The mounting bracket with a sample headlamp installed must not have a resonant frequency in the 10–55 Hz. range.

S14.6.8.2 *Procedure.* The mounted sample headlamp is bolted to the anvil end of the table of the vibration test machine of Figure 21 and vibrated 750 cpm through a distance of ⅛ in. The table is spring mounted at one end and fitted with steel calks on the underside of the other end. The table is of sufficient size to completely contain the test fixture base with no overhang. The calks are to make contact with the steel anvil once during each cycle at

the completion of the fall. The rack is operated under a spring tension of 60 to 70 lb. The vibration is applied in the vertical axis of the headlamp as mounted on the vehicle. Bulb filaments are not energized during the test. The test is continued for 1 hour.

S14.6.8.3 *Performance requirements.* After completion of the vibration test, there must be no evidence of loose or broken parts, other than filaments, visible without magnification.

S14.6.9 *Sealing test.*

S14.6.9.1 *Procedure.*

S14.6.9.1.1 An unfixtured sample headlamp in its design mounting position is placed in water at a temperature of 176° ±5 °F (80° ±3 °C) for one hour. The headlamp is energized in its highest wattage mode, with the test voltage at 12.8 ±0.1 V during immersion.

S14.6.9.1.2 The lamp is then de-energized and immediately submerged in its design mounting position into water at 32° + 5° −0 °F (0° + 3° −0 °C). The water is in a pressurized vessel, and the pressure is increased to 10 psi (70 kPa), upon placing the lamp in the water. The lamp must remain in the pressurized vessel for a period of thirty minutes.

S14.6.9.1.3 This entire procedure is repeated for four cycles.

S14.6.9.1.4 Then the lamp is inspected for any signs of water on its interior. During the high temperature portion of the cycles, the lamp is observed for signs of air escaping from its interior.

S14.6.9.2 *Performance requirements.* After completion of the sealing test, a sample headlamp confirmed to be sealed need not meet the corrosion test, dust test, or humidity test of this Section. If any water is on the interior or air escapes, the lamp is not a sealed lamp.

S14.6.10 *Chemical resistance test of reflectors of replaceable lens headlamps test.*

S14.6.10.1 *Procedure.*

S14.6.10.1.1 *Test fluids.* The three test fluids used in the chemical resistance test include;

(a) Tar remover (consisting by volume of 45% xylene and 55% petroleum base mineral spirits);

(b) Mineral spirits; and

(c) Fluids other than water contained in the manufacturer's instructions for cleaning the reflector.

S14.6.10.1.2 *Fluid application.* With a sample headlamp in the headlamp test fixture and the lens removed, the entire surface of the reflector that receives light from a headlamp light source is wiped once to the left and once to the right with a 6-inch square soft cotton cloth (with pressure equally applied) which has been saturated once in a container with 2 ounces of one of the test fluids listed in S14.6.10.1.1. The lamp is wiped within 5 seconds after removal of the cloth from the test fluid.

S14.6.10.1.3 *Test duration.* After the headlamp has been wiped with the test fluid, it is stored in its designed operating attitude for 48 hours at a temperature of 73° ±7 °F (23° ±4 °C) and a relative humidity of 30% ±10%. At the end of the 48-hour period, the headlamp is wiped clean with a soft dry cotton cloth and visually inspected.

S14.6.10.2 *Performance requirements.* After completion of the chemical resistance test, the sample headlamp must have no surface deterioration, coating delamination, fractures, deterioration of bonding or sealing materials, color bleeding or color pickup visible without magnification and the headlamp must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A ¼° reaim is permitted in any direction at any test point.

S14.6.11 *Corrosion resistance test of reflectors of replaceable lens headlamps test.*

S14.6.11.1 *Procedure.*

S14.6.11.1.1 A sample headlamp with the lens removed, unfixtured and in its designed operating attitude with all drain holes, breathing devices or other designed openings in their normal operating positions, must be subjected to a salt spray (fog) test in accordance with ASTM B117–73, *Method of Salt Spray (Fog) Testing* (incorporated by reference, see 571.108 S5.2 of this title), for 24 hours, while mounted in the middle of the chamber.

S14.6.11.1.2 Afterwards, the headlamp must be stored in its designed operating attitude for 48 hours at a temperature of 73° ±7 °F (23° ±4 °C) and a relative humidity of 30% ±10%

and allowed to dry by natural convection only. At the end of the 48-hour period, the reflector must be cleaned according to the instructions supplied with the headlamp manufacturer's replacement lens, and inspected. The lens and seal must then be attached according to these instructions and the headlamp tested for photometric performance.

S14.6.11.2 *Performance requirements.* After the completion of the corrosion test, the sample headlamp must show no evidence of corrosion or rust visible without magnification on any part of the headlamp reflector that receives light from a headlamp light source, on any metal light or heat shield assembly, or on a metal reflector of any other lamp. The sample headlamp with the replacement lens installed must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A ¼° re-aim is permitted in any direction at any test point.

S14.6.12 *Inward force test.*

S14.6.12.1 *Procedure.* A sample headlamp mechanism, including the aiming adjusters, must be subjected to an inward force of 222 N directed normal to the headlamp aiming plane and symmetrically about the center of the headlamp lens face.

S14.6.12.2 *Performance requirements.* After the completion of the inward force test, a sample headlamp must not permanently recede by more than 2.5 mm. The aim of the headlamp must not permanently deviate by more than 3.2 mm at a distance of 7.6 m. The aim of any headlamp that is capable of being mechanically aimed by externally applied aiming devices must not change by more than 0.30°.

S14.6.13 *Torque deflection test.*

S14.6.13.1 *Procedure.*

S14.6.13.1.1 The sample headlamp assembly is mounted in designed vehicle position and set at nominal aim (H = 0, V = 0).

S14.6.13.1.2 A sealed beam headlamp, except Type G and Type H, is removed from its mounting and replaced by the applicable deflectometer. (Type C and Type D-Figure 18, Type A and Type E-Figure 16, Type B-Figure 17, and Type F-Figure 14).

S14.6.13.1.3 Sealed beam headlamps Type G and Type H have the adapter of Figure 15 and the deflectometer of Figure 14 attached to the headlamp.

S14.6.13.1.4 A torque of 2.25 Nm must be applied to the headlamp assembly through the deflectometer and a reading on the thumbwheel is taken. The torque must be removed and a second reading on the thumbwheel is taken.

S14.6.13.1.5 Headlamps other than sealed beam headlamps must have the downward force used to create the torque applied parallel to the aiming reference plane, through the aiming pads, and displaced forward using a lever arm such that the force is applied on an axis that is perpendicular to the aiming reference plane and originates at the center of the aiming pad pattern (see Figure 3).

S14.6.13.1.6 For headlamps using the aiming pad locations of Group I, the distance between the point of application of force and the aiming reference plane is not less than 168.3 mm plus the distance from the aiming reference plane to the secondary plane, if used.

S14.6.13.1.7 For headlamps using the aiming pad locations of Group II, the distance between the point of application of force and the aiming reference plane is not less than 167.9 mm plus the distance to the secondary plane, if used.

S14.6.13.1.8 For headlamps using the nonadjustable Headlamp Aiming Device Locating Plates for the 146 mm diameter, the 176 mm diameter, and the 92x150 mm sealed beam, the distance between the point of application of force and the aiming plane is not, respectively, less than 177.4 mm, 176.2 mm, and 193.7 mm.

S14.6.13.2 *Performance requirements.* The aim of each sample headlamp must not deviate more than 0.30° when the downward torque is removed.

S14.6.14 *Retaining ring test.*

S14.6.14.1 *Procedure.* A sample headlamp with the minimum flange thickness of: Type A–31.5 mm, Type B–10.1 mm, Type C–11.8 mm, Type D–11.8 mm, Type E–31.5 mm, and Type F–8.6 mm, is secured between the appropriate mounting ring and retaining ring (mounting ring and aiming ring for Type F).

S14.6.14.2 *Performance requirements.* The sample headlamp when secured per

the procedure must be held tight enough that it will not rattle.

S14.6.15 *Headlamp connector test.*

S14.6.15.1 *Procedure.* A sample headlamp connected into the test circuit of Figure 4 has the power supply adjusted until 10 amperes DC are flowing through the circuit. The test is repeated for each filament circuit of the headlamp.

S14.6.15.2 *Performance requirements.* The voltage drop, as measured in the test circuit of Figure 4, must not exceed 40 mv DC in any applicable filament circuit of the sample headlamp.

S14.6.16 *Headlamp wattage test.*

S14.6.16.1 *Procedure.* A sample headlamp that has been seasoned is energized so as to have 12.8v ±20 mv DC applied across each filament circuit and the current flowing in each circuit is measured.

S14.6.16.2 *Performance requirements.* The wattage of each filament circuit of the sample headlamp must not exceed the applicable value for that type of headlamp as shown in Table II.

S14.6.17 *Aiming adjustment test-laboratory.*

S14.6.17.1 *Procedure.* A sample headlamp is mounted in design position at nominal (H = 0, V = 0) aim with an accurate measuring device such as a spot projector or other equally accurate means attached. The headlamp is adjusted to the extremes of travel in each horizontal and vertical direction.

S14.6.17.2 *Performance requirements.* Visually aimed lower beam headlamps without a VHAD are required not to have a horizontal adjustment mechanism and horizontal aim range requirements do not apply.

S14.6.17.2.1 A sample sealed beam headlamp, other than a Type F, tested per the procedure must provide a minimum of ±4.0° adjustment range in both the vertical and horizontal planes and if equipped with independent vertical and horizontal aiming screws, the adjustment must be such that neither the vertical nor horizontal aim must deviate more than 100 mm from horizontal or vertical planes, respectively, at a distance of 7.6 m through an angle of ±4.0°.

S14.6.17.2.2 A sample Type F sealed beam, integral beam, replaceable bulb, or combination headlamp tested per the procedure must provide a minimum of ±4.0° adjustment range in the vertical plane and ±2.5° in the horizontal plane and if equipped with independent vertical and horizontal aiming screws, the adjustment must be such that neither the vertical nor horizontal aim must deviate more than 100 mm from horizontal or vertical planes, respectively, at a distance of 7.6 m through an angle of ±2.5° and ±4.0°, respectively.

S14.6.17.2.3 A sample headlamp that is aimed by moving the reflector relative to the lens and headlamp housing, and vice versa must provide a minimum adjustment range in the vertical plane not less than the full range of the pitch on the vehicle on which it is installed and ±2.5° in the horizontal plane.

S14.6.18 *Aiming adjustment test-on vehicle.*

S14.6.18.1 *Procedure.*

S14.6.18.1.1 A sample headlamp is mounted on the vehicle at nominal (H = 0, V = 0) aim with an accurate measuring device such as a spot projector or other equally accurate means attached.

S14.6.18.1.2 The installed range of static pitch angle is, at a minimum, determined from unloaded vehicle weight to gross vehicle weight rating, and incorporates pitch angle effects from maximum trailer or trunk loadings, the full range of tire intermix sizes and suspensions recommended and/or installed by the vehicle manufacturer, and the anticipated effects of variable passenger loading.

S14.6.18.1.3 The headlamp is adjusted to the extremes of travel in each horizontal and vertical direction.

S14.6.18.2 *Performance requirements.*

S14.6.18.2.1 A sample headlamp tested per the procedure must provide a minimum vertical adjustment range not less than the full range of pitch of the vehicle on which it is installed.

S14.6.18.2.2 The vertical aim mechanism must be continuously variable over the full range.

S14.6.18.2.3 The adjustment of one aim axis through its full on-vehicle range must not cause the aim of the other axis to deviate more than ±0.76°. If this performance is not achievable, the requirements of S10.18.3.1 apply, except that if the aiming mechanism is

not a VHAD, the requirements specific to VHADs are not applicable, and the instruction must be specific to the aiming mechanism installed.

S14.7 *Replaceable light source physical test procedures and performance requirements.*

S14.7.1 *Deflection test for replaceable light sources.*

S14.7.1.1 *Procedure.*

S14.7.1.1.1 With the sample light source rigidly mounted in a fixture in a manner indicated in Figure 8, a force 4.0 ±0.1 pounds (17.8 ±0.4N) is applied at a distance ''A'' from the reference plane perpendicular to the longitudinal axis of the glass capsule and parallel to the smallest dimension of the pressed glass capsule seal.

S14.7.1.1.2 The force is applied (using a rod with a hard rubber tip with a minimum spherical radius of .039 in [1 mm]) radially to the surface of the glass capsule in four locations in a plane parallel to the reference plane and spaced at a distance ''A'' from that plane. These force applications are spaced 90° apart starting at the point perpendicular to the smallest dimension of the pressed seal of the glass capsule.

S14.7.1.1.3. The bulb deflection is measured at the glass capsule surface at 180° opposite to the force application. Distance ''A'' for a replaceable light source other than an HB Type is the dimension provided in accordance with appendix A of part 564 of this chapter, section I.A.1 if the light source has a lower beam filament, or as specified in section I.B.1 if the light source has only an upper beam filament.

S14.7.1.2 *Performance requirements.* After completion of the deflection test, a sample light source must have no permanent deflection of the glass envelope exceeding 0.13 mm in the direction of applied force.

S14.7.2 *Pressure test for replaceable light sources.*

S14.7.2.1 *Procedure.*

S14.7.2.1.1 The capsule, lead wires and/or terminals, and seal on each sample Type HB1, Type HB3, Type HB4, and Type HB5 light source, and on any other replaceable light source which uses a seal, is installed in a pressure chamber as shown in Figure 10 so as to provide an airtight seal. The diameter of the aperture in Figure 10 on a replaceable light source (other than an HB Type) must be that dimension furnished for such light source in compliance with appendix A or appendix B of part 564 of this chapter.

S14.7.2.1.2 The light source is immersed in water for one minute while inserted in a cylindrical aperture specified for the light source, and subjected to an air pressure of 70 KPa (10 psig) on the glass capsule side.

S14.7.2.2 *Performance requirements.* After completion of the pressure test, the sample light source with an airtight seal on the low pressure (connector side) must show no evidence of air bubbles on that side.

S14.7.3 *Replaceable light source power and flux measurement procedure.* The measurement of maximum power and luminous flux that is submitted in compliance with section VII of appendix A of part 564 of this chapter, or section IV of appendix B of part 564 of this chapter, is made in accordance with this paragraph.

S14.7.3.1 *Seasoning.* The filament or discharge arc is seasoned before measurement of either maximum power and luminous flux.

S14.7.3.1.1 *Resistive filament source.* Seasoning of a light source with a resistive element type filament is made in accordance with this S14.2.5.4 of this standard.

S14.7.3.1.2 *Discharge source.* For a light source using excited gas mixtures as a filament or discharge arc, seasoning of the light source system, including any ballast required for its operation, is made in accordance with section 4.0 of SAE Recommended Practice J2009 (1993) (incorporated by reference, see §571.5).

S14.7.3.2 *Test voltage.* Measurements are made with a direct current test voltage of 12.8 v regulated within one quarter of one percent.

S14.7.3.3 *Luminous flux measurement.* The measurement of luminous flux is made in accordance with IES LM 45 (incorporated by reference, see §571.5).

S14.7.3.3.1 *Resistive filament light source setup.* Luminous flux measurements are made with the black cap installed on Type HB1, Type HB2, Type HB4, and Type HB5, and on any other

replaceable light source so designed; and is with the electrical conductor and light source base shrouded with an opaque white cover, except for the portion normally located within the interior of the lamp housing. The measurement of luminous flux for the Types HB3 and HB4 is made with the base covered with a white cover as shown in the drawings for Types HB3 and HB4 filed in Docket No. NHTSA 98–3397. The white covers are used to eliminate the likelihood of incorrect lumen measurement that will occur should the reflectance of the light source base and electrical connector be low.

S14.7.3.3.2 *Discharge light source setup.* With the test voltage applied to the ballast input terminals, the measurement of luminous flux is made with the black cap installed, if so designed, and is made with an opaque white colored cover, except for the portion normally located within the interior of the lamp housing.

S14.8 *Vehicle headlamp aiming devices (VHAD) physical test procedures and performance requirements.*

S14.8.1 *Samples.* The same VHAD and associated headlamp(s) or headlamp assembly must be rigidly mounted in a headlamp test fixture with the aiming plane horizontal and vertical and with the scale on the device set at 0.

S14.8.2 *Scale graduation test.*

S14.8.2.1 *Procedure.* Check each graduation on the horizontal and vertical aim scales.

S14.8.2.2 *Performance requirements.* Scale graduation from correct aim must not exceed ±0.2° horizontally and ±0.1° vertically.

S14.8.3 *Cold scale graduation test.*

S14.8.3.1 *Procedure.* The VHAD and an unlighted headlamp assembly must then be stabilized at −7° ±3 °C in a circulating air environmental test chamber for a 30 minute temperature soak.

S14.8.3.2 *Performance requirements.* After completion of a 30 minute temperature soak the variation from correct aim shown by the sample VHAD must not exceed ±0.2° horizontally and ±0.1° vertically.

S14.8.4 *Hot scale graduation test.*

S14.8.4.1 *Procedure.* The VHAD and the headlamp assembly with its highest wattage filament, or combination of filaments intended to be used simultaneously, energized at its design voltage, is then stabilized at 38° ±3 °C in a circulating air environmental test chamber for a 30 minute temperature soak.

S14.8.4.2 *Performance requirements.* After completion of a 30 minute temperature soak the variation from correct aim shown by the sample VHAD must not exceed ±0.2° horizontally and ±0.1° vertically.

S14.8.5 *Thermal cycle test.*

S14.8.5.1 *Procedure.* The VHAD and an unlighted headlamp assembly are then placed in a circulating air environmental test chamber and exposed to a temperature of 60° ±3 °C for 24 hours, followed by a temperature of −40° ±3 °C for 24 hours, and are then permitted to return to room temperature.

S14.8.5.2 *Performance requirements.* After completion of the thermal cycle test the variation from correct aim shown by the sample VHAD must not exceed ±0.2° horizontally and ±0.1° vertically and the VHAD and headlamp assembly must show no damage which would impair its ability to perform as specified in this standard.

S14.8.6 *Corrosion test.*

S14.8.6.1 *Procedure.* The VHAD and headlamp assembly are then tested according to the headlamp corrosion test of S14.6.3.

S14.8.6.2 *Performance requirements.* After completion of the corrosion test the sample VHAD and headlamp must not have any observed corrosion that would result in the failure of any other applicable tests contained in this section.

S14.8.7 *Photometry test.*

S14.8.7.1 *Procedure.* The VHAD and headlamp assembly are then tested for photometric compliance according to the procedure of S14.2.5 and for replacement units per S10.18.8.4.

S14.8.7.2 *Performance requirements.* The sample headlamp must comply with the applicable photometric requirements of Table XIX and Table XVIII and with replacement units installed per S10.18.8.4.

S14.9 *Associated equipment physical test procedures and performance requirements.*

S14.9.1 *Turn signal operating unit durability test.*

S14.9.1.1 *Power supply specifications.* During the test, the unit is operated at 6.4 volts for 6 volt systems or 12.8 volts for 12 volt systems from a power supply meeting the following requirements:

(a) An output current that is at least 10 times the load current;

(b) Voltage regulation that allows a voltage change of less than 5%;

(c) Ripple voltage of not more than 5%;

(d) A response time of not more than 25 milliseconds rise time from 0 to rated current at rated voltage in a pure resistance circuit; and

(e) An output impedance of not more than 0.005 ohms dc.

S14.9.1.2 *Procedure.*

S14.9.1.2.1 The sample unit is operated with the maximum bulb load it will experience on the vehicle on which it will be installed. Bulbs that fail during the test are replaced. The turn signal flasher is not to be included in the test circuit. When the unit includes a self-canceling means, the test equipment is arranged so that the unit will be turned ''off'' in its normal operating manner.

S14.9.1.2.2 The test is conducted at a rate not to exceed 15 complete cycles per minute. One complete cycle consists of the following sequence: Off, left turn, off, right turn, and return to off.

S14.9.1.2.3 The voltage drop from the input terminal of the device to each lamp output terminal, including 3 in of 16 or 18 gage wire, is measured at the start of the test, at intervals of not more than 25,000 cycles during the test, and at the completion of the test.

S14.9.1.3 *Performance requirements.*

S14.9.1.3.1 A turn signal operating unit is considered to have met the requirements of the durability test if it remains operational after completing at least 100,000 cycles, and the voltage drop between the input contact and any output contact, including required length of wire, does not exceed 0.25 volts.

S14.9.1.3.2 A turn signal operating unit is considered to have met the requirements of the durability test if it remains operational after completing at least 175,000 cycles for a unit installed on a multipurpose passenger vehicle, truck, or bus 2032 mm or more in overall width, and the voltage drop between the input contact and any output contact, including required length of wire, does not exceed 0.25 volts.

S14.9.1.3.3 If stop signals also operate through the turn signal operating unit, the voltage drop of any additional switch contacts must meet the same requirements as the turn signal contacts.

S14.9.2 *Vehicular hazard warning signal operating unit durability test.*

S14.9.2.1 *Procedure.*

S14.9.2.1.1 The sample unit is operated at its rated voltage with the maximum bulb load it will experience on the vehicle on which it will be installed. Bulbs that fail during the test are replaced. The hazard warning signal flasher is not to be included in the test circuit.

S14.9.2.1.2 The unit is turned ''on'' and ''off'' in its normal operating manner at a rate not to exceed 15 complete cycles per minute. One complete cycle consists of the sequence: Off, on, and return to off. The test consists of 10,000 cycles at an ambient temperature of 75° ±10 °F followed by 1 hour constant ''on'' at the same temperature.

S14.9.2.1.3 The voltage drop from the input terminal of the device to each lamp output terminal, including 3 in of 16 or 18 gage wire, is measured at the start of the test and at the completion of the test.

S14.9.2.2 *Performance requirements.* A hazard warning signal operating unit is considered to have met the requirements of the durability test if it remains operational after completing 10,000 cycles and the 1 hour constant ''on'' and the voltage drop between the input contact and any output contact, including required length of wire, does not exceed 0.3 volts for either 6.4 or 12.8 line voltage both at the start and completion of the test.

S14.9.3 *Turn signal flasher and vehicular hazard warning signal flasher tests.*

S14.9.3.1 *Standard test circuit.* All turn signal flasher and vehicular hazard warning signal flasher tests use the standard test circuit of Figure 22.

S14.9.3.1.1 *Test circuit setup.*

S14.9.3.1.1.1 The effective series resistance in the total circuit between the power supply and the bulb sockets (excluding the flasher and bulb load(s) using shorting bars) is 0.10 ±0.01 ohm.

S14.9.3.1.1.2 The circuit resistance at A–B of Figure 22 is measured with flasher and bulb load(s) each shorted out with an effective shunt resistance not to exceed 0.005 ohms.

S14.9.3.1.1.3 The voltage to the bulbs at C–D of Figure 22 is adjusted to 12.8 volts (or 6.4 volts) with the flasher shorted out by an effective shunt resistance not to exceed 0.005 ohms. The load current is adjusted by simultaneously adjusting trimmer resistors, R.

S14.9.3.1.1.4 For testing fixed-load flashers at other required voltages, adjust the power supply to provide required voltages, at the required temperatures, at C–D of Figure 22, without readjustment of trimming resistors, R.

S14.9.3.1.1.5 For variable-load flashers, the circuit is first adjusted for 12.8 volts (or 6.4 volts) at C–D of Figure 22, with the minimum required load, and the power supply is adjusted to provide other required test voltages, at required temperatures, at C–D of Figure 22, without readjustment of trimming resistors, R (each such required voltage being set with the minimum required load in place). The required voltage tests with the maximum load are conducted without readjusting each corresponding power supply voltage, previously set with minimum bulb load.

S14.9.3.1.1.6 A suitable high impedance measuring device connected to points X–Y in Figure 22 is used for measuring flash rate, percent current ''on'' time, and voltage drop across the flasher. The measurement of these quantities does not affect the circuit.

S14.9.3.2 *Power supply specifications.*

S14.9.3.2.1 *Starting time, voltage drop, and flash rate and percent current ''on'' time tests.* The power supply used in the standard test circuit for conducting the starting time, the voltage drop, and the flash rate and percent current ''on'' time tests must comply with the following specifications:

(a) Must not generate any adverse transients not present in motor vehicles;

(b) Be capable of supplying 11–16 vdc for 12 volt flashers and 5–9 vdc for 6 volt flashers to the input terminals of the standard test circuit;

(c) Be capable of supplying required design current(s) continuously and inrush currents as required by the design bulb load complement;

(d) Be capable of supplying an output voltage that does not deviate more than 2% with changes in the static load from 0 to maximum (not including inrush current) nor for static input line voltage variations;

(e) Be capable of supplying an output voltage that does not deviate more than 1.0 vdc from 0 to maximum load (including inrush current) and must recover 63% of its maximum excursion within 100 μsec; and

(f) Have a ripple voltage of 75mv, peak to peak.

S14.9.3.2.2 *Durability tests.* The power supply used in the standard test circuit for conducting durability tests must comply with the following specifications:

(a) Must not generate any adverse transients not present in motor vehicles;

(b) Be capable of supplying 13 vdc and 14 vdc for 12 volt flashers and 6.5 vdc and 7 vdc for 6 volt flashers to the input terminals of the standard test circuit;

(c) Be capable of supplying a continuous output current of the design load for one flasher times the number of flashers and inrush currents as required by the design bulb load complement;

(d) Be capable of supplying an output voltage that does not deviate more than 2% with changes in the static load from 0 to maximum (not including inrush current) and means must be provided to compensate for static input line voltage variations;

(e) Be capable of supplying an output voltage that does not deviate more than 1.0 vdc from 0 to maximum load (including inrush current) and must recover 63% of its maximum excursion within 5 μsec; and

(f) Have a ripple voltage of 300 mv, peak to peak.

S14.9.3.3 *Turn signal flasher starting time test.*

S14.9.3.3.1 *Samples.* Twenty sample flashers chosen from random from fifty representative samples are subjected to a starting time test using the standard test circuit.

S14.9.3.3.2 *Procedure.*

S14.9.3.3.2.1 The test is conducted in an ambient temperature of 75 ±10 °F with the design load (variable load flashers are tested with their minimum and their maximum design load) connected and the power source for the test circuit adjusted to apply design voltage at the bulbs.

S14.9.3.3.2.2 The time measurement starts when the voltage is initially applied. Compliance is based on an average of three starts for each sample separated by a cooling interval of 5 minutes.

S14.9.3.3.3 *Performance requirements.* The requirements of the starting time test are considered to have been met if 17 of 20 samples comply with the following:

(a) A flasher having normally closed contacts must open (turn off) within 1.0 second for a device designed to operate two signal lamps, or within 1.25 seconds for a device designed to operate more than two lamps, or

(b) A flasher having normally open contacts must complete the first cycle (close the contacts and then open the contacts) within 1.5 seconds.

S14.9.3.4 *Turn signal flasher voltage drop test.*

S14.9.3.4.1 *Samples.* The same twenty sample flashers used in the starting time test are subjected to a voltage drop test using the standard test circuit.

S14.9.3.4.2 *Procedure.*

S14.9.3.4.2.1 The test is conducted in an ambient temperature of 75 ±10 °F with the design load (variable load flashers are tested with their maximum design load) connected and the power source for the standard test circuit adjusted to apply 12.8 volts or 6.4 volts at the bulbs according to the flasher rating.

S14.9.3.4.2.2 The voltage drop is measured between the input and load terminals of the flasher during the ''on'' period after the flashers have completed at least five consecutive cycles.

S14.9.3.4.3 *Performance requirements.* The requirements of the voltage drop test are considered to have been met if 17 of 20 samples comply with the lowest voltage drop across any flasher not exceeding 0.80 volt.

S14.9.3.5 *Turn signal flasher flash rate and percent current ''on'' time test.*

S14.9.3.5.1 *Samples.* The same twenty sample flashers used in the voltage drop test are subjected to a flash rate and percent of current ''on'' time test.

S14.9.3.5.2 *Procedure.*

S14.9.3.5.2.1 The test is conducted using the standard test circuit with the design load (variable load flashers are tested with their minimum and their maximum design load) connected and design voltage applied to the bulbs.

S14.9.3.5.2.2 Compliance is determined using the following combinations of ambient temperature and bulb voltage:

(a) 12.8 volts (or 6.4 volts) and 75° ±10 °F,

(b) 12.0 volts (or 6.0 volts) and 0° ±5 °F,

(c) 15.0 volts (or 7.5 volts) and 0° ±5 °F,

(d) 11.0 volts (or 5.5 volts) and 125° ±5 °F, and

(e) 14.0 volts (or 7.0 volts) and 125° ±5 °F.

S14.9.3.5.2.3 Flash rate and percent current ''on'' time are measured after the flashers have completed five consecutive cycles and are determined by an average of at least three consecutive cycles.

S14.9.3.5.3 *Performance requirements.* The requirements of the flash rate and percent current ''on'' time test are considered to have been met if 17 of 20 samples comply with the following:

(a) The performance of a normally closed type flasher must be within the unshaded portion of the polygon shown in Figure 2, or

(b) The performance of a normally open type flasher must be within the entire rectangle including the shaded areas shown in Figure 2.

S14.9.3.6 *Turn signal flasher durability test.*

S14.9.3.6.1 *Samples.* Twenty sample flashers chosen from random from the thirty samples not used in the previous tests are subjected to a durability test.

S14.9.3.6.2 *Procedure.*

S14.9.3.6.2.1 Conformance of the samples to the starting time, voltage drop, and flash rate and percent of current ''on'' time tests (limited to the 12.8 volts or 6.4 volts and 75° ±10 °F test condition only) is established.

S14.9.3.6.2.2 The test is conducted on each sample with the design load (variable load flashers are tested with their maximum design load) connected and 14 volts or 7.0 volts, according to the flasher rating, applied to the input terminals of the standard test circuit.

S14.9.3.6.2.3 The test cycle consists of 15 seconds on followed by 15 seconds off for a total time of 200 hours in an ambient temperature of 75° ±10 °F.

S14.9.3.6.3 *Performance requirements.* The requirements of the durability test are considered to have been met if, after completion, 17 of 20 samples comply with the performance requirements of the starting time, voltage drop, and flash rate and percent of current ''on'' time tests (limited to the 12.8 volts or 6.4 volts and 75° ±10 °F test condition only) when tested in the standard test circuit with design load and 12.8 volts (or 6.4 volts) applied to the bulbs.

S14.9.3.7 *Vehicular hazard warning signal flasher starting time test.*

S14.9.3.7.1 *Samples.* Twenty sample flashers chosen from random from fifty representative samples are subjected to a starting time test using the standard test circuit.

S14.9.3.7.2 *Procedure.*

S14.9.3.7.2.1 The test is conducted test in an ambient temperature of 75° ±10 °F with the minimum and maximum load connected and the power source for the test circuit adjusted to apply design voltage at the bulbs.

S14.9.3.7.2.2 The time measurement starts when the voltage is initially applied.

S14.9.3.7.3 *Performance requirements.* The requirements of the starting time test are considered to have been met if 17 of 20 samples comply with the following:

(a) A flasher having normally closed contacts must open (turn off) within 1.5 seconds after the voltage is applied, or

(b) A flasher having normally open contacts must complete the first cycle (close the contacts and then open the contacts) within 1.5 seconds after the voltage is applied.

S14.9.3.8 *Vehicular hazard warning signal flasher voltage drop test.*

S14.9.3.8.1 *Samples.* The same twenty sample flashers used in the starting time test are subjected to a voltage drop test using the standard test circuit.

S14.9.3.8.2 *Procedure.*

S14.9.3.8.2.1 The test is conducted in an ambient temperature of 75° ±10 °F with the maximum design load connected and the power source for the test circuit adjusted to apply design voltage at the bulbs.

S14.9.3.8.2.2 The voltage drop is measured between the input and load terminals of the flasher during the ''on'' period after the flashers have completed at least five consecutive cycles.

S14.9.3.8.3 *Performance requirements.* The requirements of the voltage drop test are considered to have been met if 17 of 20 samples comply with the lowest voltage drop across any flasher must not exceed 0.8 volt.

S14.9.3.9 *Vehicular hazard warning signal flasher flash rate and percent ''on'' time test.*

S14.9.3.9.1 *Samples.* The same twenty sample flashers used in the voltage drop test are subjected to a flash rate and percent of current ''on'' time test.

S14.9.3.9.2 *Procedure.*

S14.9.3.9.2.1 The test is conducted using the standard test circuit by and applying loads of from two signal lamps to the maximum design loading including pilot indicator.

S14.9.3.9.2.2 Compliance is determined using the following combinations of ambient temperature and bulb voltage:

(a) 12.8 volts (or 6.4 volts) and 75° ±10 °F,

(b) 11.0 volts (or 5.5 volts) and 125° ±5 °F,

(c) 11.0 volts (or 5.5 volts) and 0° ±5 °F,

(d) 13.0 volts (or 6.5 volts) and 125° ±5 °F, and

(e) 13.0 volts (or 6.5 volts) and 0° ±5 °F.

S14.9.3.9.2.3 Flash rate and percent current ''on'' time are measured after the flashers have completed five consecutive cycles and are determined by an average of at least three consecutive cycles.

S14.9.3.9.3 *Performance requirements.* The requirements of the flash rate and percent current ''on'' time test are considered to have been met if 17 of 20 samples comply with the following:

(a) The performance of a normally closed type flasher must be within the

unshaded portion of the polygon shown in Figure 2, or

(b) The performance of a normally open type flasher must be within the entire rectangle including the shaded areas shown in Figure 2.

S14.9.3.10 *Vehicular hazard warning signal flasher durability test.*

S14.9.3.10.1 *Samples.* Twenty sample flashers chosen from random from the thirty samples not used in the previous tests are subjected to a durability test.

S14.9.3.10.2 *Procedure.*

S14.9.3.10.2.1 Conformance of the samples to the starting time, voltage drop, and flash rate and percent of current ''on'' time tests (limited to the 12.8 volts or 6.4 volts and 75° ±10 °F test condition only) is established.

S14.9.3.10.2.2 The test is conducted on each sample with the maximum design load connected and 13.0 volts (or 6.5 volts) applied to the input terminals of the standard test circuit.

S14.9.3.10.2.3 The flasher is subjected to continuous flashing for a total time of 36 hours in an ambient temperature of 75° ±10 °F.

S14.9.3.10.3 *Performance requirements.* The requirements of the durability test are considered to have been met if, after completion, 17 of 20 samples comply with the performance requirements of the starting time, voltage drop, and flash rate and percent of current ''on'' time tests (limited to the 12.8 volts or 6.4 volts and 75° ±10 °F test condition only) when tested in the standard test circuit with the power source adjusted to provide design voltage to the bulbs and with a minimum load of two signal lamp bulbs and the maximum design load, including pilot lamps, as specified by the manufacturer at an ambient temperature of 75° ±10 °F.

S14.9.3.11 *Semiautomatic headlamp beam switching device tests.*

S14.9.3.11.1 *Test conditions.* All tests are conducted with 13 volts input to the device unless otherwise specified.

S14.9.3.11.2 *Sensitivity test.*

S14.9.3.11.2.1 *Samples.* The sample device is mounted in and operated in the laboratory in the same environment as that encountered on the vehicle, that is tinted glass, grille work, etc.

S14.9.3.11.2.2 *Procedure.*

S14.9.3.11.2.2.1 The sample device is adjusted for sensitivity in accordance with the manufacturer's instructions. It is exposed to a light source capable of providing a variable intensity of at least 1.5 cd to 150 cd at 100 feet from the sample device.

S14.9.3.11.2.2.2 The device is switched to the lower beam mode in accordance with the ''dim'' limits specified and switched back to the upper beam mode in accordance with the ''hold'' limits specified for the specified test positions.

S14.9.3.11.2.2.3 To provide more complete information on sensitivity throughout the required vertical and horizontal angles, a set of constant footcandle curves are made at ''dim'' sensitivities of 17, 25, and 100 cd at 100 ft.

S14.9.3.11.2.3 *Performance requirements.*

S14.9.3.11.2.3.1 *Operating limits.*

Test position (degrees)	Dim (cd at 100 ft)	Hold (cd at 100 ft)
H V	Adjust to 15	1.5 min to 3.75 max.
H 2L	25 max	1.5 min.
H 4L	40 max	1.5 min.
H 6L	75 max	1.5 min.
H 2R	25 max	1.5 min.
H 5R	150 max to 40 min	1.5 min.
1D V	30 max	1.5 min.
1U V	30 max	1.5 min.

S14.9.3.11.2.3.2 There must be no sensitivity voids shown in the constant footcandle curves within the area limited by the test positions.

S14.9.3.11.3 *Voltage regulation test.*

S14.9.3.11.3.1 *Procedure.*

S14.9.3.11.3.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.3.1.2 The ''dim'' sensitivity is measured at the H–V test position at 11 volts input to the device and at 15 volts input to the device.

S14.9.3.11.3.2 *Performance requirements.* The device must switch to the lower beam mode at between 8 (cd at 100 ft) and 25 (cd at 100 ft) with the input voltage at 11 volts and at 15 volts.

S14.9.3.11.4 *Manual override test.*

S14.9.3.11.4.1 *Procedure.*

S14.9.3.11.4.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.4.1.2 The device is exposed to a test light that causes it to switch to the lower beam mode.

S14.9.3.11.4.1.3 The manufacturer's instructions are followed to cause the device to override the test light and switch to upper beam.

S14.9.3.11.4.1.4 In a similar manner, the test light is extinguished to cause the device to switch to the upper beam mode.

S14.9.3.11.4.1.5 Again the manufacturer's instructions are followed to cause the device to switch to lower beam.

S14.9.3.11.4.2 *Performance requirements.* The device, when operated in accordance with the manufacturer's instructions, must switch to the opposite beam with the test light energized and with the test light extinguished.

S14.9.3.11.5 *Warmup test.*

S14.9.3.11.5.1 *Procedure.*

S14.9.3.11.5.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test and the test lamp extinguished.

S14.9.3.11.5.1.2 The test lamp will then be energized at a level of 25 (cd at 100 ft) at the H–V position of the device and the time for the device to switch to lower beam is measured.

S14.9.3.11.5.2 *Performance requirements.* If the warmup time of the device exceeds 10 seconds it shall maintain the headlamps on lower beam during warmup.

S14.9.3.11.6 *Temperature test.*

S14.9.3.11.6.1 *Procedure.*

S14.9.3.11.6.1.1 The sample device is exposed for 1 hour in a temperature corresponding to that at the device mounting location.

S14.9.3.11.6.1.2 For a device mounted in the passenger compartment or the engine compartment, the temperature is 210 °F, mounted elsewhere, the temperature is 150 °F.

S14.9.3.11.6.1.3 After this exposure the H–V ''dim'' sensitivity of the sample device is measured over the temperature range of −30 °F to + 100 °F.

S14.9.3.11.6.2 *Performance requirements.* The device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft) over the temperature range of −30 °F to + 100 °F.

S14.9.3.11.7 *Dust test.*

S14.9.3.11.7.1 *Procedure.*

S14.9.3.11.7.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.7.1.2 The device is then subjected to the dust test of S14.5.3.

S14.9.3.11.7.1.3 At the conclusion of the dust exposure the lens of the device must be wiped clean and the H–V ''dim'' sensitivity of the sample device is measured.

S14.9.3.11.7.2 *Performance requirements.* The device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.8 *Corrosion test.*

S14.9.3.11.8.1 *Procedure.*

S14.9.3.11.8.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.8.1.2 All system components located outside the passenger compartment must be subjected to the corrosion test of S14.5.4 with the device not operating.

S14.9.3.11.8.1.3 Water is not permitted to accumulate on any connector socket.

S14.9.3.11.8.1.4 At the conclusion of the test the H–V ''dim'' sensitivity of the sample device must be measured.

S14.9.3.11.8.2 *Performance requirements.* The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.9 *Vibration test.*

S14.9.3.11.9.1 *Procedure.*

S14.9.3.11.9.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test and the mechanical aim of the photounit determined.

S14.9.3.11.9.1.2 The sample device must be mounted in proper vehicle position and subjected to vibration of 5g constant acceleration for ½ hour in

each of three directions: vertical; horizontal and parallel to the vehicle longitudinal axis; and horizontal and normal to the vehicle longitudinal axis.

S14.9.3.11.9.1.3 The vibration frequency must be varied from 30 to 200 and back to 30 cycles per second over a period of approximately 1 minute.

S14.9.3.11.9.1.4 The device must be operating during the test.

S14.9.3.11.9.1.5 At the conclusion of the test the H–V ''dim'' sensitivity of the sample device and the mechanical aim of the photounit must be measured.

S14.9.3.11.9.2 *Performance requirements.*

S14.9.3.11.9.2.1 The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.9.2.2 The mechanical aim of the device photounit must not have changed by more than 0.25° from the initial value.

S14.9.3.11.10 *Sunlight test.*

S14.9.3.11.10.1 *Procedure.*

S14.9.3.11.10.1.1 The sample device must be exposed for 1 hour in bright noonday sunlight (5000 fc minimum illumination with a clear sky) with the photounit aimed as it would be in service and facing an unobstructed portion of the horizon in the direction of the sun.

S14.9.3.11.10.1.2 The device must then be rested for 1 hour in normal room light at room temperature and the H–V ''dim'' sensitivity of the sample device is measured.

S14.9.3.11.10.2 *Performance requirements.* The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.11 *Durability test.*

S14.9.3.11.11.1 *Procedure.*

S14.9.3.11.11.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.11.1.2 The device photounit operated at a 13.0 input voltage on a cycle of 90 minutes on and 30 minutes off must be activated by a 60 cd light source at 100 ft, or equivalent, which is cycled on and off 4 times per minute for a period of 200 hours.

S14.9.3.11.11.1.3 The device must then rest for 2 hours in a lighted area of 50 to 150 fc after which the H–V ''dim'' sensitivity must be measured.

S14.9.3.11.11.2 *Performance requirements.* The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.12 *Return to upper beam test.*

S14.9.3.11.12.1 *Procedure.*

S14.9.3.11.12.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.12.1.2 The lens of the photounit must be exposed to light of 100 fc for 10 seconds.

S14.9.3.11.12.2 *Performance requirements.* The sample device must switch to upper beam mode within 2 seconds after the 100 fc light is extinguished.

S14.9.3.12 *Test for compliance with adaptive driving beam photometry requirements.*

S14.9.3.12.1 *Test scenarios.*

S14.9.3.12.1.1 Any of the scenarios specified in Table XXII and Figures 27, 28, 29, and 30 may be tested. Where a range of values is specified, the vehicle shall be able to meet the requirements at all values within the range.

S14.9.3.12.1.2 Any speed that conforms to the speeds specified for that test scenario will be selected for the test vehicle. The vehicle will achieve and maintain this speed ± 0.45 m/s (1 mph) prior to reaching, and then throughout, the measurement distance range specified for that scenario. Once the test speed is achieved and maintained, no sudden steering inputs, acceleration, braking, or anything that causes a change in vehicle pitch that affects the results of the test shall occur.

S14.9.3.12.1.3 For test scenarios involving curves, any radius within the allowable range specified for that test scenario may be selected. The curve shall nominally consist of a constant radius path and be referenced to the headlighting system midpoint. The actual path of the test vehicle shall not deviate from the nominal path by more than ± 0.5 m throughout the measurement distance range.

S14.9.3.12.1.4 The test vehicle shall be driven within the lane and will not change lanes.

S14.9.3.12.1.5 The measurement distance is the linear distance measured

from the headlighting system midpoint to the most forward point of the relevant photometric receptor head mounted on the test fixture.

S14.9.3.12.1.6 The illuminance values for each photometer, the instantaneous pitch of the test vehicle, and the measurement distance shall be recorded and synchronized throughout the measurement distance range specified for that scenario.

S14.9.3.12.2 *Compliance criteria.* The maximum calculated illuminance for each measurement distance interval specified in Table XXI that is applicable to the scenario being tested, as determined according to S14.9.3.12.2.1, shall not exceed the applicable maximum illuminance listed in Table XXI.

S14.9.3.12.2.1 The maximum calculated illuminance for each measurement distance interval specified in Table XXI that is applicable to the scenario being tested will be the highest illuminance recorded in that distance interval, excluding any illuminance value(s) that meet any of the following conditions:

(a) A single illuminance value exceeding the applicable maximum illuminance in Table XXI (*i.e.*, the illuminance value is not immediately preceded or followed by an illuminance value exceeding the applicable maximum illuminance); or

(b) consecutive illuminance values occurring over a span of no more than 0.1 seconds exceeding the applicable maximum illuminance in Table XXI; or

(c) any illuminance values collected while the vehicle pitch exceeds the average pitch recorded throughout the entire measurement distance range specified for that scenario in Table XXII by more than 0.3 degrees.

S14.9.3.12.3 *Stimulus test fixtures.* Testing shall be conducted using the stimulus test fixtures specified in this section and Figures 23 through 26.

S14.9.3.12.3.1 *Headlamps.* The headlamps specified in Fig. 23 (Opposite Direction Car/Truck) shall be a right- and left-hand 2018 Ford F–150 Halogen headlamp (part # KL3Z13008C KL3Z13008D) using any replaceable light source designated for use in the system and, separately, a right- and left-hand 2018 Toyota Camry LED headlamp (part # 8111006C40/8115006C40). The headlamps specified in Fig. 25 (Opposite Direction Motorcycle) shall be a 5.75-inch round headlamp kit from a 2018 Harley Davidson Sportster (part #68297–05B) using an HB2 replaceable light source. Each headlamp shall energize the lower beam only, powered at 12.8 volts DC ± 500 mV when measured at the lamp terminals, and shall have been energized for a minimum of 5 minutes before each test trial. The measurement locations specified in Figures 23 and 25 shall be measured to the optical axis marking of the headlamps.

S14.9.3.12.3.2 *Taillamps.* The taillamps specified in Fig. 24 (Same Direction Car/Truck) shall be a right and left-hand 2018 Ford F–150 incandescent rear combination lamp (part # JL3Z13405H/JL3Z13404H) and, separately, a right and left-hand 2018 Toyota Camry rear combination lamp (part # 81550–06730/81560–06730). The taillamps specified in Fig. 26 (Same Direction Motorcycle) shall be a 2018 Harley Davidson Roadster layback LED taillamp assembly (part #67800355). The taillamps shall be powered at 12.8 volts DC ± 500 mV when measured at the lamp terminals and shall have been energized for a minimum of 5 minutes before each test trial. The measurement locations specified in Figures 24 and 26 shall be measured to the center of the taillamp.

S14.9.3.12.3.3 *Photometers.* Photometers must be capable of a minimum measurement unit of 0.01 lux. The color response of the photometer must be corrected to that of the 1931 CIE Standard Observer (2-degree) Photopic Response Curve, as shown in the CIE 1931 Chromaticity Diagram (incorporated by reference, see § 571.5), with a cosine correction characteristic within 3%. The photometer lenses on the test fixture shall be clean and free from dirt and debris, and the photometers will be zero-calibrated for each test to account for ambient light. The illuminance values from the photometers shall be collected at a rate of at least 100 Hz and a maximum 25-degree angle of incidence.

S14.9.3.12.3.4 The projection of the fixture lamp's optical axis onto the road surface shall be parallel to a tangent of the road edge at the location of the photometer.

S14.9.3.12.3.5 The test fixture shall be centered in the lane.

S14.9.3.12.4 *Test vehicle preparation.*

S14.9.3.12.4.1 Tires on the test vehicle shall be inflated to the manufacturer's recommended cold inflation pressure ± 7 kPa (1 psi). If more than one recommendation is provided, the tires are inflated to the cold inflation pressure ± 7 kPa (1 psi) that corresponds to the lowest loaded condition listed.

S14.9.3.12.4.2 Before initiating testing, if the test vehicle is equipped with a fuel tank it shall be filled to approximately 100% of capacity with the appropriate fuel and maintained to at least 75% capacity throughout the testing.

S14.9.3.12.4.3 Headlamps on the test vehicle shall be aimed according to the vehicle manufacturer's instructions. The test vehicle shall be loaded within ± 5 kg of the total vehicle weight during track testing prior to aiming the adaptive driving beam headlamps.

S14.9.3.12.4.4 The adaptive driving beam system shall be adjusted according to the manufacturer's instructions.

S14.9.3.12.4.5 To the extent practicable, adaptive driving beam system sensors and the windshield on the test vehicle (if an adaptive driving beam system sensor is behind the windshield) shall be clean and free of dirt and debris.

S14.9.3.12.4.6 The headlamp lenses of the test vehicle shall be clean and free from dirt and debris.

S14.9.3.12.4.7 The adaptive driving beam system shall be activated according to the manufacturer's instructions and all other independently controlled lamps, such as fog lamps, shall be turned off.

S14.9.3.12.5 *Test road*

S14.9.3.12.5.1 The test road shall have a longitudinal grade (slope) that does not exceed 2%.

S14.9.3.12.5.2 The lane width shall be any width from 3.05 m (10 ft) to 3.66 m (12 ft).

S14.9.3.12.5.3 The lanes shall be adjacent to one another.

S14.9.3.12.5.4 The tests are conducted on a uniform, solid-paved surface.

S14.9.3.12.5.5 The test road surface may be concrete or asphalt and shall not be bright white.

S14.9.3.12.5.6 The test road surface may have pavement markings but shall be free of retroreflective material or elements that affect the outcome of the test.

S14.9.3.12.6 *Other test parameters and conditions*

S14.9.3.12.6.1 Testing shall be conducted on dry pavement and with no precipitation.

S14.9.3.12.6.2 Testing shall be conducted when the ambient illumination at the test road as recorded by the photometers is at or below 0.2 lux.

S14.9.3.12.6.3 Photometer data signals shall be passed through a low-pass filter with a cutoff frequency of 35 Hz.

TABLE I–a—REQUIRED LAMPS AND REFLECTIVE DEVICES

Lighting device	Number and color	Mounting location	Mounting height	Device activation
All Passenger Cars, Multipurpose Passenger Vehicles (MPV), Trucks, and Buses				
Lower Beam Headlamps.	White, of a headlighting system listed in Table II.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 55.9 cm nor more than 137.2 cm.	The wiring harness or connector assembly of each headlighting system must be designed so that only those light sources intended for meeting lower beam photometrics are energized when the beam selector switch is in the lower beam position, and that only those light sources intended for meeting upper beam photometrics are energized when the beam selector switch is in the upper beam position, except for certain systems listed in Table II and semiautomatic headlamp beam switching devices certified to S9.4.1.6. Steady burning, except that may be flashed for signaling purposes or (for semiautomatic headlamp beam switching devices certified to S9.4.1.6) vary in intensity for adaptive driving beam functionality.
Upper Beam Headlamps.	White, of a headlighting system listed in Table II.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 22 inches (55.9 cm) nor more than 54 inches (137.2 cm).	
Turn Signal Lamps	2 Amber	At or near the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 83 inches.	Flash when the turn signal flasher is actuated by the turn signal operating unit.
	2 Amber or red Truck tractor exception, see S6.1.1.3.	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable.		
Taillamps	2 Red	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 72 inches.	Steady burning. Must be activated when the headlamps are activated in a steady burning state or the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activated. May be activated when the headlamps are activated at less than full intensity as Daytime Running Lamps (DRL).
Stop Lamps	2 Red	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 72 inches.	Steady burning. Must be activated upon application of the service brakes. When optically combined with a turn signal lamp, the circuit must be such that the stop signal cannot be activated if the turn signal lamp is flashing. May also be activated by a device designed to retard the motion of the vehicle.

TABLE I–a—REQUIRED LAMPS AND REFLECTIVE DEVICES—Continued

Lighting device	Number and color	Mounting location	Mounting height	Device activation
Side Marker Lamps	2 Amber	On each side as far to the front as practicable.	Not less than 15 inches.	Steady burning except may be flashed for signaling purposes. Must be activated when the headlamps are activated in a steady burning state or the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activated.
	2 Red (not required on truck tractor).	On each side as far to the rear as practicable.		
Reflex Reflectors	2 Amber	On each side as far to the front as practicable.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
	2 Red (not required on truck tractor)..	On each side as far to the rear as practicable.		
	2 Red	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. On a truck tractor may be mounted on the back of the cab not less than 4 inches above the height of the rear tires.		
Backup Lamp	1 White Additional lamps permitted to meet requirements.	On the rear	No requirement	Steady burning. Must be activated when the ignition switch is energized and reverse gear is engaged. Must not be energized when the vehicle is in forward motion.
License Plate Lamp	1 White Additional lamps permitted to meet requirements.	On the rear to illuminate license plate from top or sides.	No requirement	Steady burning. Must be activated when the headlamps are activated in a steady burning state or when the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activated.
Additional Lamps Required on All Passenger Cars, and on Multipurpose Passenger Vehicles (MPV), Trucks, and Buses, Less Than 2032 MM in Overall Width				
Parking lamps	2 Amber or white	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 72 inches.	Steady burning. Must be activated when the headlamps are activated in a steady burning state.
Additional Lamp(s) Required on All Passenger Cars, and on Multipurpose Passenger Vehicles (MPV), Trucks, and Buses, Less Than 2032 MM in Overall Width and With a GVWR of 10,000 Lbs or Less				
High mounted stop lamp.	1 Red, or 2 red where exceptions apply. See Section 6.1.1.2.	On the rear including glazing, with the lamp center on the vertical centerline as viewed from the rear.	Not less than 34 inches except for passenger cars. See Section 6.1.4.1.	Steady burning. Must only be activated upon application of the service brakes or may be activated by a device designed to retard the motion of the vehicle.

TABLE I–a—REQUIRED LAMPS AND REFLECTIVE DEVICES—Continued

Lighting device	Number and color	Mounting location	Mounting height	Device activation
Additional Lamps and Reflective Devices Required on All Passenger Cars, Multipurpose Passenger Vehicles (MPV), Trucks, and Buses, 30 Feet or Longer				
Intermediate side marker lamps.	2 Amber	On each side located at or near the midpoint between the front and rear side marker lamps.	Not less than 15 inches.	Steady burning except may be flashed for signaling purposes. Must be activated when the headlamps are activated in a steady burning state or when the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activated.
Intermediate side reflex reflectors.	2 Amber	On each side located at or near the midpoint between the front and rear side reflex reflectors.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
Additional Lamps Required on All Multipurpose Passenger Vehicles (MPV), Trucks, and Buses, 2032 MM or More in Overall Width				
Clearance lamps	2 Amber	On the front to indicate the overall width of the vehicle, or width of cab on truck tractor, at the same height, symmetrically about the vertical centerline. May be located at a location other than the front if necessary to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle.	As near the top as practicable.	Steady burning.
	2 Red (not required on truck tractor).	On the rear to indicate the overall width of the vehicle, at the same height, symmetrically about the vertical centerline. May be located at a location other than the rear if necessary to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle.	As near the top as practicable, except where the rear identification lamps are mounted at the extreme height of the vehicle.. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors.	Steady burning.
Identification lamps	3 Amber	On the front, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6 inches or more than 12 inches apart.	As near the top of the vehicle or top of the cab as practicable.	Steady burning.

TABLE I–a—REQUIRED LAMPS AND REFLECTIVE DEVICES—Continued

Lighting device	Number and color	Mounting location	Mounting height	Device activation
	3 Red (not required on truck tractor).	On the rear, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6 inches or more than 12 inches apart.	As near the top as practicable. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors.	Steady burning.
Additional Lamps Required on All School Buses Except Multifunction School Activity Buses				
Signal warning lamps.	2 Red plus 2 amber optional.	On the front of the cab as far apart as practicable, but in no case shall the spacing between lamps be less than 40 inches. Amber lamps, when installed, at the same height as and just inboard of the red lamp.	As high as practicable but at least above the windshield.	Flashing alternately between 60 to 120 cycles per minute, with an activation period sufficient to allow the lamp to reach full brightness, when actuated by a manual switch. Amber lamps, when installed, may only be activated by manual or foot operation, and must be automatically deactivated and the red lamps must be automatically activated when the bus entrance door is opened.
	2 Red plus 2 amber optional.	On the rear cab as far apart as practicable, but in no case shall the spacing between lamps be less than 40 inches. Amber lamps, when installed, at the same height as and just inboard of the red lamp.	As high as practicable but at least above the top of any side window opening.	Flashing alternately between 60 to 120 cycles per minute, with an activation period sufficient to allow the lamp to reach full brightness, when actuated by a manual switch. Amber lamps, when installed, may only be activated by manual or foot operation, and must be automatically deactivated and the red lamps must be automatically activated when the bus entrance door is opened.
Daytime Running Lamps Permitted But Not Required on Passenger Cars, Multipurpose Passenger Vehicles (MPV), Trucks, and Buses				
Daytime running lamp (DRL).	2 identically colored either white, white to yellow, white to selective yellow, selective yellow, or yellow.	On the front, symmetrically disposed about the vertical centerline if not a pair of lamps required by this standard or if not optically combined with a pair of lamps required by this standard.	Not more than 1.067 meters above the road surface if not a pair of lamps required by this standard or if not optically combined with a pair of lamps required by this standard. See S7.10.13(b) for additional height limitation.	Steady burning. Automatically activated as determined by the vehicle manufacturer and automatically deactivated when the headlamp control is in any ''on'' position. Each DRL optically combined with a turn signal lamp must be automatically deactivated as a DRL when the turn signal lamp or hazard warning lamp is activated, and automatically reactivated as a DRL when the turn signal lamp or hazard warning lamp is deactivated. See S7.10.10.1(c) for additional activation requirements when mounted close to, or combined with, a turn signal lamp.

TABLE I–b—REQUIRED LAMPS AND REFLECTIVE DEVICES

Lighting device	Number and color	Mounting location	Mounting height	Device activation
		ALL TRAILERS		
Turn Signal Lamps	2 Red or amber	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 83 inches.	Flash when the turn signal flasher is actuated by the turn signal operating unit.
Taillamps	2 Red or 1 red on trailers less than 30 inches wide.	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. When a single lamp is installed it must be mounted at or near the vertical centerline.	Not less than 15 inches, nor more than 72 inches.	Steady burning.
Stop Lamps	2 Red, or 1 red on trailers less than 30 inches wide.	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. When a single lamp is installed it must be mounted at or near the vertical centerline.	Not less than 15 inches, nor more than 72 inches.	Steady burning. Must be activated upon application of the service brakes. When optically combined with a turn signal lamp, the circuit must be such that the stop signal cannot be activated if the turn signal lamp is flashing. May also be activated by a device designed to retard the motion of the vehicle.
Side Marker Lamps	2 Amber ..... None required on trailers less than 1829 mm [6 ft] in overall length including the trailer tongue.	On each side as far to the front as practicable exclusive of the trailer tongue.	Not less than 15 inches.	Steady burning except may be flashed for signaling purposes.
	2 Red	On each side as far to the rear as practicable.	Not less than 15 inches. Not more than 60 inches on trailers 2032 mm or more in overall width.	
Reflex Reflectors. A trailer equipped with a conspicuity treatment in conformance with S8.2 of this standard need not be equipped with reflex reflectors if the conspicuity material is placed at the locations of the required reflex reflectors.	2 Amber ..... None required on trailers less than 1829 mm [6 ft] in overall length including the trailer tongue.	On each side as far to the front as practicable exclusive of the trailer tongue.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
	2 Red	On each side as far to the rear as practicable.		
	2 Red or 1 red on trailers less than 30 inches wide.	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. When a single reflector is installed it must be mounted at or near the vertical centerline..		

TABLE I–b—REQUIRED LAMPS AND REFLECTIVE DEVICES—Continued

Lighting device	Number and color	Mounting location	Mounting height	Device activation
License Plate Lamp	1 White ..... Additional lamps permitted to meet requirements.	On the rear to illuminate license plate from top or sides.	No requirement	Steady burning.
Additional Lamps and Reflective Devices Required on all Trailers 30 Feet or Longer				
Intermediate side marker lamps.	2 Amber	On each side located at or near the midpoint between the front and rear side marker lamps.	Not less than 15 inches.	Steady burning except may be flashed for signaling purposes.
Intermediate side reflex reflectors. A trailer equipped with a conspicuity treatment in conformance with S8.2 of this standard need not be equipped with reflex reflectors if the conspicuity material is placed at the locations of the required reflex reflectors.	2 Amber	On each side located at or near the midpoint between the front and rear side reflex reflectors.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
Additional Lamps Required on all Trailers 2032 MM or More in Overall Width				
Clearance lamps	2 Amber	On the front to indicate the overall width of the vehicle, at the same height, symmetrically about the vertical centerline. May be located at a location other than the front if necessary to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle.	As near the top as practicable.	Steady burning.
	2 Red	On the rear to indicate the overall width of the vehicle, at the same height, symmetrically about the vertical centerline. May be located at a location other than the rear if necessary to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle.	As near the top as practicable, except where the rear identification lamps are mounted at the extreme height of the vehicle. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors.	Steady burning.
	2 Amber to front and red to rear.	On a boat trailer the requirement for front and rear clearance lamps may be met by installation at or near the midpoint on each side of a dual facing lamp so as to indicate the extreme width. May be located at a location other than the front and the rear if necessary to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle.	As near the top as practicable.	Steady burning.

TABLE I–b—REQUIRED LAMPS AND REFLECTIVE DEVICES—Continued

Lighting device	Number and color	Mounting location	Mounting height	Device activation
Identification lamps	3 Red	On the rear, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6 inches or more than 12 inches apart.	As near the top as practicable. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors.	Steady burning.

TABLE I–c—REQUIRED LAMPS AND REFLECTIVE DEVICES

Lighting device	Number and color	Mounting location	Mounting height	Device activation
All Motorcycles				
Lower Beam Headlamps.	White, of a headlighting system listed in S10.17.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable. See additional requirements in S10.17.1.1, S10.17.1.2, and S10.17.1.3.	Not less than 22 inches (55.9 cm) nor more than 54 inches (137.2 cm).	The wiring harness or connector assembly of each headlighting system must be designed so that only those light sources intended for meeting lower beam photometrics are energized when the beam selector switch is in the lower beam position, and that only those light sources intended for meeting upper beam photometrics are energized when the beam selector switch is in the upper beam position, except for certain systems listed in Table II and semiautomatic headlamp beam switching devices certified to S9.4.1.6. Steady burning, except that may be flashed for signaling purposes or (for semiautomatic headlamp beam switching devices certified to S9.4.1.6) vary in intensity for adaptive driving beam functionality. The upper beam or the lower beam, but not both, may be wired to modulate from a higher intensity to a lower intensity in accordance with S10.17.5.
Upper Beam Headlamps.	White, of a headlighting system listed in S10.17.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable. See additional requirements in S10.17.1.1, S10.17.1.2, and S10.17.1.3.	Not less than 55.9 cm nor more than 137.2 cm.	The upper beam or the lower beam, but not both, may be wired to modulate from a higher intensity to a lower intensity in accordance with S10.17.5

TABLE I–c—REQUIRED LAMPS AND REFLECTIVE DEVICES—Continued

Lighting device	Number and color	Mounting location	Mounting height	Device activation
Turn Signal Lamps	2 Amber. None required on a motor driven cycle whose speed attainable in 1 mile is 30 mph or less.	At or near the front, at the same height, symmetrically about the vertical centerline, and having a minimum horizontal separation distance (centerline of lamps) of 16 inches. Minimum edge to edge separation distance between a turn signal lamp and headlamp is 4 inches.	Not less than 15 inches, nor more than 83 inches.	Flash when the turn signal flasher is actuated by the turn signal operating unit.
	2 Amber or red. None required on a motor driven cycle whose speed attainable in 1 mile is 30 mph or less.	At or near the rear, at the same height, symmetrically about the vertical centerline, and having a minimum horizontal separation distance (centerline to centerline of lamps) of 9 inches. Minimum edge to edge separation distance between the turn signal lamp and the taillamp or stop lamp is 4 inches, when a single stop and taillamp is installed on the vertical centerline and the turn signal lamps are red.		
Taillamps	1 Red	On the rear, on the vertical centerline except that if two are used, they must be symmetrically disposed about the vertical centerline.	Not less than 15 inches, nor more than 72 inches.	Steady burning.
				Must be activated when the headlamps are activated in a steady burning state.
Stop Lamps	1 Red	On the rear, on the vertical centerline except that if two are used, they must be symmetrically disposed about the vertical centerline.	Not less than 15 inches, nor more than 72 inches.	Steady burning.
				Must be activated upon application of the service brakes. When optically combined with a turn signal lamp, the circuit must be such that the stop signal cannot be activated if the turn signal lamp is flashing. May also be activated by a device designed to retard the motion of the vehicle.

TABLE I–c—REQUIRED LAMPS AND REFLECTIVE DEVICES—Continued

Lighting device	Number and color	Mounting location	Mounting height	Device activation
Reflex Reflectors	2 Amber	On each side as far to the front as practicable.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
	2 Red	On each side as far to the rear as practicable.		
	1 Red	On the rear, on the vertical centerline except that, if two are used on the rear, they must be symmetrically disposed about the vertical centerline.		
License Plate Lamp	1 White	On the rear to illuminate license plate.	No requirement	Steady burning.
	Additional lamps permitted to meet requirements.	.....	.....	Must be activated when the headlamps are activated in a steady burning state.

TABLE II-a: HEADLIGHTING SYSTEMS-SEALED BEAMS

SYSTEM DESIGNATION	UNIT NOMINAL SIZE	NUMBER OF HEADLAMPS	HEADLAMP DESIGNATION	BEAM COMPOSITION	PHOTOMETRY REQUIREMENTS REFERENCE			MAXIMUM FILAMENT POWER AT 12.8 V	
					TABLE XVIII	TABLES XIX-A, XIX-b, XIX-c			
					UPPER BEAM MECHANICAL AND VISUAL AIM	LOWER BEAM MECH AIM	LOWER BEAM VISUAL AIM	UPPER BEAM	LOWER BEAM
TYPE A	100x165 mm	2	1A1	1 UB FILAMENT	UB4	N.A.	N.A.	55	N.A.
		2	2A1	1 UB & 1 LB FILAMENTS	UB5	LB4M	LB2V	43	65
TYPE B	142x200 mm	2	2B1	1 UB & 1 LB FILAMENTS	UB3	LB3M	LB3V	70	60
TYPE C	146 mm DIA.	2	1C1	1 UB FILAMENT	UB4	N.A.	N.A.	55	N.A.
		2	2C1	1 UB & 1 LB FILAMENTS	UB5	LB4M	LB2V	43	65
TYPE D	178 mm DIA.	2	2D1	1 UB & 1 LB FILAMENTS	UB3	LB3M	LB3V	65	55
TYPE E	100x165 mm	2	2E1	1 UB & 1 LB FILAMENTS	UB3	LB3M	LB3V	70	60
TYPE F[2]	92x150 mm	2	UF	1 UB FILAMENT	UB1	N.A.	N.A.	70	N.A.
		2	LF	1 LB FILAMENT	N.A[1]	LB1M[1]	LB1V[1]	N.A.	60
TYPE G		2	1G1	1 UB FILAMENT	UB4	N.A.	N.A.	55	N.A.
		2	2G1	1 UB & 1 LB FILAMENTS	UB5	LB4M	LB2V	43	65
TYPE H		2	2H1	1 UB & 1 LB FILAMENTS	UB3	LB3M	LB3V	70	60

[1] Headlamps marked "LF" may remain activated when headlamps marked "UF" are activated.

[2] Type F headlamps may be mounted on common or parallel seating and aiming planes to permit simultaneous aiming with restrictions. See S10.13.2.

TABLE II–b—HEADLIGHTING SYSTEMS—COMBINATION

System designation	System composition	Photometry requirements reference		
		Table XVIII	Tables XIX–a, XIX–b, XIX–c	
		Upper beam mechanical and visual aim	Lower beam mech aim	Lower beam visual aim
2 LAMP SYSTEM.	A COMBINATION OF TWO DIFFERENT HEADLAMPS CHOSEN FROM; TYPE F, AN INTEGRAL BEAM HEADLAMP, OR A REPLACEABLE BULB HEADLAMP.	UB2 [1]	LB2M [1]	LB2V [1]
4 LAMP SYSTEM.	ANY COMBINATION OF FOUR DIFFERENT HEADLAMPS CHOSEN FROM; TYPE F, AN INTEGRAL BEAM HEADLAMP [3], OR A REPLACEABLE BULB HEADLAMP.	UB1	LB1M [2]	LB1V [2]

[1] Headlamps designed to conform to the photometry requirements of UB2 and LB2M or LB2V may allow the lower beam light source(s) to remain activated when an upper beam light source is activated if the lower beam light source(s) contribute to upper beam photometric compliance.
[2] Lower beams may remain activated when upper beams are activated.
[3] Beam contributor photometric allocation formula of S14.2.5.9 may apply.

TABLE II–c—HEADLIGHTING SYSTEMS—INTEGRAL BEAMS

System designation	Beam composition	Photometry requirements reference		
		Table XVIII	Tables XIX–a, XIX–b, XIX–c	
		Upper beam mechanical and visual aim	Lower beam mech aim	Lower beam visual aim
2 LAMP SYSTEM.	UPPER BEAM & LOWER BEAM	UB2 [1] OR UB3	LB2M [1] OR LB3M.	LB2V [1] OR LB3V
4 LAMP SYSTEM.	UPPER BEAM	UB4	N.A.	N.A.
	UPPER BEAM & LOWER BEAM	UB5	LB4M	LB2V
4 LAMP SYSTEM.	UPPER BEAM (U)	UB1	N.A.	N.A.
	LOWER BEAM (L)	N.A. [2]	LB1M [2]	LB1V [2]
4 LAMP SYSTEM.	UPPER BEAM	UB6	N.A.	N.A.
	LOWER BEAM	N.A. [3]	LB5M [3]	LB4V [3]
BEAM CONTRIBUTOR.	UPPER BEAM & LOWER BEAM	UB1 [4]	LB1M [2][4]	LB1V [2][4]

[1] Headlamps designed to conform to the photometry requirements of UB2 and LB2M or LB2V may allow the lower beam light source(s) to remain activated when an upper beam light source is activated if the lower beam light source(s) contribute to upper beam photometric compliance.
[2] Lower beams may remain activated when upper beams are activated.
[3] Lower beams must remain activated when upper beams are activated.
[4] Beam contributor photometric allocation formula of S14.2.5.9 applies.

TABLE II–d—HEADLIGHTING SYSTEMS—REPLACEABLE BULB

System designation	Light source composition	Photometry requirements reference		
		Table XVIII	Tables XIX–a, XIX–b, XIX–c	
		Upper beam mechanical and visual aim	Lower beam mech aim	Lower beam visual aim
2 LAMP SYSTEM	ANY DUAL FILAMENT TYPE, OTHER THAN HB2, USED ALONE OR WITH ANOTHER DUAL FILAMENT TYPE OTHER THAN HB2.	UB2 [1] OR UB3	LB2M [1] OR LB3M.	LB2V [1] OR LB3V
2 LAMP SYSTEM	HB2 OR ANY SINGLE FILAMENT TYPE USED ALONE OR WITH ANY OTHER SINGLE OR DUAL FILAMENT TYPE.	UB2 [1] OR UB3	LB2M [1]	LB2V [1]

TABLE II–d—HEADLIGHTING SYSTEMS—REPLACEABLE BULB—Continued

System designation	Light source composition	Photometry requirements reference		
		Table XVIII	Tables XIX–a, XIX–b, XIX–c	
		Upper beam mechanical and visual aim	Lower beam mech aim	Lower beam visual aim
4 LAMP SYSTEM	ANY DUAL FILAMENT TYPE, OTHER THAN HB2, USED ALONE OR WITH ANOTHER DUAL FILAMENT TYPE OTHER THAN HB2.	UB1 (2) OR UB3	LB1M (2) OR LB3M.	LB1V (2) OR LB3V
4 LAMP SYSTEM	HB2 OR ANY SINGLE FILAMENT TYPE USED ALONE OR WITH ANY OTHER SINGLE OR DUAL FILAMENT TYPE. (U & L).	UB1 (2)	LB1M (2)	LB1V (2)

(1) Headlamps designed to conform to the photometry requirements of UB2 and LB2M or LB2V may allow the lower beam light source(s) to remain activated when an upper beam light source is activated if the lower beam light source(s) contribute to upper beam photometric compliance.
(2) Lower beams may remain activated when upper beams are activated.

TABLE III—MARKING REQUIREMENTS LOCATION

Lamp, reflective device, or other component	Marking	Marking location	Requirement
HEADLAMPS, BEAM CONTRIBUTORS, OR HEADLAMP REPLACEABLE LENS.			
	"DOT"	Lens	S6.5.1
	Optical axis marking	See requirement	S10.18.5
	Manufacturer name and/or trademark.	Lens	S6.5.3
	Voltage	See requirement	S6.5.3
	Part number or trade number	See requirement	S6.5.3
HEADLAMP REPLACEABLE LENS.	Manufacturer identification	Lens	S6.5.3
	Headlamp identification.		
REPLACEABLE BULB HEADLAMPS.	"U" or "L" (4 lamp system)	Lens	S10.15.4
	Replaceable bulb type	Lens	S6.5.3.4
SEALED BEAM HEADLAMPS	"sealed beam"	Lens	S6.5.3.3
	Type designation	See requirements	S6.5.3.3
INTEGRAL BEAM HEADLAMPS	"U" or "L" (4 lamp system)	Lens	S10.14.4
MOTORCYCLE REPLACEABLE BULB HEADLAMPS.	"motorcycle"	Lens	S10.17.2
VISUALLY/OPTICALLY AIMED HEADLAMPS.	"VOR" or "VOL" or "VO"	Lens	S10.18.9.6
EXTERNALLY AIMED HEADLAMPS.	Aim pad location & "H" or "V"	Lens	S10.18.7.1
VEHICLE HEADLAMP AIMING DEVICES (VHAD).	Aiming scale(s)	See requirement	S10.18.8
(HEADLAMP) REPLACEABLE LIGHT SOURCES.	"DOT"	See requirement	S11.1
	Replaceable light source designation.	See requirement.	
	Manufacturer name and/or trademark.	See requirement.	
REPLACEABLE LIGHT SOURCE BALLASTS.	Manufacturer name or logo	See requirement	S11.2
	Part number.		
	Light source identification.		
	Rated laboratory life.		
	High voltage warning.		
	Output in watts and volts.		
	"DOT".		
LAMPS (OTHER THAN HEADLAMPS), REFLECTIVE DEVICES, AND ASSOCIATED EQUIPMENT.	"DOT"	See requirement	S6.5.1.2
DAYTIME RUNNING LAMPS (DRL).	"DRL"	Lens	S6.5.2
CONSPICUITY REFLEX REFLECTORS.	"DOT–C"	Exposed surface	S8.2.2.1

TABLE III—MARKING REQUIREMENTS LOCATION—Continued

Lamp, reflective device, or other component	Marking	Marking location	Requirement
RETROREFLECTIVE SHEETING	"DOT–C2" or "DOT–C3" or "DOT–C4".	Exposed surface	S8.2.1.3

TABLE IV–a—EFFECTIVE PROJECTED LUMINOUS LENS AREA REQUIREMENTS

Lighting device	Passenger cars, multipurpose passenger vehicles, trucks, trailers, and buses of less than 2032 mm in overall width minimum effective projected luminous lens area (sq mm)			Multipurpose passenger vehicles, trucks, trailers, and buses 2032 mm or more in overall width minimum effective projected luminous lens area each lamp (sq mm)	Motorcycles minimum effective projected luminous lens area (sq mm)	
		Multiple compartment lamp or multiple lamps			Multiple compartment lamp or multiple lamps	
	Single compartment lamp	Each compartment or lamp	Combined compartments or lamps		Each compartment or lamp	Single or combined compartments or lamps
Front turn signal lamp	2200		2200	7500	2200	2258
Rear turn signal lamp	5000	2200	5000	7500	2200	2258
Stop lamp	5000	2200	5000	7500	2200	[1] 5000

[1] A motor driven cycle whose speed attainable in 1 mile is 30 mph or less may be equipped with a stop lamp whose minimum effective projected luminous lens area is not less than 2258 sq mm.

TABLE IV–b—EFFECTIVE PROJECTED LUMINOUS LENS AREA REQUIREMENTS

Lighting device	Passenger cars, multipurpose passenger vehicles, trucks, and buses of less than 2032 mm in overall width and with a GVWR of 10,000 lbs or less using a single lamp minimum effective projected luminous lens area (sq mm)	Multipurpose passenger vehicles, trucks, and buses of less than 2032 mm in overall width and with a GVWR of 10,000 lbs or less using dual lamps of identical size and shape minimum effective projected luminous lens area each lamp (sq mm)
High-mounted stop lamp	2903	1452

TABLE IV–c—EFFECTIVE PROJECTED LUMINOUS LENS AREA REQUIREMENTS

Lighting device	School bus minimum effective projected luminous lens area each lamp (sq mm)
School bus signal lamp	12,258

TABLE V–a—VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES

Lighting device	Required visibility
Backup lamp	Lamps must be mounted so that the optical center of at least one lamp is visible from any eye point elevation from at least 1828 mm (6 ft) to 610 mm (2 ft) above the horizontal plane on which the vehicle is standing; and from any position in the area, rearward of a vertical plane perpendicular to the longitudinal axis of the vehicle, 914 mm (3 ft), to the rear of the vehicle and extending 914 mm (3 ft) beyond each side of the vehicle.
High-mounted stop lamp	Signal must be visible to the rear through a horizontal angle from 45° to the left to 45° to the right of the longitudinal axis of the vehicle. (Single lamp or two lamps together where required by S6.1.1.2 of this standard).
School bus signal lamp	Signal of front lamps to the front and rear lamps to the rear must be unobstructed within area bounded by 5° up to 10° down and 30° left to 30° right.

TABLE V–b—VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES—LENS AREA VISIBILITY OPTION

Lighting device	Corner points[1] [2]				Required visibility
	Motorcycle		All other		
Turn signal lamp[3].	15° UP–20° IB 15° DOWN–20° IB.	15° UP–45° OB. 15° DOWN–45° OB.	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–45° OB. 15° DOWN–45° OB.	Unobstructed minimum effective projected
Stop lamp	15° UP–45° RIGHT[4]. 15° DOWN–45° RIGHT[4].	15° UP–45° LEFT[4]. 15° DOWN–45° LEFT[4].	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–45° OB. 15° DOWN–45° OB.	luminous lens area of 1,250 sq mm in any
Taillamp	15° UP–45° RIGHT[5]. 15° DOWN–45° RIGHT[5].	15° UP–45° LEFT[5]. 15° DOWN–45° LEFT[5].	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–45° OB. 15° DOWN–45° OB.	direction throughout the pattern defined by
Parking lamp.	No Requirement No Requirement	No Requirement. No Requirement.	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–45° OB. 15° DOWN–45° OB.	the specified corner points.

[1] IB indicates an inboard direction (toward the vehicle's longitudinal centerline) and OB indicates an outboard direction.
[2] Where a lamp is mounted with its axis of reference less than 750 mm above the road surface, the vertical test point angles located below the horizontal plane subject to visibility requirements may be reduced to 5° down.
[3] Where more than one lamp or optical area is lighted at the front on each side of a multipurpose passenger vehicle, truck, trailer, or bus, of 2032 mm or more overall width, only one such area need comply.
[4] If a multiple lamp arrangement is used for a motorcycle stop lamp, the inboard angle for each lamp shall be 10 degrees.
[5] If a multiple lamp arrangement is used for a motorcycle tail lamp, the inboard angle for each lamp shall be 45 degrees.

TABLE V–c—VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES—LUMINOUS INTENSITY VISIBILITY OPTION

Lighting device	Corner points [1] [2]				Required visibility Minimum luminous intensity in any direction throughout the pattern defined by the specified corner points.
	Motorcycle		All Other		Candela
Turn signal lamp.	15° UP–20° IB 15° DOWN–20° IB.	15° UP–80° OB. 15° DOWN–80° OB.	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–80° OB. 15° DOWN–80° OB.	0.3
Stop lamp	15° UP–45° RIGHT[4]. 15° DOWN–45° RIGHT[4].	15° UP–45° LEFT[4]. 15° DOWN–45° LEFT[4].	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–45° OB. 15° DOWN–45° OB.	0.3

TABLE V–c—VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES—LUMINOUS INTENSITY VISIBILITY OPTION—Continued

Lighting device					
Taillamp [3] ..	15° UP–80° RIGHT [5]. 15° DOWN–80° RIGHT [5].	15° UP–80° LEFT [5]. 15° DOWN–80° LEFT [5].	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–80° OB. 15° DOWN–80° OB.	0.05
Parking lamp.	No Requirement No Requirement	No Requirement. No Requirement.	15° UP–45° IB. 15° DOWN–45° IB.	15° UP–80° OB. 15° DOWN–80° OB.	0.05

[1] IB indicates an inboard direction (toward the vehicle's longitudinal centerline) and OB indicates an outboard direction.
[2] Where a lamp is mounted with its axis of reference less than 750 mm above the road surface, the vertical test point angles located below the horizontal plane subject to visibility requirements may be reduced to 5° down
[3] Inboard and outboard corner points are 80° for a single taillamp installed on a motorcycle
[4] If a multiple lamp arrangement is used for a motorcycle stop lamp, the inboard angle for each lamp shall be 10 degrees.
[5] If a multiple lamp arrangement is used for a motorcycle tail lamp, the inboard angle for each lamp shall be 45 degrees.

TABLE V–d—VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES (LEGACY VISIBILITY ALTERNATIVE)

Lighting device		Required visibility [1]
Turn signal lamp	All passenger cars, multipurpose passenger vehicles, trucks, buses, motorcycles, and trailers of less than 2032 mm overall width.	Unobstructed minimum effective projected luminous lens area of 1250 sq mm through horizontal angle of H–V to H–45° OB.
	All multipurpose passenger vehicles, trucks, buses, and trailers of 2032 mm or more overall width.	Unobstructed minimum effective projected luminous lens area of 1300 sq mm through horizontal angle of H–V to H–45° OB. Where more than one lamp or optical area is lighted on each side of the vehicle, only one such area on each side need comply.
Stop lamp		Unobstructed minimum effective projected luminous lens area of 1250 sq mm through horizontal angle of H–45° IB to H–45° OB. Where more than one lamp or optical area is lighted on each side of the vehicle, only one such area on each side need comply.
Taillamp		Unobstructed minimum effective projected luminous lens area of 2 sq in through horizontal angle of H–45° IB to H–45° OB. Where more than one lamp or optical area is lighted on each side of the vehicle, only one such area on each side need comply.

[1] IB indicates an inboard direction (toward the vehicle's longitudinal centerline) and OB indicates an outboard direction.

TABLE VI-a: FRONT TURN SIGNAL LAMP PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		MINIMUMPHOTOMETRIC INTENSITY RATIO WHERE COMBINED WITH A :		BASE REQUIREMENTS						2.5X BASE REQUIREMENTS					
					MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd)			GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)			MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd)			GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)		
			PARKING LAMP	CLEARANCE LAMP[4]	Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
					1	2	3	1	2	3	1	2	3	1	2	3
1	20L	5U	3	3	25	30	35	130	155	180	62.5	75	87.5	325	387.5	450
		5D	-	3	25	30	35				62.5	75	87.5			
	5L	10U	3	3	40	48	55				100	120	137.5			
		10D[3]	-	3	40	48	55				100	120	137.5			
2	10L	5U	3	3	75	88	100	250	295	340	187.5	220	250	625	737.5	850
		H	3	3	100	120	140				250	300	350			
		5D	-	3	75	88	100				187.5	220	250			
3	V	5U	5	5	175	205	235	950	1130	1295	437.5	512.5	587.5	2375	2825	3237 .5
	5L	H	5	5	200	240	275				500	600	687.5			
	V		5	5	200	240	275				500	600	687.5			
	5R		5	5	200	240	275				500	600	687.5			
	V	5D	-	3	175	205	235				437.5	512.5	587.5			
4	10R	5U	3	3	75	88	100	250	295	340	187.5	220	250	625	737.5	850
		H	3	3	100	120	140				250	300	350			
		5D	-	3	75	88	100				187.5	220	250			
5	5R	10U	3	3	40	48	55	130	155	180	100	120	137.5	325	387.5	450
		10D[3]	-	3	40	48	55				100	120	137.5			
	20R	5U	3	3	25	30	35				62.5	75	87.5			
		5D	-	3	25	30	35				62.5	75	87.5			

[1] The measured values at each test point must not be less than 60% of the minimum value.

[2] The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

[3] Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

[4] When a clearance lamp on a vehicle 2032 mm or more in overall width is combined with a front turn signal lamp and the maximum luminous intensity of the clearance lamp is located below horizontal and within a 1.0° radius around the test point, the ratio for the test point may be computed by using the lowest value of the clearance lamp luminous intensity within the generated area.

TABLE VI-b: FRONT TURN SIGNAL LAMP PHOTOMETRY REQUIREMENTS																	
					2 X BASE REQUIREMENTS						1.5X BASE REQUIREMENTS					
GROUP NUMBER	TEST POINT (degrees)		MINIMUM PHOTOMETRIC INTENSITY RATIO WHERE COMBINED WITH A :		MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd)			GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)			MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd)			GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)		
			PARKING LAMP	CLEARANCE LAMP[4]	Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
					1	2	3	1	2	3	1	2	3	1	2	3
1	20L	5U	3	3	50	60	70	260	310	360	37.5	45	52.5	195	232.5	270
		5D	-	3	50	60	70				37.5	45	52.5			
	5L	10U	3	3	80	96	110				60	72	82.5			
		10D[3]	-	3	80	96	110				60	72	82.5			
2	10L	5U	3	3	150	176	200	500	590	680	112.5	132	150	375	442.5	510
		H	3	3	200	240	280				150	180	210			
		5D	-	3	150	176	200				112.5	132	150			
3	V	5U	5	5	350	410	470	1900	2260	2590	262.5	307.5	352.5	1425	1695	1942.5
	5L	H	5	5	400	480	550				300	360	412.5			
	V		5	5	400	480	550				300	360	412.5			
	5R		5	5	400	480	550				300	360	412.5			
	V	5D	-	3	350	410	470				262.5	307.5	352.5			
4	10R	5U	3	3	150	176	200	500	590	680	112.5	132	150	375	442.5	510
		H	3	3	200	240	280				150	180	210			
		5D	-	3	150	176	200				112.5	132	150			
5	5R	10U	3	3	80	96	110	260	310	360	60	72	82.5	195	232.5	270
		10D[3]	-	3	80	96	110				60	72	82.5			
	20R	5U	3	3	50	60	70				37.5	45	52.5			
		5D	-	3	50	60	70				37.5	45	52.5			

[1] The measured values at each test point must not be less than 60% of the minimum value.

[2] The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

[3] Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

[4] When a clearance lamp on a vehicle 2032 mm or more in overall width is combined with a front turn signal lamp and the maximum luminous intensity of the clearance lamp is located below horizontal and within a 1.0° radius around the test point, the ratio for the test point may be computed by using the lowest value of the clearance lamp luminous intensity within the generated area.

TABLE VII: REAR TURN SIGNAL LAMP PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		TEST POINTS APPLICABLE TO DOUBLE FACED LAMPS[6]		MINIMUM PHOTOMETRIC INTENSITY RATIO WHERE COMBINED WITH A TAIL LAMP OR CLEARANCE LAMP[7][8]	MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd) RED LAMPS			GROUP MINIMUM PHOTOMETRIC INTENSITY (cd) RED LAMPS			MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd) AMBER LAMPS			GROUP MINIMUM PHOTOMETRIC INTENSITY (cd) AMBER LAMPS		
			LEFT SIDE LAMP	RIGHT SIDE LAMP		Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
						1	2	3	1	2	3	1[5]	2	3	1[5]	2	3
1	20L	5U	NO	YES	3	10	12	15	50	60	70	15	20	25	80/84	100	120
		5D	NO	YES	3	10	12	15				15	20	25			
	5L	10U	NO	YES	3	16	19	22				26/27	30	35			
		10D[3]	NO	YES	3	16	19	22				26/27	30	35			
2	10L	5U	NO	YES	3	30	35	40	100	115	135	50	55	65	165	185	220
		H	NO	YES	3	40	47	55				65	75	90			
		5D	NO	YES	3	30	35	40				50	55	65			
3	V	5U	YES	YES	5	70	82	95	380	445	520	110	130	150	610/590	710	825
	5L	H	NO	YES	5	80	95	110				130/120	150	175			
	V		YES	YES	5	80	95	110				130	150	175			
	5R		YES	NO	5	80	95	110				130/120	150	175			
	V	5D	YES	YES	3	70	82	95				110	130	150			
4	10R	5U	YES	NO	3	30	35	40	100	115	135	50	55	65	165	185	220
		H	YES	NO	3	40	47	55				65	75	90			
		5D	YES	NO	3	30	35	40				50	55	65			
5	5R	10U	YES	NO	3	16	19	22	50	60	70	26/27	30	35	80/84	100	120
		10D[3]	YES	NO	3	16	19	22				26/27	30	35			
	20R	5U	YES	NO	3	10	12	15				15	20	25			
		5D	YES	NO	3	10	12	15				15	20	25			
MAXIMUM PHOTOMETRIC INTENSITY[4]						300	360	420				750	900	900			

[1] The measured values at each test point must not be less than 60% of the minimum value.

[2] The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

[3] Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the required downward angle.

[4] The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range

[5] Values preceded by a slash (/) apply only to multipurpose passenger vehicles, trucks, trailers, and buses of 2032 mm or more in overall width.

[6] A double faced turn signal lamp installed as described in S6.1.1.3 on a truck tractor need only meet the photometric requirements for a left side lamp where the lamp is mounted on the left side of the vehicle, and for a right side lamp where the lamp is mounted on the right side of the vehicle.

[7] Required only when combined turn signal lamp and clearance lamp is installed on a vehicle 2032 mm or more in overall width.

[8] When a taillamp (or clearance lamp on a vehicle 2032 mm or more in overall width) is combined with a rear turn signal lamp and the maximum luminous intensity of the taillamp (or clearance lamp) is located below horizontal and within an area generated by a 0.5° radius around a test point (1.0° radius on lamps installed on a vehicle 2032 mm or more in overall width), the ratio for the test point may be computed by using the lowest value of the taillamp (or clearance lamp) luminous intensity within the generated area.

TABLE VIII: TAILLAMP PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		PHOTOMETRIC INTENSITY[1][2][4] (cd)						GROUP MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd)		
			Lighted Sections						Lighted Sections		
			1		2		3		1	2	3
			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM			
1	20L	5U	0.3	18	0.5	20	0.7	25	1.4	2.4	3.5
		5D	0.3	-	0.5	-	0.7	-			
	5L	10U	0.4	18	0.7	20	1.0	25			
		10D[3]	0.4	-	0.7	-	1.0	-			
2	10L	5U	0.8	18	1.4	20	2.0	25	2.4	4.2	6.0
		H	0.8	18	1.4	20	2.0	25			
		5D	0.8	-	1.4	-	2.0	-			
3	V	5U	1.8	18	3.1	20	4.5	25	9.6	16.8	24.0
	5L	H	2.0	18	3.5	20	5.0	25			
	V		2.0	18	3.5	20	5.0	25			
	5R		2.0	18	3.5	20	5.0	25			
	V	5D	1.8	-	3.1	-	4.5	-			
4	10R	5U	0.8	18	1.4	20	2.0	25	2.4	4.2	6.0
		H	0.8	18	1.4	20	2.0	25			
		5D	0.8	-	1.4	-	2.0	-			
5	5R	10U	0.4	18	0.7	20	1.0	25	1.4	2.4	3.5
		10D[3]	0.4	-	0.7	-	1.0	-			
	20R	5U	0.3	18	0.5	20	0.7	25			
		5D	0.3	-	0.5	-	0.7	-			

(1) The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

(2) If the sum of intensity values for all points in the group is not less than the specified total value for the group, the measured intensity value for each individual test point is not required to meet the minimum value.

(3) Where taillamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5º down may be met at 5º down rather than at the specified required downward angle.

(4) A taillamp shall not exceed the maximum intensity at H or above.

TABLE IX: STOP LAMP PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		MINIMUM PHOTOMETRIC INTENSITY RATIO WHERE COMBINED WITH A TAIL LAMP[5]	MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd)			GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)		
				Lighted Sections			Lighted Sections		
				1	2	3	1	2	3
1	20L	5U	3	10	12	15	50	60	70
	5L	5D	3	10	12	15			
		10U	3	16	19	22			
		10D[4]	3	16	19	22			
2	10L	5U	3	30	35	40	100	115	135
		H	3	40	47	55			
		5D	3	30	35	40			
3	V	5U	5	70	82	95	380	445	520
	5L	H	3/5[6]	80	95	110			
	V		5	80	95	110			
	5R		5	80	95	110			
	V	5D	3	70	82	95			
4	10R	5U	3	30	35	40	100	115	135
		H	3	40	47	55			
		5D	3	30	35	40			
5	5R	10U	3	16	19	22	50	60	70
		10D[4]	3	16	19	22			
	20R	5U	3	10	12	15			
		5D	3	10	12	15			
MAXIMUM PHOTOMETRIC INTENSITY[3]				300	360	420			

[1] The measured values at each test point must not be less than 60% of the minimum value.
[2] The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.
[3] The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range

(4) Where stop lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

(5) When a taillamp is combined with a stop lamp and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5° radius around a test point (1.0° radius on lamps installed on a vehicle 2032 mm or more in overall width), the ratio for the test point may be computed by using the lowest value of the taillamp luminous intensity within the generated area.

(6) Values followed by a slash (/) apply only to lamps installed on multipurpose passenger vehicles, trucks, trailers, and buses of 2032 mm or more in overall width.

TABLE X—SIDE MARKER LAMP PHOTOMETRY REQUIREMENTS

Test point (degrees)	Minimum photometric intensity (cd) (2) red lamps	Minimum photometric intensity (cd) (2) amber lamps
10U:		
45L (1)	0.25	0.62
V	0.25	0.62
45R (1)	0.25	0.62
H:		
45L (1)	0.25	0.62
V	0.25	0.62
45R (1)	0.25	0.62
10D: (3)		
45L (1)	0.25	0.62
V	0.25	0.62
45R (1)	0.25	0.62

(1) Where a side marker lamp installed on a motor vehicle less than 30 feet in overall length has the lateral angle nearest the other required side marker lamp on the same side of the vehicle reduced from 45° by design as specified by S7.4.13.2, the photometric intensity measurement may be met at the lesser angle.

(2) The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

(3) Where side marker lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

TABLE XI—CLEARANCE AND IDENTIFICATION LAMPS PHOTOMETRY REQUIREMENTS

Test point (degrees)	Minimum photometric intensity (cd) [2] red lamps	Minimum photometric intensity (cd) [2] amber lamps
10U:		
45L [4]	0.25	0.62
V	0.25	0.62
45R [4]	0.25	0.62
H:		
45L [4]	0.25	0.62
V	0.25	0.62
45R [4]	0.25	0.62
10D: [1]		
45L [4]	0.25	0.62
V	0.25	0.62
45R [4]	0.25	0.62
Maximum photometric intensity [3] (cd) red lamps	15	

[1] Where clearance lamps or identification lamps are mounted with their axis of reference less than 750mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

[2] The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

[3] When optically combined with a stop lamp or turn signal lamp, this maximum applies on or above the horizontal.

[4] Where clearance lamps are installed at locations other than on the front and rear due to the necessity to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle, they need not meet the photometric intensity requirement at any test point that is 45° inboard.

*****

TABLE XII: BACKUP LAMP PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		MAXIMUM PHOTOMETRIC INTENSITY (cd) ANY SINGLE LAMP	TWO LAMP SYSTEMS– EACH LAMP		SINGLE LAMP SYSTEM	
				MINIMUM PHOTOMETRIC INTENSITY (cd)[10][14]	GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)[10][14]	GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)
1[2][3]	45L	5U	300/600[5]	15	45	30	90
		H	300/600[5]	15		30	
		5D	-	15		30	
2[2][3]	30L	H	300/600[5]	25	50	50	100
		5D	-	25		50	
3	10L	10U	300/600[5]	10	100	20	200
	V	5U	300/600[5]	20		40	
		10U	300/600[5]	15		30	
	10R	5U	300/600[5]	25		50	
		10U	300/600[5]	10		20	
		5U	300/600[5]	20		40	
4	10L	H	300/600[5]	50	360	100	720
	V	5D	-	50		100	
		H	300/600[5]	80		160	
	10R	5D	-	80		160	
		H	300/600[5]	50		100	
		5D	-	50		100	
5[2][3]	30R	H	300/600[5]	25	50	50	100
		5D	-	25		50	
6[2][3]	45R	5U	300/600[5]	15	45	30	90
		H	300/600[5]	15		30	
		5D	-	15		30	

(1) The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

(2) When two lamps of the same or symmetrically opposite design are used, the tested photometric values along the vertical axis and the averages of the tested photometric values for the same horizontal test point left and right of vertical for one lamp must be used to determine compliance with the requirements.

(3) When two lamps of differing designs are used, they must be tested individually and the tested photometric values added to determine the combined units compliance with twice the stated requirements.

(4) If the sum of intensity values for all points in the group is not less than the specified total value for the group, the measured intensity value for each individual test point is not required to meet the minimum value.

(5) The value before the slash applies to each lamp in a multiple lamp system; the value after the slash applies to a single lamp system.

*****

TABLE XIII-a: MOTORCYCLE TURN SIGNAL LAMP ALTERNATIVE PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		MINIMUM PHOTOMETRIC INTENSITY RATIO WHERE COMBINED WITH A:		MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd) FRONT TURN SIGNAL LAMP				GROUP MINIMUM PHOTOMETRIC INTENSITY (cd) FRONT TURN SIGNAL LAMP			MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd) RED REAR TURN SIGNAL LAMP				GROUP MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd) RED REAR TURN SIGNAL LAMP			MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd) AMBER REAR TURN SIGNAL LAMP				GROUP MINIMUM PHOTOMETRIC INTENSITY (cd) AMBER REAR TURN SIGNAL LAMP		
			PARKING LAMP	TAIL LAMP[5]	Lighted Sections				1	2	3	1	2	3		Lighted Sections			1	2	3		Lighted Sections			
					1	2	3																			
1	20L	5U	3	3	12.5	15	17.5												7.5	10	12.5					
		5D	-	3	12.5	15	17.5	65	77.5	90		5	6	7.5					7.5	10	12.5	40	50	60		
	5L	10U	3	3	20	24	27.5					8	9.5	11	25	30	35		13	15	17.5					
		10D[4]	-	3	20	24	27.5					8	9.5	11					13	15	17.5					
2	10L	5U	3	3	37.5	44	50					15	17.5	20					25	27.5	32.5					
		H	3	3	50	60	70	125	147.5	170		20	23.5	27.5	50	57.5	67.5		32.5	37.5	45	82.5	92.5	110		
		5D	-	3	37.5	44	50					15	17.5	20					25	27.5	32.5					
3	V	5U	5	5	87.5	102.5	117.5					35	41	47.5					55	65	75					
	5L		5	5	100	120	137.5	475	565	647.5		40	47.5	55	190	222.5	260		65	75	87.5	305	355	412.5		
	V	H	5	5	100	120	137.5					40	47.5	55					65	75	87.5					
	5R		5	5	100	120	137.5					40	47.5	55					65	75	87.5					
	V	5D	-	3	87.5	102.5	117.5					35	41	47.5					55	65	75					
4	10R	5U	3	3	37.5	44	50					15	17.5	20					25	27.5	32.5					
		H	3	3	50	60	70	125	147.5	170		20	23.5	27.5	50	57.5	67.5		32.5	37.5	45	82.5	92.5	110		
		5D	-	3	37.5	44	50					15	17.5	20					25	27.5	32.5					
5	5R	10U	3	3	20	24	27.5					8	9.5	11					13	15	17.5					
		10D[4]	-	3	20	24	27.5	65	77.5	90		8	9.5	11	25	30	35		13	15	17.5	40	50	60		
	20R	5U	3	3	12.5	15	17.5					5	6	7.5					7.5	10	12.5					
		5D	-	3	12.5	15	17.5					5	6	7.5					7.5	10	12.5					
MAXIMUM PHOTOMETRIC INTENSITY[3]												300	360	420					750	900	900					

(1) The measured values at each test point must not be less than 60% of the minimum value.

(2) The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

(3) The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range.

(4) Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

(5) When a taillamp is combined with a rear turn signal lamp and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5° radius around a test point the ratio for the test point may be computed by using the lowest value of the taillamp luminous intensity within the generated area.

TABLE XIII-b: MOTOR DRIVEN CYCLE STOP LAMP[3] ALTERNATIVE PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		MINIMUM PHOTOMETRIC INTENSITY RATIO WHERE A MOTOR DRIVEN CYCLE STOP LAMP IS COMBINED WITH A TAIL LAMP[4]	GROUP MINIMUM PHOTOMETRIC INTENSITY (cd) MOTOR DRIVEN CYCLE STOP LAMP		
				Lighted Sections		
				1	2	3
1	20L	5U	3	26	31	36
		5D	3			
	5L	10U	3			
		10D[2]	3			
2	10L	5U	3	50	59	69
		H	3			
		5D	3			
3	V	5U	5	190	226	261
	5L		5			
	V	H	5			
	5R		5			
	V	5D	3			
4	10R	5U	3	50	59	69
		H	3			
		5D	3			
5	5R	10U	3	26	31	36
		10D[2]	3			
	20R	5U	3			
		5D	3			
MAXIMUM PHOTOMETRIC INTENSITY[1]				300	360	420

[1] The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range.

[2] Where stop lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

[3] Requirements for a motor-driven cycle whose speed attainable in 1 mile is 30 mph or less.

[4] When a taillamp is combined with a stop lamp and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5° radius around a test point the ratio for the test point may be computed by using the lowest value of the taillamp luminous intensity within the generated area

TABLE XIV: PARKING LAMP PHOTOMETRY REQUIREMENTS

GROUP NUMBER	TEST POINT (degrees)		MINIMUM PHOTOMETRIC INTENSITY[1][2] (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	GROUP MINIMUM PHOTOMETRIC INTENSITY (cd)
1	20L	5U	0.4	125	2.4
		5D	0.4	250	
	5L	10U	0.8	125	
		10D[3]	0.8	250	
2	10L	5U	0.8	125	3.0
		H	1.4	125	
		5D	0.8	250	
3	V	5U	2.8	125	16.8
	5L	H	3.6	125	
	V		4.0	125	
	5R		3.6	125	
	V	5D	2.8	250	
4	10R	5U	0.8	125	3.0
		H	1.4	125	
		5D	0.8	250	
5	5R	10U	0.8	125	2.4
		10D[3]	0.8	250	
	20R	5U	0.4	125	
		5D	0.4	250	

[1] The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

[2] If the sum of intensity values for all points in the group is not less than the specified total value for the group, the measured intensity value for each individual test point is not required to meet the minimum value.

[3] Where parking lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

TABLE XV: HIGH-MOUNTED STOP LAMP PHOTOMETRY REQUIREMENTS				
GROUP NUMBER	**TEST POINT (degrees)**		**MINIMUM PHOTOMETRIC INTENSITY[(1)(2)(3)] (cd)**	**GROUP MINIMUM PHOTOMETRIC INTENSITY[(3)] (cd)**
1	V	5U	25	125
	5L	H	25	
	V	H	25	
	5R	H	25	
	V	5D	25	
2	5R	5U	25	98
	10R	5U	16	
	10R	H	16	
	10R	5D	16	
	5R	5D	25	
3	5L	5U	25	98
	10L	5U	16	
	10L	H	16	
	10L	5D	16	
	5L	5D	25	
4	10L	10U	8	32
	V	10U	16	
	10R	10U	8	
MAXIMUM PHOTOMETRIC INTENSITY[(4)]			160	

(1) The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

(2) The photometric intensity at each test point must not be less than 60% of the specified minimum value when considering overall group photometry tables.

(3) Where a pair of lamps identical in size and shape are used due to vehicle construction, they together must meet photometric requirements.

(4) The maximum photometric intensity must not occur over any area larger than that generated by a 0.25º radius within a solid cone angle within the rectangle bounded by test points 10U-10L, 10U-10R, 5D-10L, and 5D-10R.

*****

TABLE XVI–a—REFLEX REFLECTOR PHOTOMETRY REQUIREMENTS

Observation angle (degrees)	Entrance angle (degrees)	Minimum performance					
		Red reflectors		Amber reflectors		White reflectors	
		(cd/incident ft-c)	(mcd/lux)	(cd/incident ft-c)	(mcd/lux)	(cd/incident ft-c)	(mcd/lux)
0.2	0	4.5	420	11.25	1050	18	1680
	10U	3.0	280	7.5	700	12	1120
	10D [1]	3.0	280	7.5	700	12	1120
	20L	1.5	140	3.75	350	6	560
	20R	1.5	140	3.75	350	6	560
1.5	0	0.07	6	0.175	15	0.28	24
	10U	0.05	5	0.125	12.5	0.2	20
	10D [1]	0.05	5	0.125	12.5	0.2	20
	20L	0.03	3	0.075	7.5	0.12	12
	20R	0.03	3	0.075	7.5	0.12	12

[1] Where reflex reflectors are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the required specified downward angle.

TABLE XVI–b—ADDITIONAL PHOTOMETRY REQUIREMENTS FOR CONSPICUITY REFLEX REFLECTORS

Observation angle (degrees)	Entrance angle (degrees)	Minimum performance		
		Red (mcd/lux)	White horizontal orientation (mcd/lux)	White vertical orientation (mcd/lux)
0.2	0	300	1250	1680
	20L TO 20R			560
	30L TO 30R	300	1250	
	45L TO 45R	75	300	
	10U TO 10D	1120		

TABLE XVI–c—RETROREFLECTIVE SHEETING PHOTOMETRY REQUIREMENTS

Observation angle (degrees)	Entrance angle (degrees)	Minimum performance					
		Grade dot-C2		Grade dot-C3		Grade dot-C4	
		White	Red	White	Red	White	Red
		(cd/lux/sq m)	(cd/lux/sq m)	(cd/lux/sq m)	(cd/lux/sq m)	(cd/lux/sq m)	(cd/lux/sq m)
0.2	−4	250	60	165	40	125	30
	30	250	60	165	40	125	30
	45	60	15	40	10	30	8
0.5	−4	65	15	43	10	33	8
	30	65	15	43	10	33	8
	45	15	4	10	3	8	2

TABLE XVII—SCHOOL BUS SIGNAL LAMP PHOTOMETRY REQUIREMENTS

Test point (degrees)	Minimum photometric intensity (cd) [2] red lamps	Minimum photometric intensity (cd) amber lamps
5U:		
20L	150	375
10L	300	750
5L	300	750
V	300	750
5R	300	750
10R	300	750
20R	150	375
H:		
30L	30	75
20L	180	450
10L	400	1000
5L	500	1250

TABLE XVII—SCHOOL BUS SIGNAL LAMP PHOTOMETRY REQUIREMENTS—Continued

Test point (degrees)	Minimum photometric intensity (cd) [2] red lamps	Minimum photometric intensity (cd) amber lamps
V	600	1500
5R	500	1250
10R	400	1000
20R	180	450
30R	30	75
5D:		
30L	30	75
20L	200	500
10L	300	750
5L	450	1125
V	450	1125
5R	450	1125
10R	300	750

TABLE XVII—SCHOOL BUS SIGNAL LAMP PHOTOMETRY REQUIREMENTS—Continued

Test point (degrees)	Minimum photometric intensity (cd) [2] red lamps	Minimum photometric intensity (cd) amber lamps
20R	200	500
30R	30	75
10D: [1]		
5L	40	100
V	40	100

TABLE XVII—SCHOOL BUS SIGNAL LAMP PHOTOMETRY REQUIREMENTS—Continued

Test point (degrees)	Minimum photometric intensity (cd) [2] red lamps	Minimum photometric intensity (cd) amber lamps
5R	40	100

[1] Where school bus signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

[2] The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

TABLE XVIII: HEADLAMP UPPER BEAM PHOTOMETRY REQUIREMENTS

TEST POINT (degrees)		UPPER BEAM #1 (UB1)		UPPER BEAM #2 (UB2)		UPPER BEAM #3 (UB3)	
		MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)
2U	V	-	1,500	-	1,500	-	1,000
1U	3L &3R	-	5,000	-	5,000	-	2,000
H	V	70,000	40,000	75,000	40,000	75,000	20,000
H	3L & 3R	-	15,000	-	15,000	-	10,000
H	6L & 6R	-	5,000	-	5,000	-	3,250
H	9L & 9R	-	3,000	-	3,000	-	1,500
H	12L & 12R	-	1,500	-	1,500	-	750
1.5D	V	-	5,000	-	5,000	-	5,000
1.5D	9L & 9R	-	2,000	-	2,000	-	1,500
2.5D	V	-	2,500	-	2,500	-	2,500
2.5D	12L & 12R	-	1,000	-	1,000	-	750
4D	V	5,000	-	12,000	-	5,000	-

		UPPER BEAM #4 (UB4)		UPPER BEAM #5 (UB5)		UPPER BEAM #6 (UB6)	
2U	V	-	750	-	750	-	1,500
1U	3L &3R	-	3,000	-	2,000	-	5,000
H	V	60,000	18,000	15,000	7,000	70,000	40,000
H	3L & 3R	-	12,000	-	3,000	-	15,000
H	6L & 6R	-	3,000	-	2,000	-	5,000
H	9L & 9R	-	2,000	-	1,000	-	3,000
H	12L & 12R	-	750	-	750	-	1,500
1.5D	V	-	3,000	-	2,000	-	5,000
1.5D	9L & 9R	-	1,250	-	750	-	1,000
2.5D	V	-	1,500	-	1,000	-	-
2.5D	12L & 12R	-	600	-	400	-	-
4D	V	5,000	-	2,500	-	5,000	-

TABLE XIX-a: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS

TEST POINT (degrees)		LOWER BEAM # 1M (LB1M)		LOWER BEAM # 1V (LB1V)		LOWER BEAM # 2M (LB2M)		LOWER BEAM # 2V (LB2V)	
		MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)
[1] 10U to 90U	[1] 90L to 90R	125	-	125	-	125	-	125	
4U	8L & 8R	-	64	-	64	-	64	--	64
2U	4L	-	135	-	135	-	135	-	135
1.5U	1R to 3R	-	200	-	200	-	200	-	200
1.5U	1R to R	1,400	-	1,400	-	1,400	-	1,400	-
1U	1.5L to L	700	-	700	-	700	-	700	-
0.5U	1.5L to L	1,000	-	1,000	-	1,000	-	1,000	-
0.5U	1R to 3R	2,700	500	2,700	500	2,700	500	2,700	500
H	V	5,000	-	5,000	-	-	-	-	-
H	4L	-	135	-	135	-	135	-	135
H	8L	-	64	-	64	-	64	-	64
0.5D	1.5L to L	3,000	-	-	-	3,000	-	-	-
0.5D	1.5R	20,000	10,000	-	-	20,000	10,000	-	-
0.6D	1.3R	-	-	-	10,000	-	-	-	10,000
0.86D	V	-	-	-	4,500	-	-	-	4,500
0.86D	3.5L	-	-	12,000	1,800	-	-	12,000	1,800
1D	6L	-	1,000	-	-	-	1,000	-	-
1.5D	2R	-	15,000	-	15,000	-	15,000	-	15,000
1.5D	9L & 9R	-	1,000	-	-	-	1,000	-	-
2D	9L & 9R	-	-	-	1,250	-	-	-	1,250
2D	15L & 15R	-	850	-	1,000	-	850	-	1,000
2.5D	V	-	-	-	-	-		-	-
2.5D	12L & 12R	-	-	-	-	-	-	-	-
4D	V	7,000	-	10,000	-	-	-	-	-
4D	4R	12,500	-	12,500	-	12,500	-	12,500	-
4D	20L & 20R	-	-	-	300	-	-	-	300

[1] These test points are boundaries, intensity values within this boundary must meet the listed photometry requirement.

TABLE XIX-b: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS

TEST POINT (degrees)		LOWER BEAM #3 M (LB3M)		LOWER BEAM # 3V (LB3V)		LOWER BEAM # 4M (LB4M)		LOWER BEAM # 5M (LB5M)	
		MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)
[1] 10U to 90U	[1] 90L to 90R	125	-	125	-	125	-	125	-
4U	8L & 8R	-	64	-	64	-	64	-	64
2U	4L	-	135	-	135	-	135	-	135
1.5U	1R to 3R	-	200	-	200	-	200	-	200
1.5U	1R to R	1,400	-	1,400	-	1,400	-	1,400	--
1U	1.5L to L	700	-	700	-	700	-	700	-
0.5U	1.5L to L	1,000	-	1,000	-	1,000	-	1,000	-
0.5U	1R to 3R	2,700	500	2,700	500	2,700	500	2,700	500
H	V	-	-	-	-	-	-	5,000	-
H	4L	-	135	-	135	-	135	-	135
H	8L	-	64	-	64	-	64	-	64
0.5D	1.5L to L	2,500	-	-	-	2500	-	3,000	-
0.5D	1.5R	20,000	8,000	-	-	20,000	8,000	20,000	10,000
0.6D	1.3R	-		-	10,000	-	-	-	-
0.86D	V	-	--	-	4,500	-	-	-	-
0.86D	3.5L	-	-	12,000	1,800	-	-	-	-
1D	6L	-	750	-	-	-	750	-	1,000
1.5D	2R	-	15,000	-	15,000	-	15,000	-	15,000
1.5D	9L & 9R	-	750	-	-	-	750	-	1,000
2D	9L & 9R	-	-	-	1,250	-	-	-	-
2D	15L & 15R	-	700	-	1,000	-	700	-	850
2.5D	V	-	-	-	-	-	-	-	2,500
2.5D	12L & 12R	-	-	-	-	-	-	-	1,000
4D	V	-	-	-	-	-	-	7,000	-
4D	4R	12,500	-	12,500	-	12,500	-	12,500	-
4D	20L & 20R	-	-	-	300	-	-	-	-

[1] These test points are boundaries, intensity values within this boundary must meet the listed photometry requirement.

TABLE XIX–c: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS

TEST POINT (degrees)		LOWER BEAM # 4 V (LB4V)	
		MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)
[1] 10U to 90U	[1] 90L to 90R	125	-
4U	8L & 8R	-	64
2U	4L	-	135
1.5U	1R to 3R	-	200
1.5U	1R to R	1,400	
1U	1.5L to L	700	-
0.5U	1.5L to L	1,000	-
0.5U	1R to 3R	2,700	500
H	V	5,000	-
H	4L	-	135
H	8L	-	64
0.5D	1.5L to L	-	-
0.5D	1.5R	-	-
0.6D	1.3R	-	10,000
0.86D	V	-	4,500
0.86D	3.5L	12,000	1,800
1D	6L	-	-
1.5D	2R	-	15,000
1.5D	9L & 9R	--	-
2D	9L & 9R	-	1,250
2D	15L & 15R	-	1,000
2.5D	V	-	2,500
2.5D	12L & 12R	-	1,000
4D	V	10,000	-
4D	4R	12,500	-
4D	20L & 20R	-	300

[1] These test points are boundaries, intensity values within this boundary must meet the listed photometry requirement.

TABLE XX: MOTORCYCLE AND MOTOR DRIVEN CYCLE HEADLAMP PHOTOMETRY REQUIREMENTS

LOWER BEAM

TEST POINT (degrees)		MOTORCYCLE		MOTOR DRIVEN CYCLE		MOTOR DRIVEN CYCLE with Single Lamp System	
		MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)
1.5U	1R to R	1,400	-	1,400	-	-	-
1.5U	1R to 3R	-	-	-	-	1,400	-
1U	1.5L to L	700	-	700	-	700	-
0.5U	1.5L to L	1,000	-	1,000	-	1,000	-
0.5U	1R to 3R	2,700	-	2,700	-	2,700	-
1.5D	9L and 9R	-	700	-	-	-	-
2D	V	-	7,000	-	5,000	-	4,000
2D	3L and 3R	-	4,000	-	3,000	-	3,000
2D	6L and 6R	-	1,500	-	1,500	-	1,500
2D	12L and 12R	-	700	-	-	-	-
3D	6L and 6R	-	800	-	800	-	-
4D	V	-	2,000	-	2,000	-	1,000
4D	4R	12,500	-	12,500	-	12,500	-

UPPER BEAM

TEST POINT (degrees)		MOTORCYCLE		MOTOR DRIVEN CYCLE	
		MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)	MAXIMUM PHOTOMETRIC INTENSITY (cd)	MINIMUM PHOTOMETRIC INTENSITY (cd)
2U	V	-	1,000	-	-
1U	3L and 3R	-	2,000	-	2,000
H	V	-	12,500	-	10,000
0.5D	V	-	20,000	-	20,000
0.5D	3L and 3R	-	10,000	-	5,000
0.5D	6L and 6R	-	3,300	-	2,000
0.5D	9L and 9R	-	1,500	-	-
0.5D	12L and 12R	-	800	-	-
1D	V	-	17,500	-	15,000
2D	V	-	5,000	-	5,000
3D	V	-	2,500	-	2,500
3D	6L and 6R	-	-	-	800
3D	9L and 9R	-	1,500	-	-
3D	12L and 12R	-	300	-	-
4D	V	-	1,500	-	-
4D	V	7,500	-	7,500	-
ANYWHERE IN BEAM		75,000	-	75,000	-

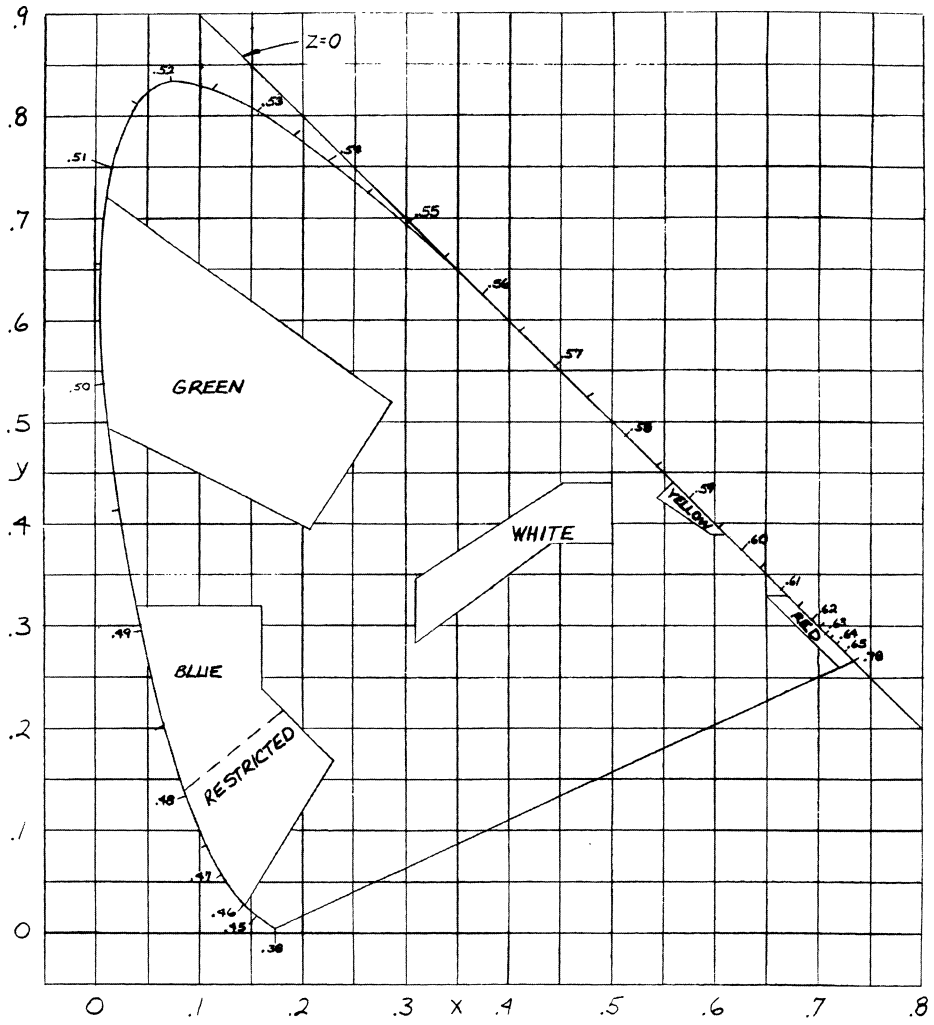
TABLE XXI—ADAPTIVE DRIVING BEAM PHOTOMETRY REQUIREMENTS (1)

Measurement distance interval (m)	Maximum illuminance Opposite direction (lux)	Maximum illuminance same direction (lux)
Greater than or equal to 15.0 and less than 30.0	3.1	18.9
Greater than or equal to 30.0 and less than 60.0	1.8	18.9
Greater than or equal to 60.0 and less than 120.0	0.6	4.0
Greater than or equal to 120.0 and less than or equal to 220	0.3	N/A

(1) For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded to the nearest 0.1 lux, in accordance with the rounding method of ASTM Practice E29 Using Significant Digits in Test Data to Determine Conformance with Specifications.

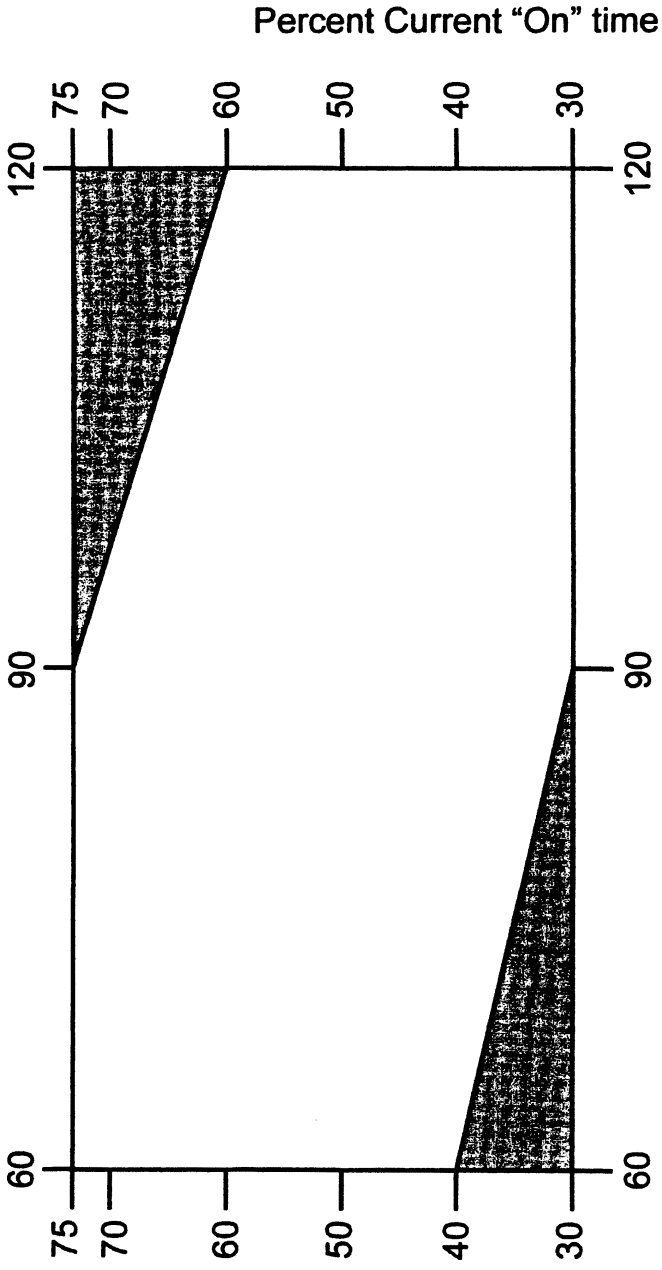
TABLE XXII—ADAPTIVE DRIVING BEAM SYSTEM TEST MATRIX

Scenario No.	Test vehicle speed (kph)	Orientation	Radius of curve (m.)	Curve direction	Superelevation (%)	Measurement distance range (m)
1	96.6–112.7 [60–70 mph]	Opposite Direction	Straight	N/A	0–2	Greater than or equal to 15 and less than or equal to 220.
2	40.2–48.3 [25–30 mph]	Opposite Direction	85–115	Left	0–2	Greater than or equal to 15 and less than 60.
3	64.4–72.4 [40–45 mph]	Opposite Direction	210–250	Left	0–2	Greater than or equal to 15 and less than or equal to 150.
4	80.5–88.5 [50–55 mph]	Opposite Direction	335–400	Left	0–2	Greater than or equal to 15 and less than or equal to 220.
5	64.4–72.4 [40–45 mph]	Opposite Direction	210–250	Right	0–2	Greater than or equal to 15 and less than or equal to 50.
6	80.5–88.5 [50–55 mph]	Opposite Direction	335–400	Right	0–2	Greater than or equal to 15 and less than or equal to 70.
7	96.6–112.7 [60–70 mph]	Same Direction	Straight	N/A	0–2	Greater than or equal to 15 and less than or equal to 100.
8	64.4–72.4 [40–45 mph]	Same Direction	210–250	Left	0–2	Greater than or equal to 15 and less than or equal to 100.



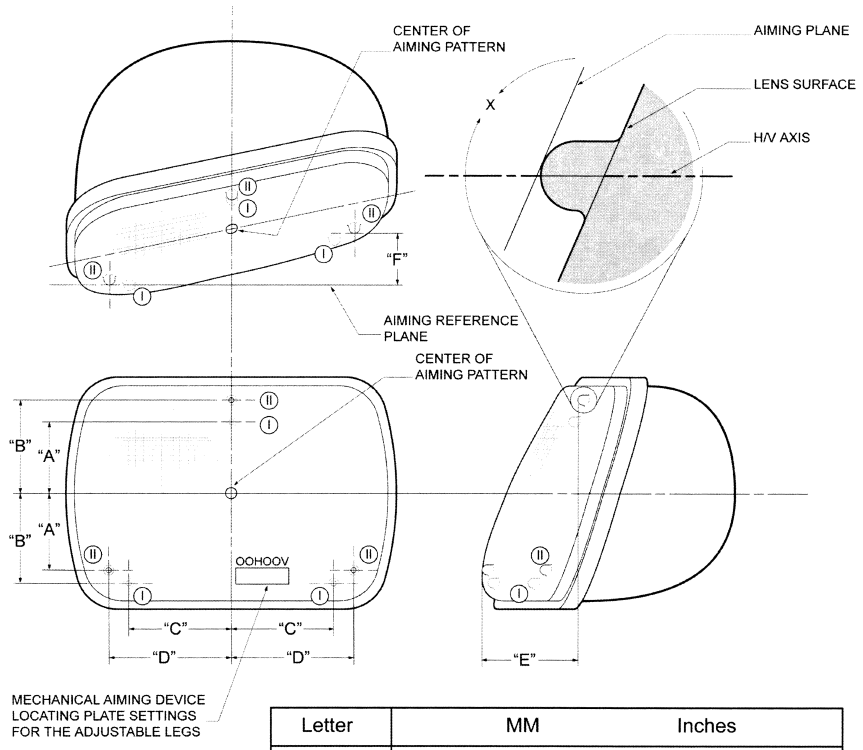
CHROMATICITY DIAGRAM

FIGURE 1



FLASHER PERFORMANCE CHART

FIGURE 2



Notes:
Group I or Group II aiming pad locations may be used

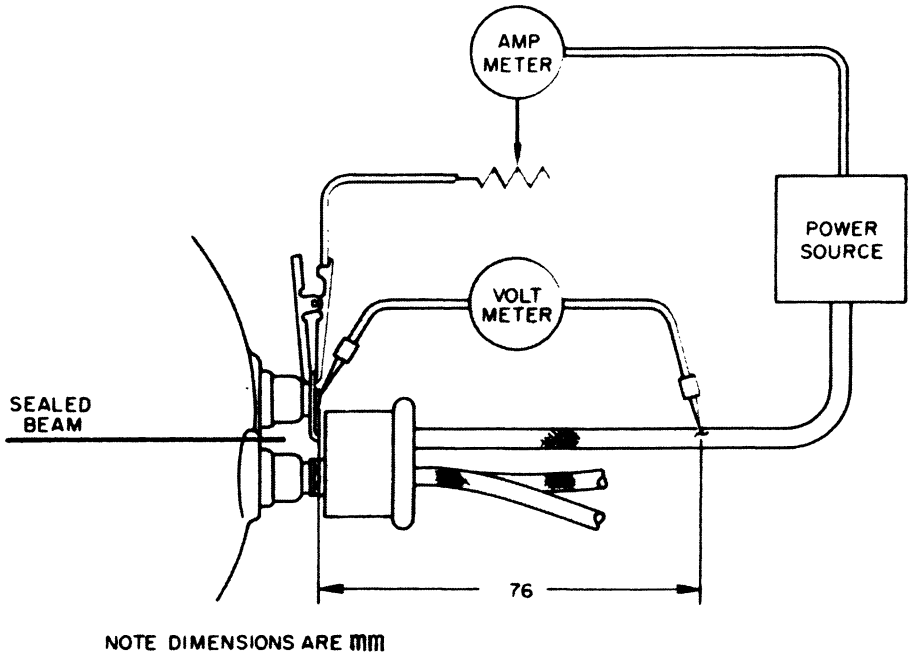
Group I aiming pad location (front view) is that prescribed for 2B1 sealed beam units

Group II aiming pad location (front view) is that prescribed for 1A1/2A1 sealed beam units

Letter	MM	Inches
A	42.16 ± 0.25	1.660 ± 0.010
B	60.05 ± 1.00	2.364 ± 0.039
C	64.0 ± 1.00	2.520 ± 0.039
D	68.58 ± 0.51	2.700 ± 0.020
E	Mechanical aiming device locating plate setting for the vertical adjustable leg. (Millimeters)	
F	Mechanical aiming device locating plate setting for the horizontal adjustable leg. (Millimeters)	

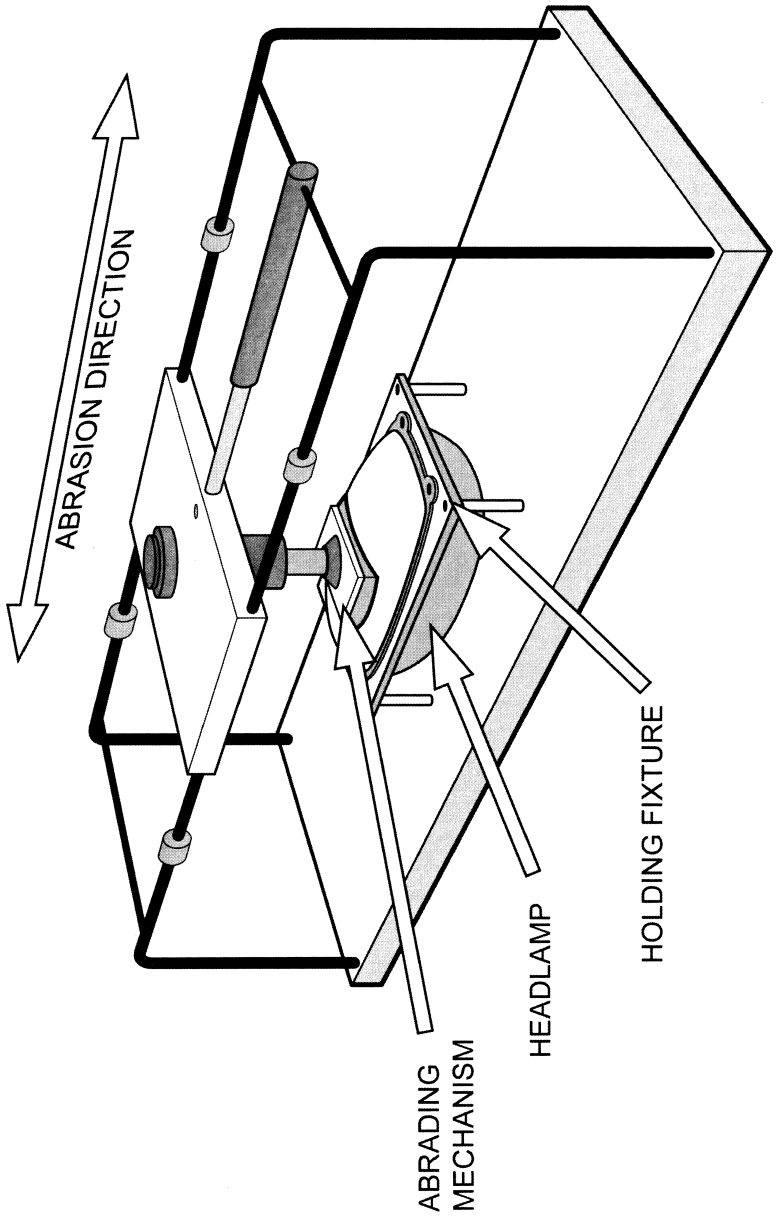
REPLACEABLE BULB HEADLAMP AIM PADS

FIGURE 3



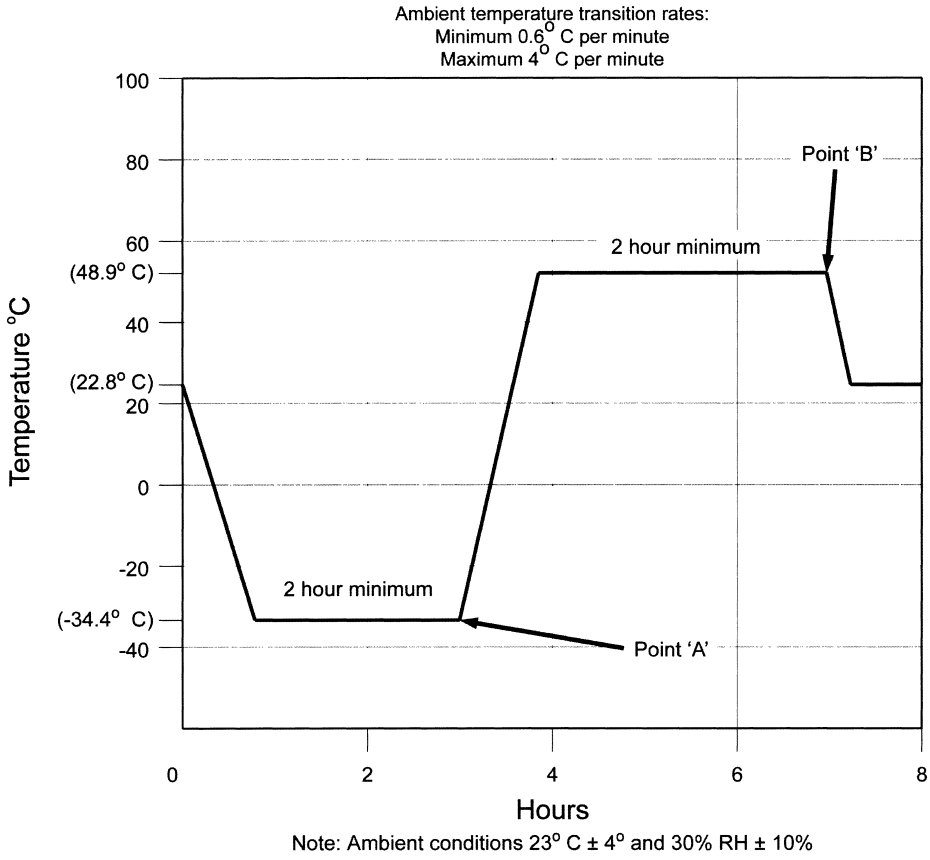
HEADLAMP CONNECTOR TEST SETUP

FIGURE 4



HEADLAMP ABRASION TEST FIXTURE

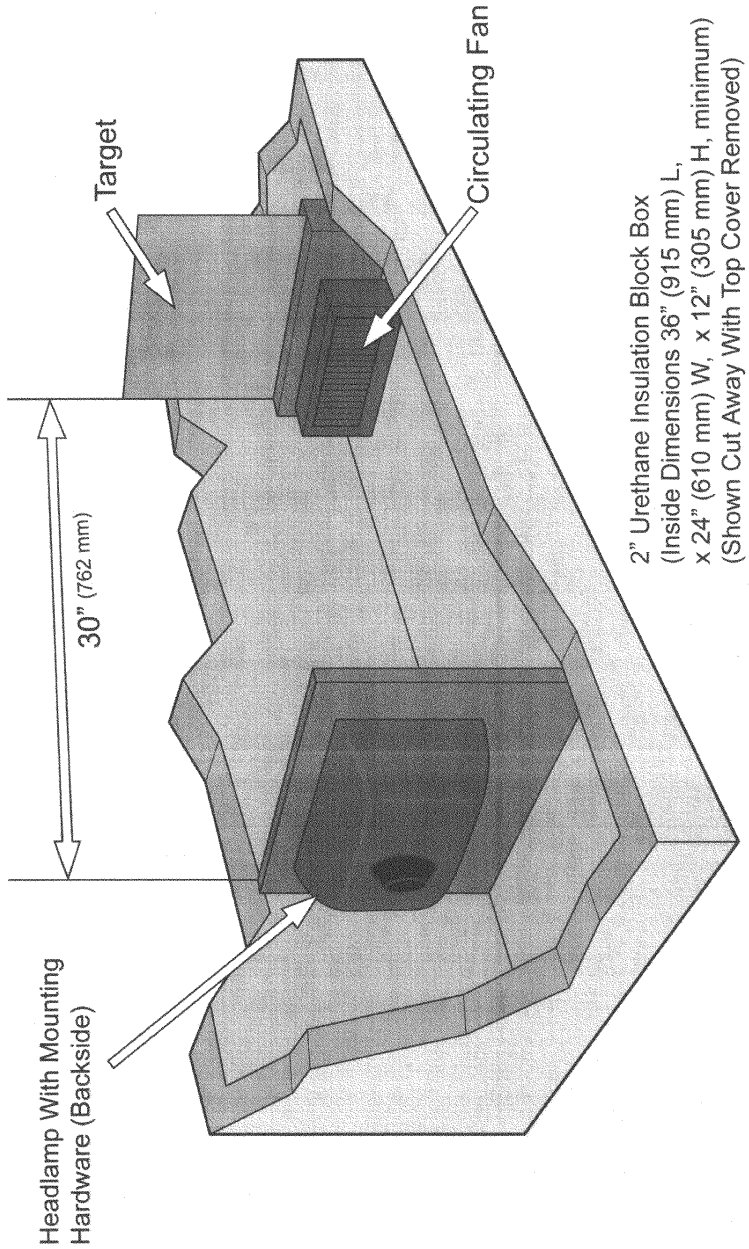
FIGURE 5



Note: Ambient conditions 23° C ± 4° and 30% RH ± 10%

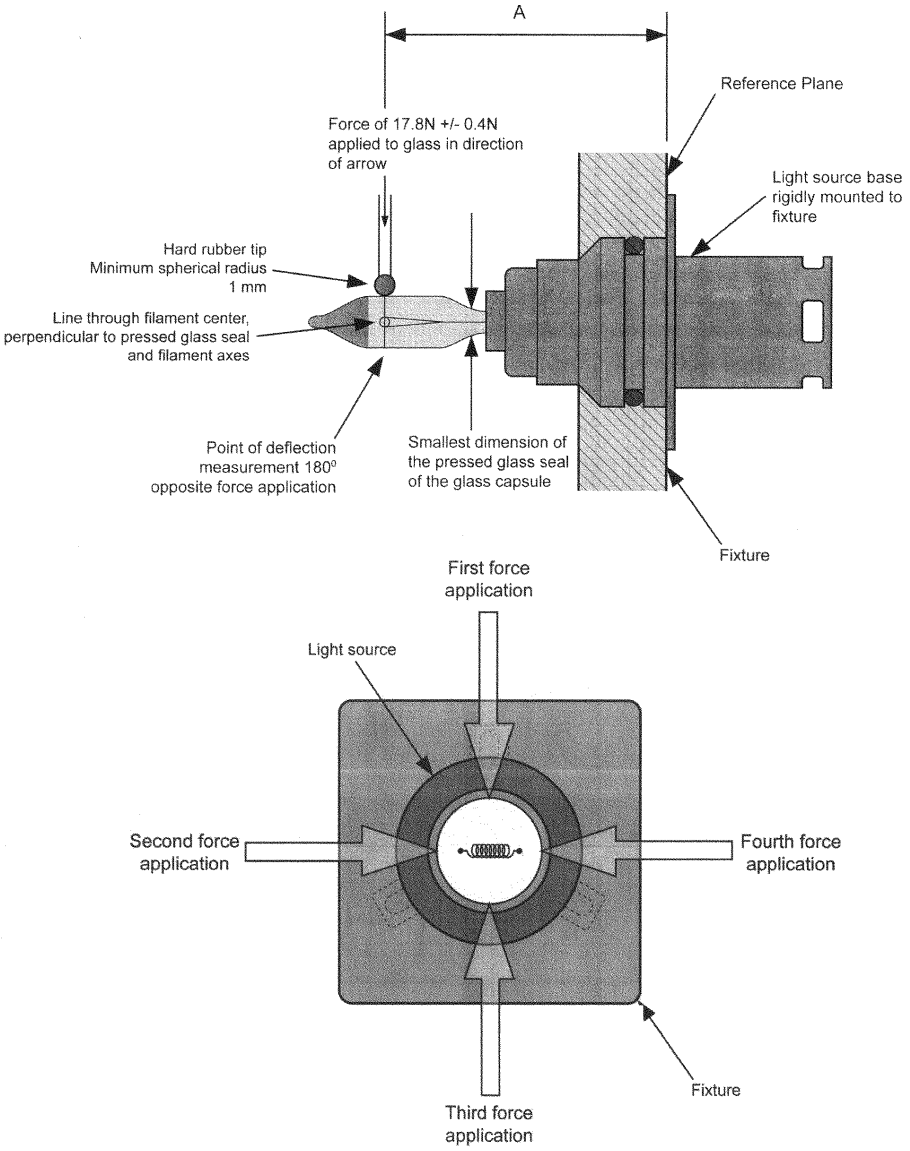
THERMAL CYCLE PROFILE

FIGURE 6



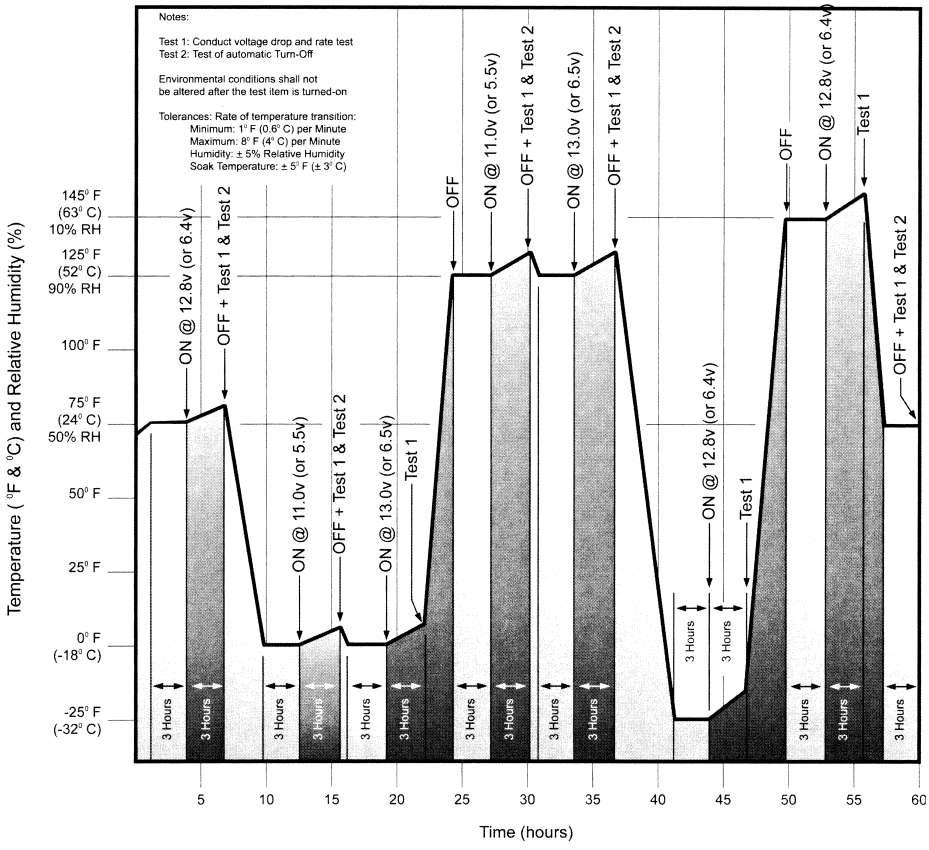
DIRT / AMBIENT TEST SETUP

FIGURE 7



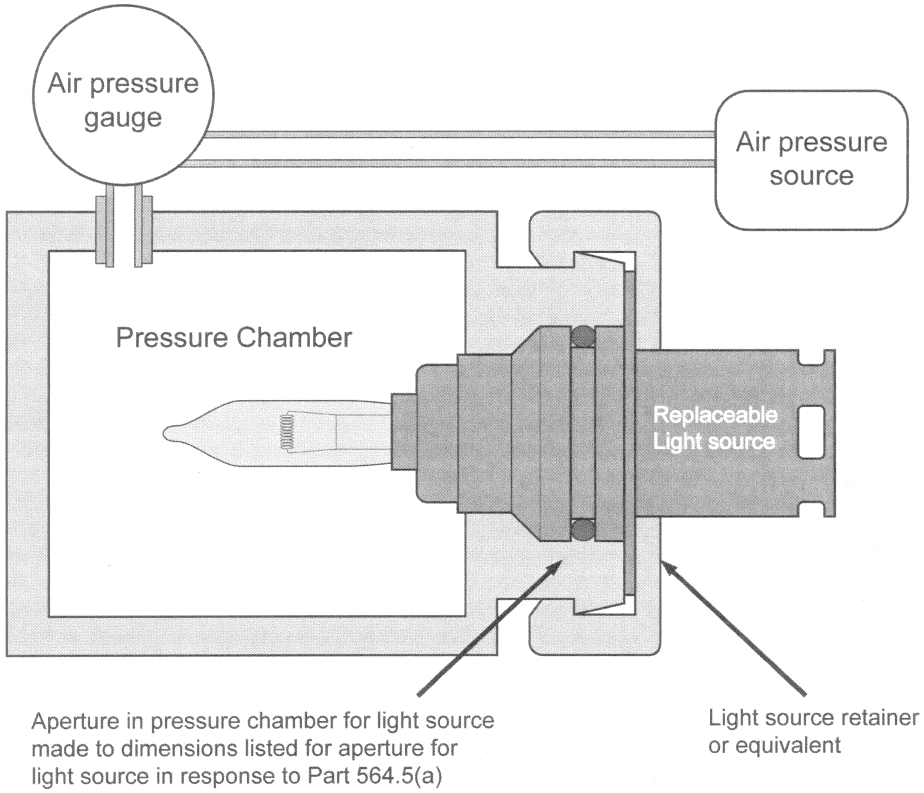
REPLACEABLE LIGHT SOURCE DEFLECTION TEST SETUP

FIGURE 8



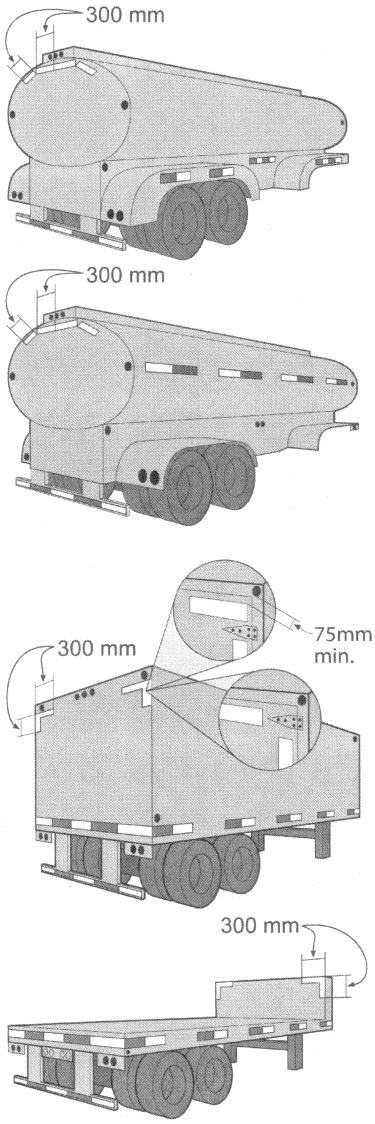
ENVIRONMENTAL TEST PROFILE

FIGURE 9



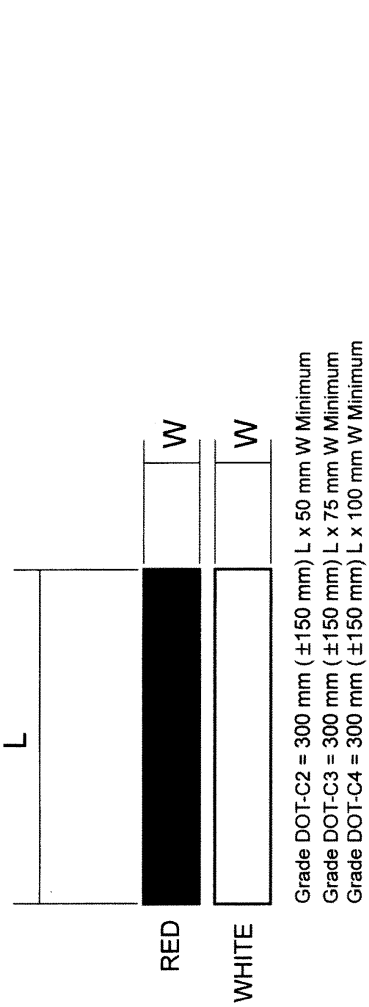
REPLACEABLE LIGHT SOURCE PRESSURE TEST SETUP

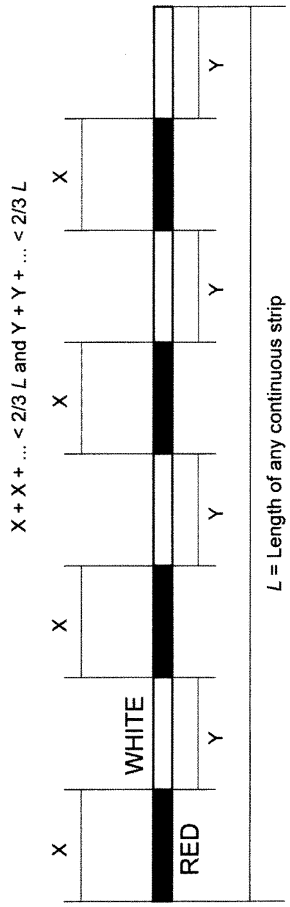
FIGURE 10



Trailer Conspicuity
Treatment Examples

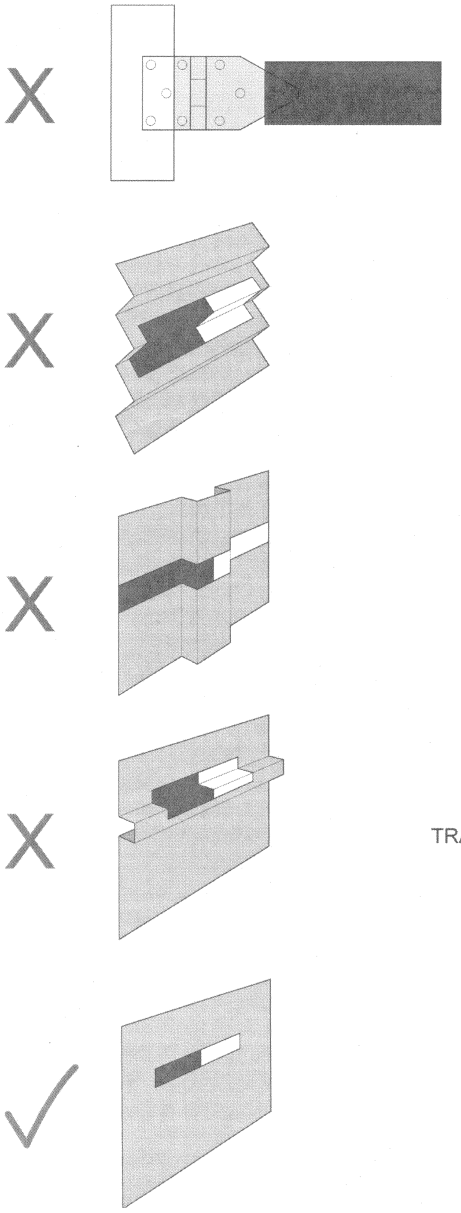
FIGURE 11

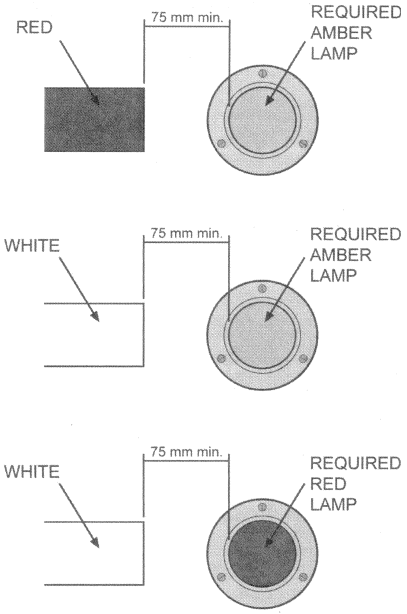




TRAILER CONSPICUITY DETAIL I

FIGURE 12-1





TRAILER CONSPICUITY DETAIL II

FIGURE 12-2

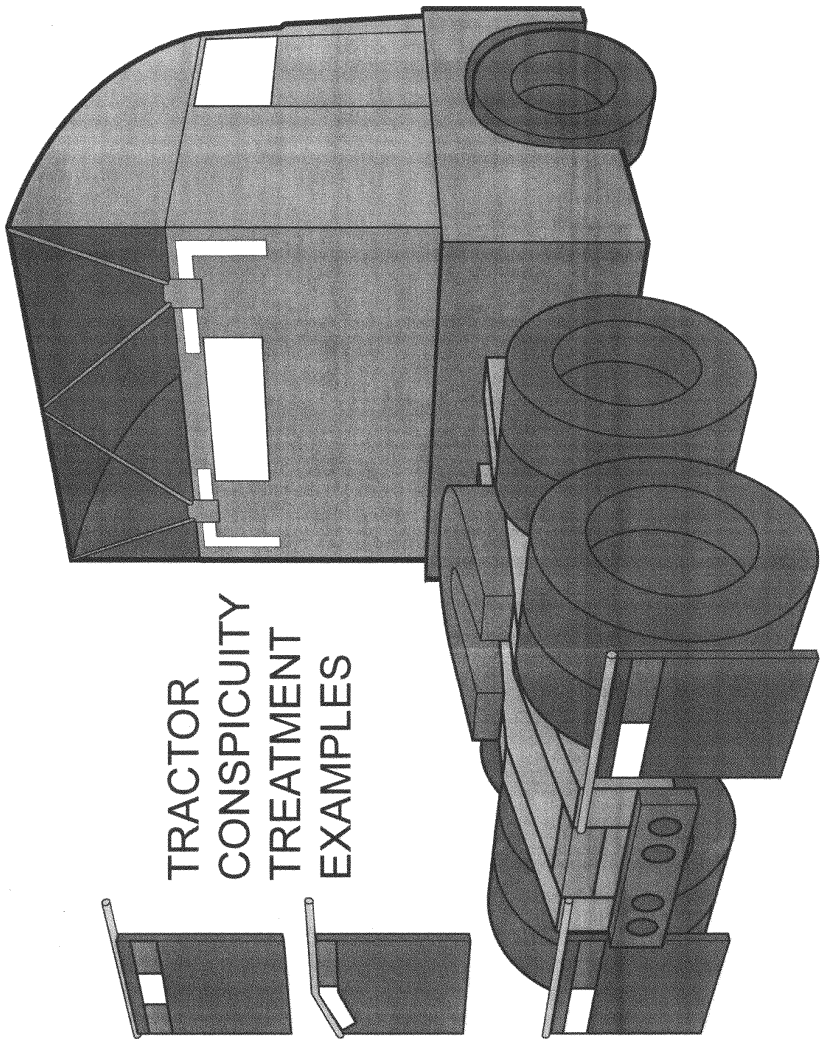
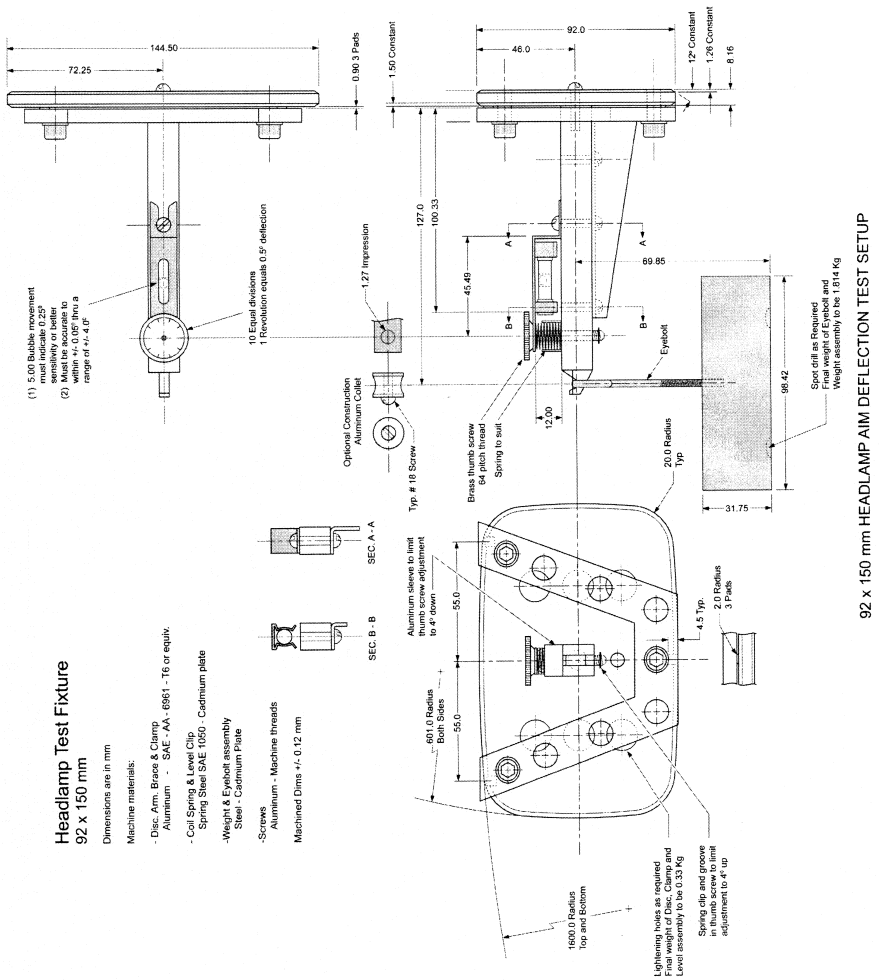
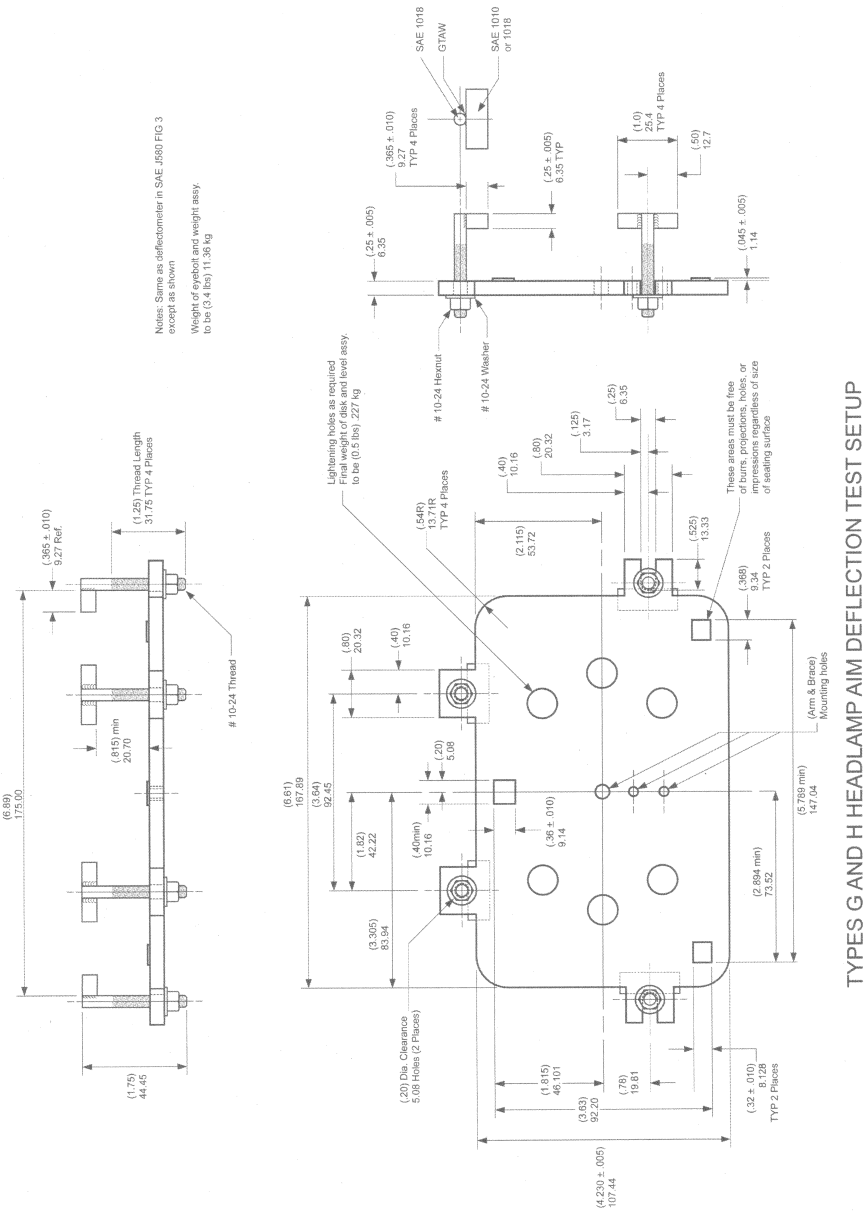


FIGURE 13



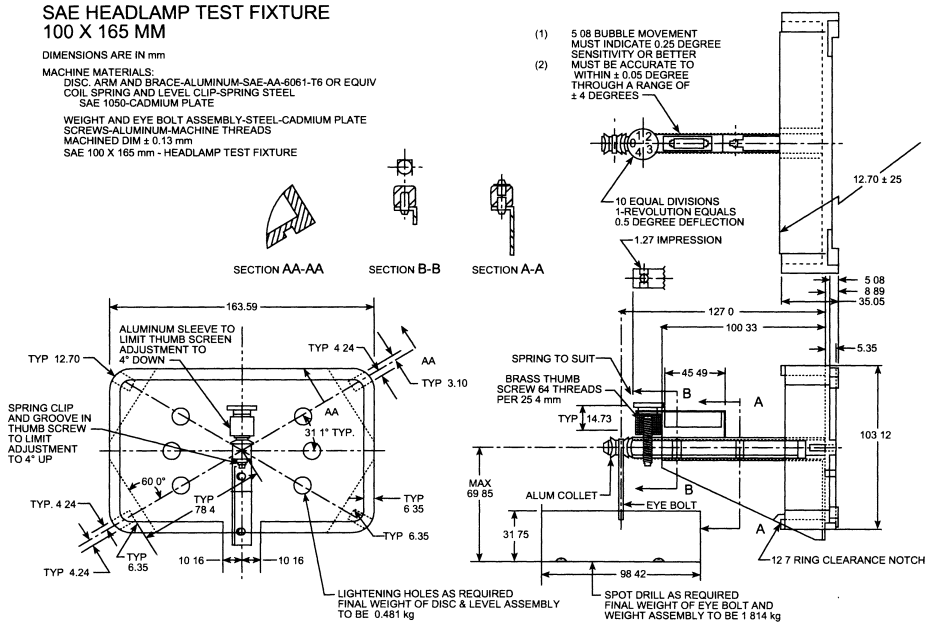
92 x 150 mm HEADLAMP AIM DEFLECTION TEST SETUP

FIGURE 14



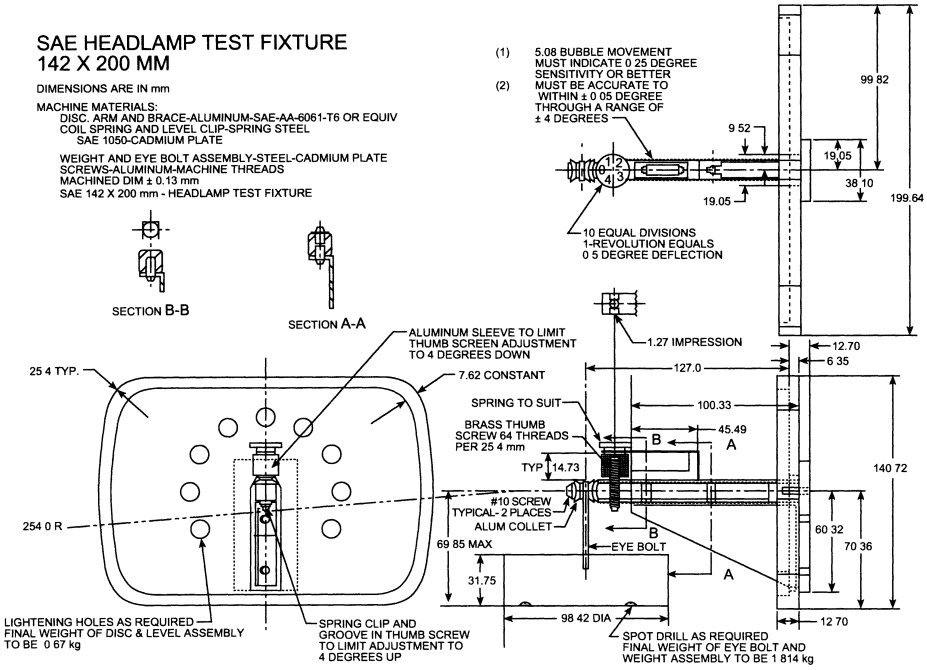
TYPES G AND H HEADLAMP AIM DEFLECTION TEST SETUP

FIGURE 15



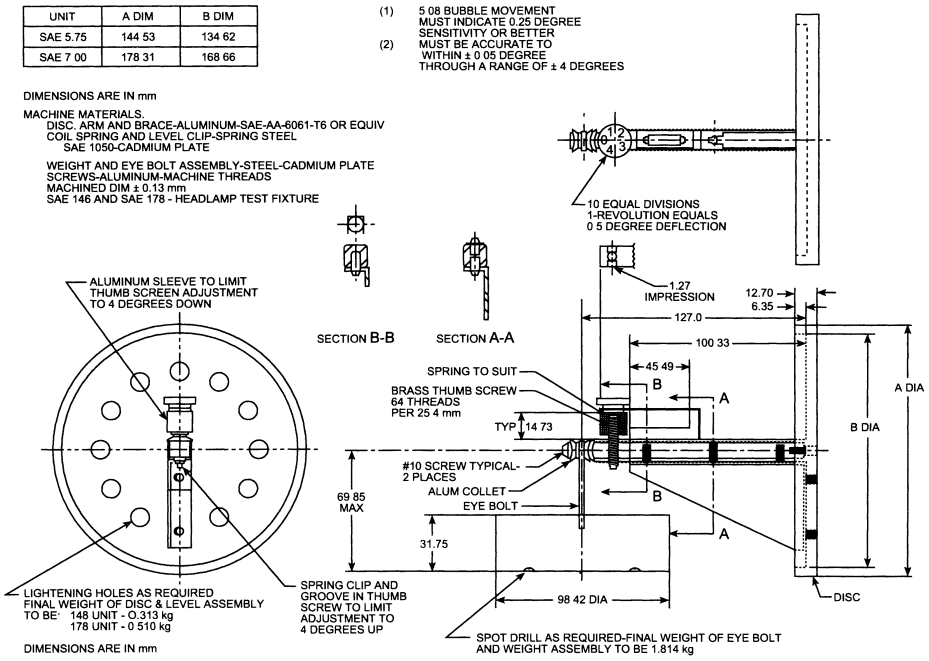
TYPES A AND E HEADLAMP AIM DEFLECTION TEST SETUP

FIGURE 16



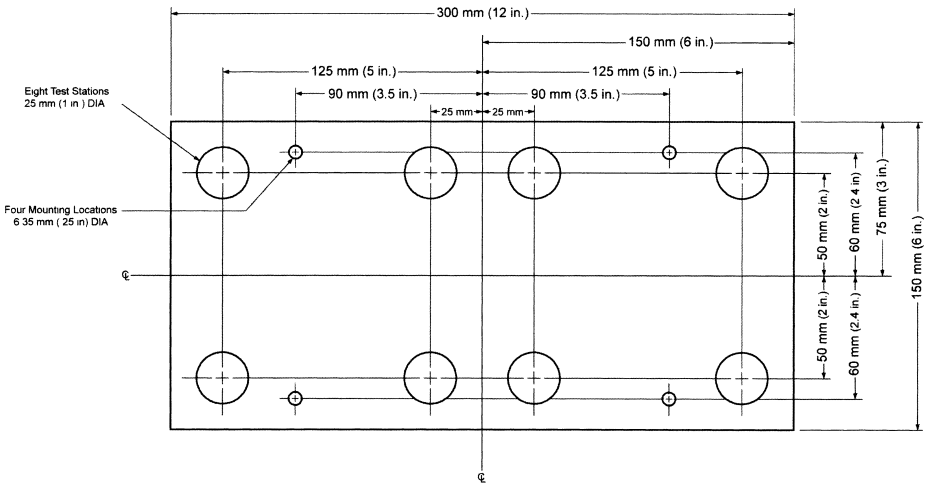
TYPE B HEADLAMP AIM DEFLECTION TEST SETUP

FIGURE 17

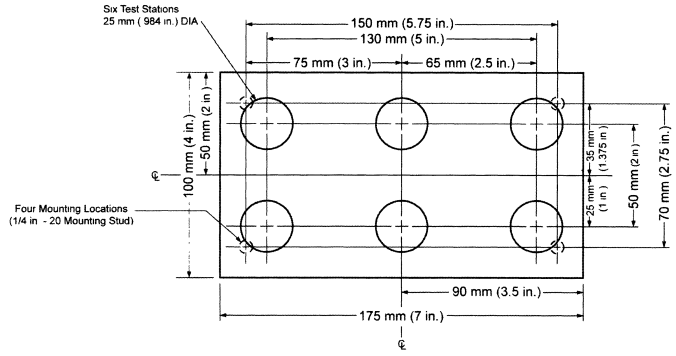


TYPES C AND D HEADLAMP AIM DEFLECTION TEST SETUP

FIGURE 18



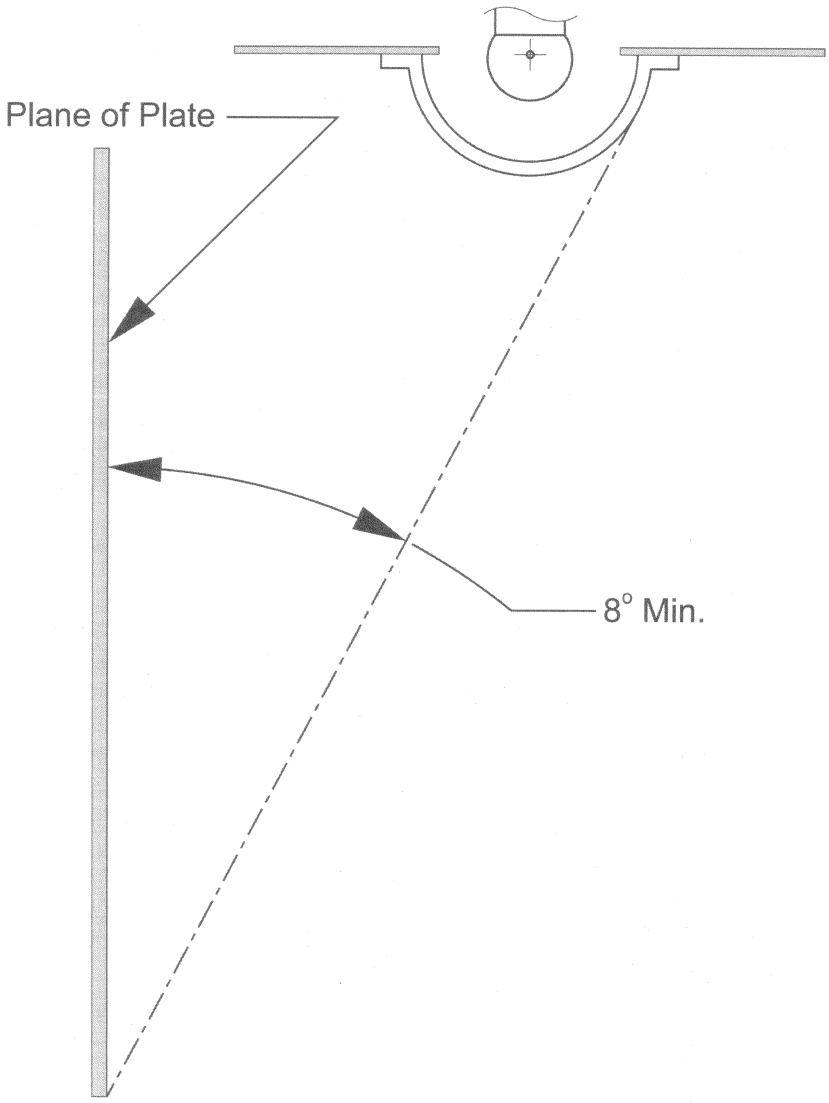
Test Plate for Vehicles other than Motorcycles and Motor Driven Cycles



Test Plate for Motorcycles and Motor Driven Cycles

LICENSE PLATE LAMP TARGET LOCATIONS

FIGURE 19



License Plate Lamp Measurement of Incident Light Angle

FIGURE 20

CAM PROFILE RADII*

Point	Radius, in.	Point	Radius, in.	Point	Radius, in.	Point	Radius, in.
1	0.5000	6	0.5504	11	0.6284	16	0.7064
2	0.5000	7	0.5660	12	0.6440	17	0.7220
3	0.5086	8	0.5816	13	0.6596	18	0.7376
4	0.5192	9	0.5972	14	0.6752	19	0.7466
5	0.5348	10	0.6128	15	0.6908	20	0.7500

* The cam width is between 1/2 and 1 in.

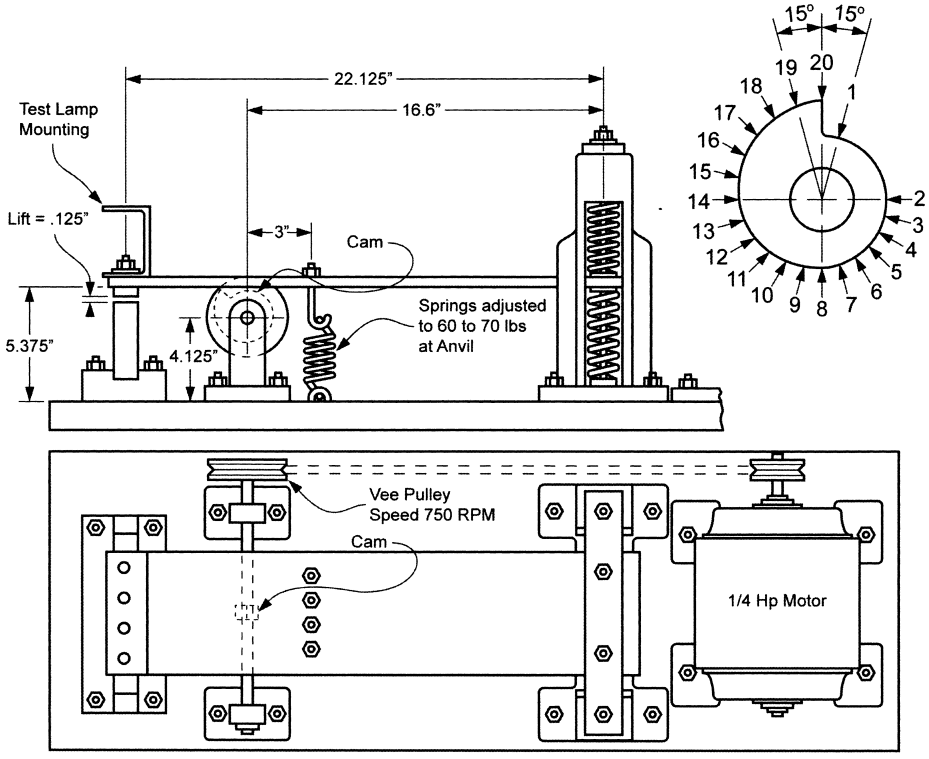
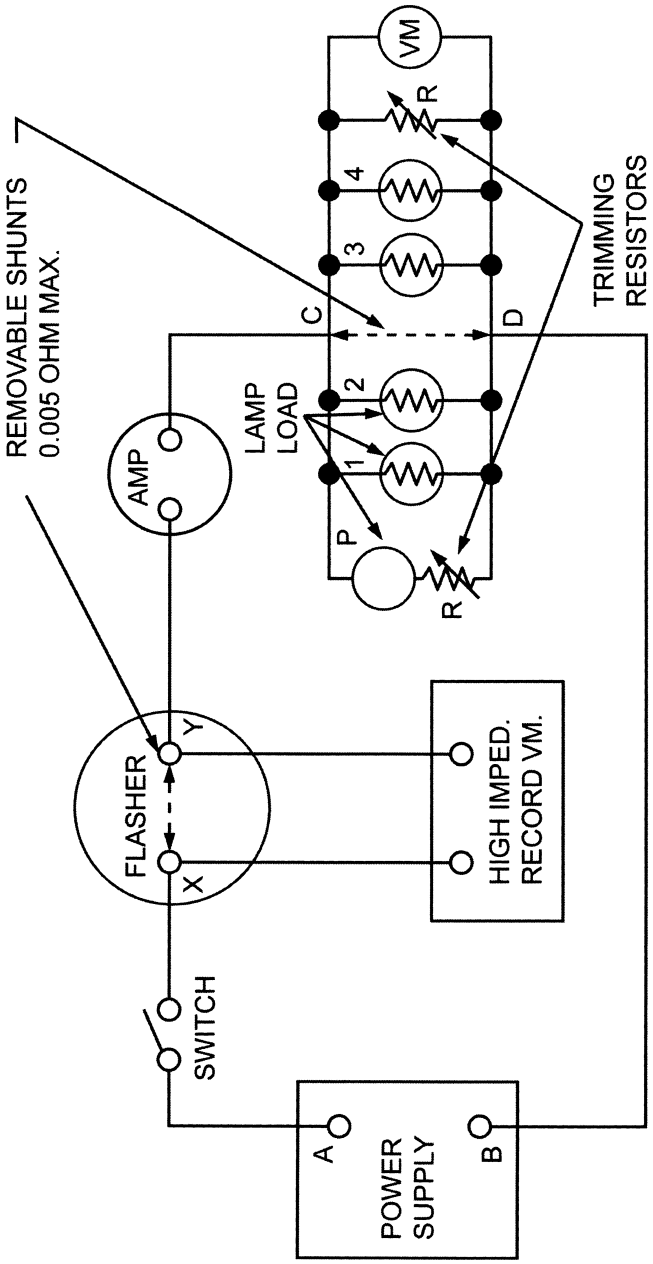
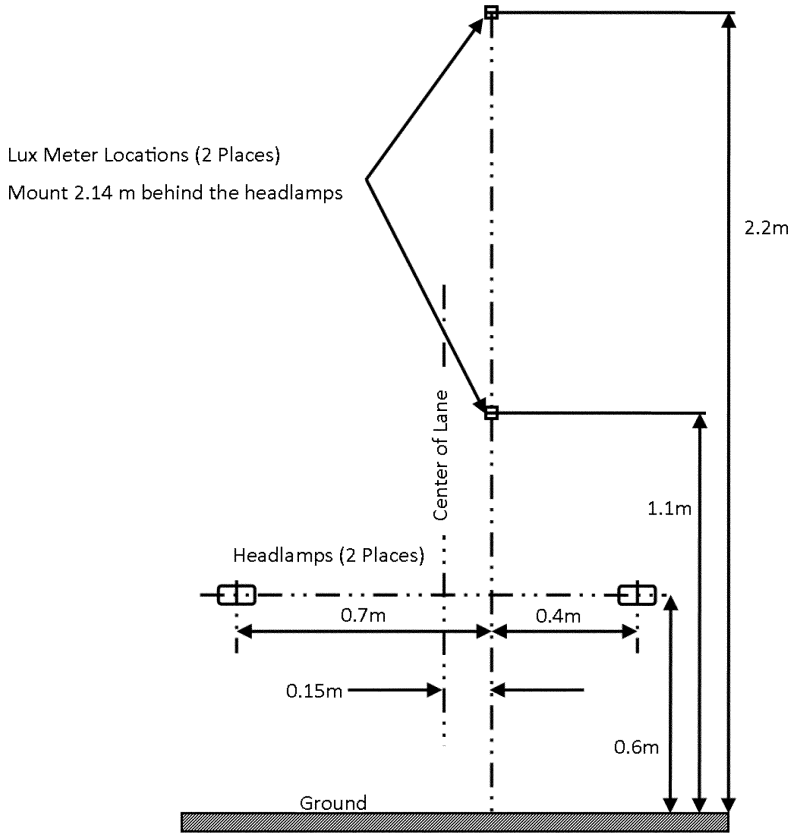


FIGURE 21 VIBRATION TEST MACHINE

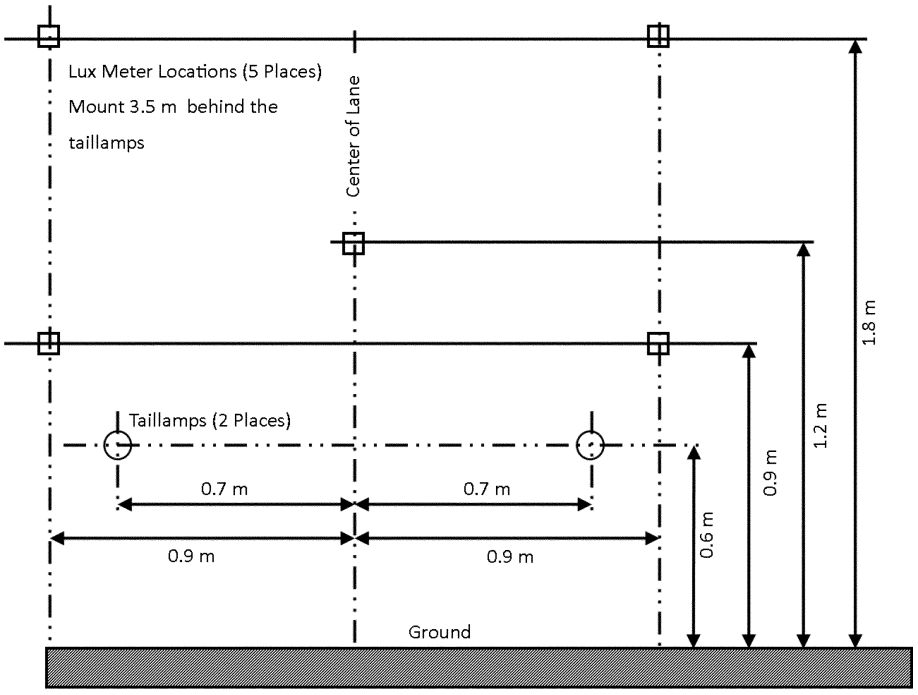


FLASHER STANDARD TEST CIRCUIT
FIGURE 22



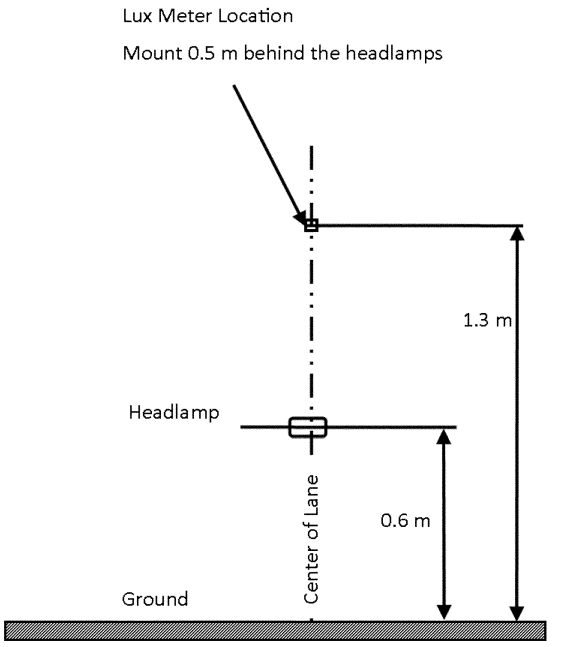
Car / Truck opposite direction stimulus test fixture dimensions

Figure 23



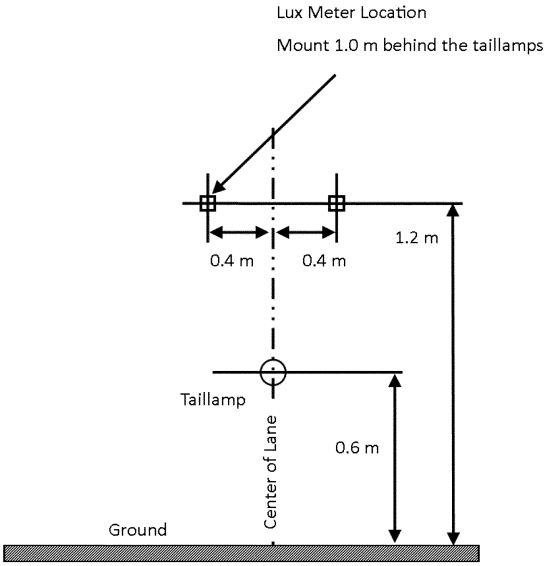
Car / Truck same direction stimulus fixture dimensions

Figure 24



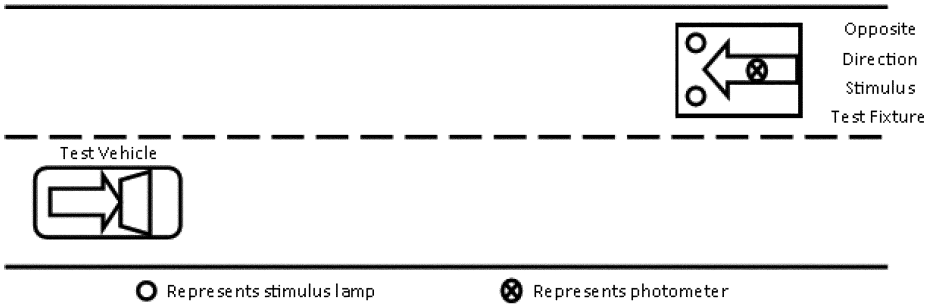
Motorcycle opposite direction stimulus test fixture dimensions

Figure 25



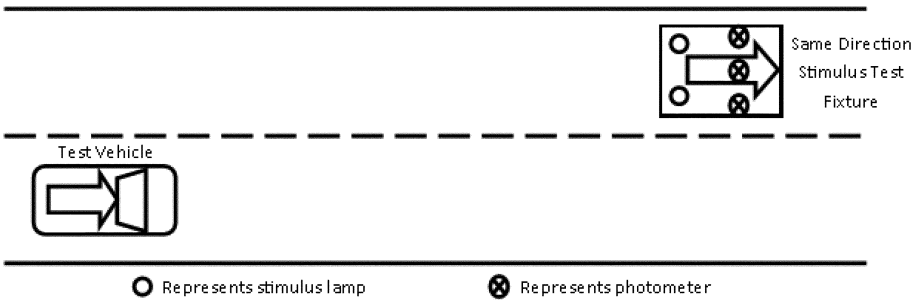
Motorcycle same direction stimulus test fixture dimensions

Figure 26



Not to scale. For illustrative purposes only.

Figure 27 Opposite Direction Test Scenarios



Not to scale. For illustrative purposes only.

Figure 28 Same Direction Test Scenarios

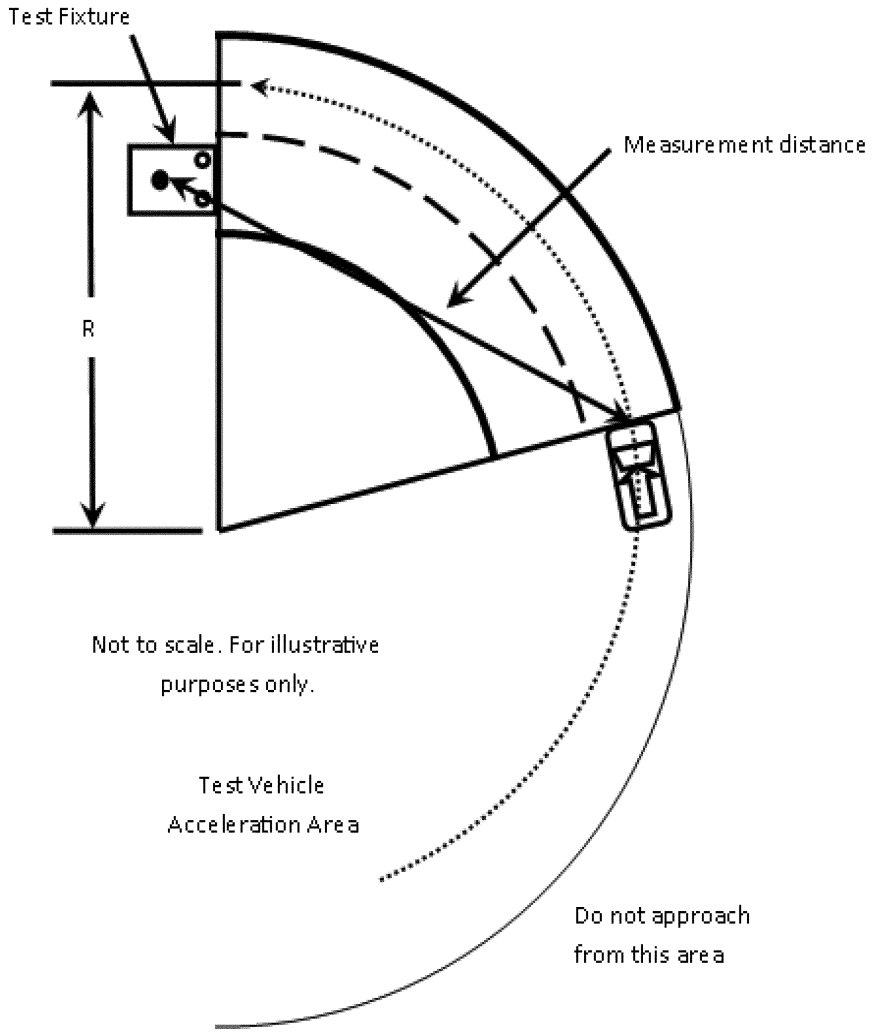


Figure 29 Left Curve Test Scenarios

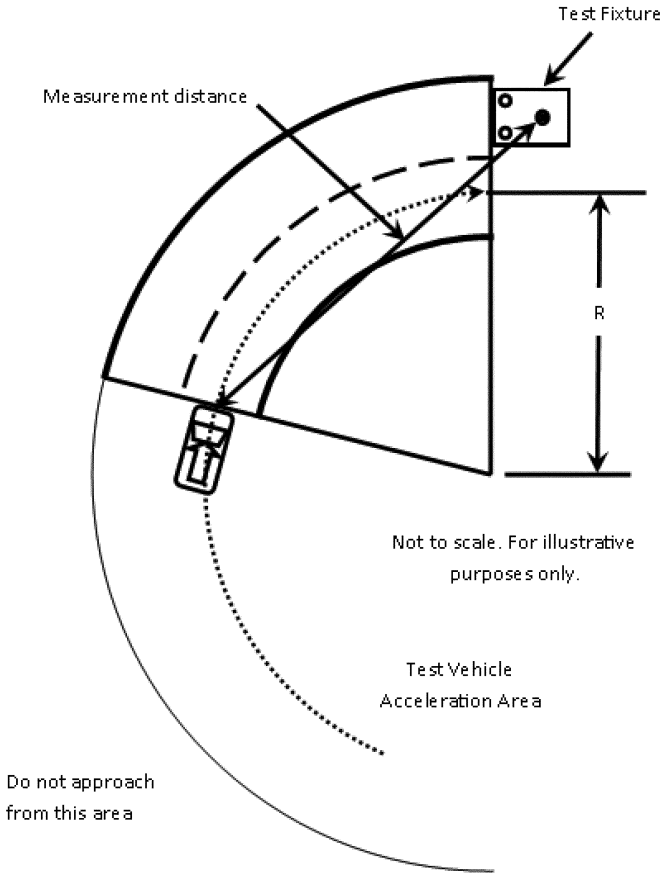


Figure 30 Right Curve Test Scenarios

[72 FR 68269, Dec. 4, 2007, as amended at 76 FR 23510, Apr. 27, 2011; 76 FR 48023, Aug. 8, 2011; 77 FR 757, Jan. 6, 2012; 77 FR 71720, Dec. 4, 2012; 80 FR 78669, Dec. 17, 2015; 81 FR 6458, Feb. 8, 2016; 87 FR 10021, Feb. 22, 2022]

§571.109 Standard No. 109; New pneumatic tires for vehicles manufactured from 1949 to 1975, bias ply tires, and T-type spare tires.

S1. *Scope.* This standard specifies tire dimensions and laboratory test requirements for bead unseating resistance, strength, endurance, and high speed performance; defines tire load ratings; and specifies labeling requirements for passenger car tires.

S2. *Application.* This standard applies to new pneumatic radial tires for use on passenger cars manufactured from 1949 through 1975, new pneumatic bias ply tires, and T-type spare tires. However, it does not apply to any tire that has been so altered so as to render impossible its use, or its repair for use, as motor vehicle equipment.

S3. *Definitions.*

Bead means that part of the tire made of steel wires, wrapped or reinforced by ply cords, that is shaped to fit the rim.

Bead separation means a breakdown of bond between components in the bead area.

Bias ply tire means a pneumatic tire in which the ply cords that extend to the beads are laid at alternate angles substantially less than 90° to the centerline of the tread.

Carcass means the tire structure, except tread and sidewall rubber.

Chunking means the breaking away of pieces of the tread or sidewall.

Cord means the strands forming the plies in the tire.

Cord separation means cords parting away from adjacent rubber compounds.

Cracking means any parting within the tread, sidewall, or innerliner of the tire extending to cord material.

Groove means the space between two adjacent tread ribs.

Innerliner means the layer(s) forming the inside surface of a tubeless tire that contains the inflating medium within the tire.

Innerliner separation means the parting of the innerliner from cord material in the carcass.

Load rating means the maximum load a tire is rated to carry for a given inflation pressure.

Maximum permissible inflation pressure means the maximum cold inflation pressure to which a tire may be inflated.

Maximum load rating means the load rating at the maximum permissible inflation pressure for that tire.

Open splice means any parting at any junction of tread, sidewall, or innerliner that extends to cord material.

Overall width means the linear distance between the exteriors of the sidewalls of an inflated tire, including elevations due to labeling, decorations, or protective bands or ribs.

Ply means a layer of rubber-coated parallel cords.

Ply separation means a parting of rubber compound between adjacent plies.

Pneumatic tire means a mechanical device made of rubber, chemicals, fabric and steel or other materials, which, when mounted on an automotive wheel, provides the traction and contains the gas or fluid that sustains the load.

Radial ply tire means a pneumatic tire in which the ply cords which extend to the beads are laid at substantially 90° to the centerline of the tread.

Rim means a metal support for a tire or a tire and tube assembly upon which the tire beads are seated.

Section width means the linear distance between the exteriors of the sidewalls of an inflated tire, excluding elevations due to labeling, decoration, or protective bands.

Sidewall means that portion of a tire between the tread and the bead.

Sidewall separation means the parting of the rubber compound from the cord material in the sidewall.

Test rim means, with reference to a tire to be tested, any rim that is listed as appropriate for use with that tire in accordance with S4.4. For purposes of this section and §571.110, each rim listing shall include dimensional specifications and a diagram of the rim.

Tread means that portion of a tire that comes into contact with the road.

Tread rib means a tread section running circumferentially around a tire.

Tread separation means pulling away of the tread from the tire carcass.

S4. *Requirements.*

S4.1 *Size and construction.* Each tire shall be designed to fit each rim specified for its size designation in each reference cited in the definition of *test rim* in S3.

S4.2 *Performance requirements.*

S4.2.1 *General.* Each tire shall conform to each of the following:

(a) It shall meet the requirements specified in S4.2.2 for its tire size designation, type, and maximum permissible inflation pressure.

(b) Its maximum permissible inflation pressure shall be either 32, 36, 40, or 60 psi, or 240, 280, 300, 340, or 350 kPa.

(c) Its load rating shall be that specified in a submission made by an individual manufacturer, pursuant to S4.4.1(a), or in one of the publications described in S4.4.1(b) for its size designation, type and each appropriate inflation pressure. If the maximum load rating for a particular tire size is shown in more than one of the publications described in S4.4.1(b), each tire of that size designation shall have a maximum load rating that is not less than the published maximum load rating, or if there are differing maximum load ratings for the same tire size designation, not less than the lowest published maximum load rating.

(d) It shall incorporate a tread wear indicator that will provide a visual indication that the tire has worn to a tread depth of 1.6 mm (1/16 inch).

(e) It shall, before being subjected to either the endurance test procedure specified in S5.4 or the high speed performance procedure specified in S5.5, exhibit no visual evidence of tread, sidewall, ply, cord, innerliner, or bead separation, chunking, broken cords, cracking, or open splices.

(f) It shall meet the requirements of S4.2.2.5 and S4.2.2.6 when tested on a test wheel described in S5.4.2.1 either alone or simultaneously with up to 5 other tires.

S4.2.2 *Test requirements.*

S4.2.2.1 *Test sample.* For each test sample use:

(a) One tire for physical dimensions, resistance to bead unseating, and strength, in sequence;

(b) Another tire for tire endurance; and

(c) A third tire for high speed performance.

S4.2.2.2 *Physical dimensions.* The actual section width and overall width for each tire measured in accordance with S5.1, shall not exceed the section width specified in a submission made by an individual manufacturer, pursuant to S4.4.1(a) or in one of the publications described in S4.4.1(b) for its size designation and type by more than:

(a) (For tires with a maximum permissible inflation pressure of 32, 36, or 40 psi) 7 percent, or

(b) (For tires with a maximum permissible inflation pressure of 240, 280, 300, 340 or 350 kPa, or 60 psi) 7 percent or 10 mm (0.4 inches), whichever is larger.

S4.2.2.3 *Tubeless tire resistance to bead unseating.*

S4.2.2.3.1 When a tubeless tire that has a maximum inflation pressure other than 420 kPa (60 psi) is tested in accordance with S5.2, the applied force required to unseat the tire bead at the point of contact shall be not less than:

(a) 6,670 N (1,500 pounds) for tires with a designated section width of less than 160 mm (6 inches);

(b) 8,890 N (2,000 pounds) for tires with a designated section width of 160 mm (6 inches) or more but less than 205 mm (8 inches);

(c) 11,120 N (2,500 pounds) for tires with a designated section width of 205 mm (8 inches) or more, using the section width specified in a submission made by an individual manufacturer, pursuant to S4.4.1(a), or in one of the publications described in S4.4.1(b) for the applicable tire size designation and type.

S4.2.2.3.2 When a tire that has a maximum inflation pressure of 420 kPa (60 psi) is tested in accordance with S5.2, the applied force required to unseat the bead at the point of contact shall be not less than:

(a) 6,670 N (1,500 pounds) for tires with a maximum load rating of less than 399 kg (880 pounds);

(b) 8,890 N (2,000 pounds) for tires with a maximum load rating of 399 kg (880 pounds) or more but less than 635 kg (1,400 pounds);

(c) 11,120 N (2,500 pounds) for tires with a maximum load rating of 635 kg (1,400 pounds) or more, using the maximum load rating marked on the sidewall of the tire.

S4.2.2.4 *Tire strength.* Each tire shall meet the requirements for minimum breaking energy specified in Table 1 when tested in accordance with S5.3.

S4.2.2.5 *Tire endurance.* When the tire has been subjected to the laboratory endurance test specified in S5.4, using a test rim that undergoes no permanent deformation and allows no loss of air through the portion that it comprises of the tire-rim pressure chamber:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, innerliner, or bead separation, chunking, broken cords, cracking, or open splices.

(b) The tire pressure at the end of the test shall be not less than the initial pressures specified in S5.4.1.1.

S4.2.2.6 *High speed performance.* When the tire has been subjected to the laboratory high speed performance test specified in S5.5, using a test rim that undergoes no permanent deformation and allows no loss of air through the portion that it comprises of the tire-rim pressure chamber, the tire shall meet the requirements set forth in S4.2.2.5 (a) and (b).

S4.3 Labeling Requirements. Except as provided in S4.3.1 and S4.3.2 of this standard, each tire, except for those certified to comply with S5.5 of §571.139, shall have permanently molded into or onto both sidewalls, in letters and numerals not less than 0.078 inches high, the information shown in paragraphs S4.3 (a) through (g) of this standard. On at least one sidewall, the information shall be positioned in an area between the maximum section width and bead of the tire, unless the maximum section width of the tire falls between the bead and one-fourth of the distance from the bead to the shoulder of the tire. For tires where the maximum section width falls in that area, locate all required labeling between the bead and a point one-half the distance from the bead to the shoulder of the tire. However, in no case shall the information be positioned on the tire so that it is obstructed by the flange or any rim designated for use with that tire in Standards Nos. 109 and 110 (Sec. 571.109 and Sec. 571.110 of this part).

(a) One size designation, except that equivalent inch and metric size designations may be used;

(b) Maximum permissible inflation pressure;

(c) Maximum load rating;

(d) The generic name of each cord material used in the plies (both sidewall and tread area) of the tire;

(e) Actual number of plies in the sidewall, and the actual number of plies in the tread area if different;

(f) The words ''tubeless'' or ''tube type'' as applicable; and

(g) The word ''radial'' if the tire is a radial ply tire.

S4.3.1 Each tire shall be labeled with the symbol DOT in the manner specified in part 574 of this chapter, which shall constitute a certification that the tire conforms to applicable Federal motor vehicle safety standards.

S4.3.2 Each tire shall be labeled with the name of the manufacturer, or brand name and number assigned to the manufacturer in the manner specified in part 574.

S4.3.3 [Reserved]

S4.3.4 If the maximum inflation pressure of a tire is 240, 280, 300, 340, or 350 kPa, then:

(a) Each marking of that inflation pressure pursuant to S4.3(b) shall be followed in parenthesis by the equivalent inflation pressure in psi, rounded to the next higher whole number; and

(b) Each marking of the tire's maximum load rating pursuant to S4.3(c) in kilograms shall be followed in parenthesis by the equivalent load rating in pounds, rounded to the nearest whole number.

S4.3.5 If the maximum inflation pressure of a tire is 420 kPa (60 psi), the tire shall have permanently molded into or onto both sidewalls, in letters and numerals not less than 12.7 mm (½ inch), the words ''Inflate to 420 kPa (60 psi)''. On both sidewalls, the words shall be positioned in an area between the tire shoulder and the bead of the tire. However, in no case shall the words be positioned on the tire so that they are obstructed by the flange of any rim designated for use with that tire in this standard or in Standard No. 110 (§571.110 of this part).

S4.4 *Tire and rim matching information.*

S4.4.1 Each manufacturer of tires not certified to comply with S4 of

§ 571.139 shall ensure that a listing of the rims that may be used with each tire that he produces is provided to the public. A listing compiled in accordance with paragraph (a) of S4.4.1 of this standard need not include dimensional specifications or diagram of a rim if the rim's dimensional specifications and diagram are contained in each listing published in accordance with paragraph (b) of S4.4.1 of this standard. The listing shall be in one of the following forms:

(a) Listed by manufacturer name or brand name in a document furnished to dealers of the manufacturer's tires, to any person upon request, and in duplicate to the Docket Section (No: NHTSA–2009–0117), National Highway Traffic Safety Administration, West Building, 1200 New Jersey Ave SE., Washington, DC 20590; or

(b) Contained in publications, current at the date of manufacture of the tire or any later date, of at least one of the following organizations:

Tire and Rim Association
The European Tyre and Rim Technical Organization
Japan Automobile Tyre Manufacturers Association, Inc.
Tyre and Rim Association of Australia
Associacao Latino Americana de Pneus e Aros (Brazil)
South African Bureau of Standards

S4.4.2 Information contained in any publication specified in S4.4.1(b) of this standard which lists general categories of tires and rims by size designation, type of construction and/or intended use, shall be considered to be manufacturer's information pursuant to S4.4.1 of this standard for the listed tires and rims, unless the publication itself or specific information provided according to S4.4.1(a) of this standard indicates otherwise.

S5. *Test procedures.*

S5.1 *Physical Dimensions.* Determine tire physical dimensions under uniform ambient conditions as follows:

(a) Mount the tire on a test rim having the test rim width specified in a submission made by an individual manufacturer, pursuant to S4.4.1(a), or in one of the publications described in S4.4.1(b) for that tire size designation and inflate it to the applicable pressure specified in Table II.

(b) Condition it at ambient room temperature for at least 24 hours.

(c) Readjust pressure to that specified in (a).

(d) Caliper the section width and overall width at six points approximately equally spaced around the tire circumference.

(e) Record the average of these measurements as the section width and overall width, respectively.

(f) Determine tire outer diameter by measuring the maximum circumference of the tire and dividing this dimension by pi (3.14).

S5.2 *Tubeless tire bead unseating resistance.*

S5.2.1 *Preparation of tire-wheel assembly.*

S5.2.1.1 Wash the tire, dry it at the beads, and mount it without lubrication or adhesives on a clean, painted test rim.

S5.2.1.2 Inflate it to the applicable pressure specified in Table II at ambient room temperature.

S5.2.1.3 Mount the wheel and tire in a fixture shown in Figure 1, and force the bead unseating block shown in Figure 2 or Figure 2A against the tire sidewall as required by the geometry of the fixture. However, in testing a tire that has an inflation pressure of 60 psi, only use the bead unseating block described in Figure 2A.

S5.2.2 *Test procedure.*

S5.2.2.1 Apply a load through the block to the tire's outer sidewall at the distance specified in Figure 1 for the applicable wheel size at a rate of 50 mm (2 inches) per minute, with the load arm substantially parallel to the tire and rim assembly at the time of engagement.

S5.2.2.2 Increase the load until the bead unseats or the applicable value specified in S4.2.2.3 is reached.

S5.2.2.3 Repeat the test at least four places equally spaced around the tire circumference.

S5.3 *Tire strength.*

S5.3.1 *Preparation of tire.*

S5.3.1.1 Mount the tire on a test rim and inflate it to the applicable pressure specified in Table II.

S5.3.1.2 Condition it at room temperature for at least 3 hours; and

S5.3.1.3 Readjust its pressure to that specified in S5.3.1.1.

S5.3.2 *Test procedure.*

S5.3.2.1 Force a 19 mm (¾ inch) diameter cylindrical steel plunger with a hemispherical end perpendicularly into the tread rib as near to the centerline as possible, avoiding penetration into the tread groove, at the rate of 50 mm (2 inches) per minute.

S5.3.2.2 Record the force and penetration at five test points equally spaced around the circumference of the tire. If the tire fails to break before the plunger is stopped by reaching the rim, record the force and penetration as the rim is reached and use these values in S5.3.2.3.

S5.3.2.3 Compute the breaking energy for each test point by means of one of the two following formulas:

$W=[(F \times P)/2] \times 10^{\times 3}$ (joules)

Where

W = Energy, in joules;
F = Force, Newtons; and
P = Penetration, mm; or

$W=[(F \times P)/2]$

Where

W = Energy, inch-pounds;
F = Force, pounds; and
P = Penetration, inches.

S5.3.2.4 Determine the breaking energy value for the tire by computing the average of the five values obtained in accordance with S5.3.2.3.

S5.4 *Tire endurance.*

S5.4.1 *Preparation of tire.*

S5.4.1.1 Mount a new tire on a test rim and inflate it to the applicable pressure specified in Table II.

S5.4.1.2 Condition the tire assembly to 38° ±3 °C (100° ±5 °F) for at least three hours.

S5.4.1.3 Readjust tire pressure to that specified in S5.4.1.1 immediately before testing.

S5.4.2 *Test procedure.*

S5.4.2.1 Mount the tire and wheel assembly on a test axle and press it against a flat-faced steel test wheel 1708 mm (67.23 inches) in diameter and at least as wide as the section width of the tire to be tested or an approved equivalent test wheel, with the applicable test load specified in the table in S5.4.2.3 for the tire's size designation, type and maximum permissible inflation pressure.

S5.4.2.2 During the test, the air surrounding the test area shall be 38° ±3 °C (100° ±5 °F).

S5.4.2.3 Conduct the test at 80 kilometers per hour (km/h)(50 miles per hour) in accordance with the following schedule without pressure adjustment or other interruptions:

The loads for the following periods are the specified percentage of the maximum load rating marked on the tire sidewall:

	Percent
4 hours	85
6 hours	90
24 hours	100

S5.4.2.4 Immediately after running the tire the required time, measure its inflation pressure. Allow the tire to cool for one hour. Then deflate the tire, remove it from the test rim, and inspect it for the conditions specified in S4.2.2.5(a).

S5.5 High speed performance.

S5.5.1 After preparing the tire in accordance with S5.4.1, mount the tire and wheel assembly in accordance with S5.4.2.1, and press it against the test wheel with a load of 88 percent of the tire's maximum load rating as marked on the tire sidewall.

S5.5.2 Break in the tire by running it for 2 hours at 80 km/h (50 mph).

S5.5.3 Allow to cool to 38° ±3 °C (100° ±5 °F) and readjust the inflation pressure to the applicable pressure specified in Table II.

S5.5.4 Without readjusting inflation pressure, test at 121 km/h (75 mph) for 30 minutes, 129 km/h (80 mph) for 30 minutes, and 137 km/h (85 mph) for 30 minutes.

S5.5.5 Immediately after running the tire the required time, measure its inflation pressure. Allow the tire to cool for one hour. Then deflate the tire, remove it from the test rim, and inspect it for the conditions specified in S4.2.2.5(a).

S6. *Nonconforming tires.* No tire that is designed for use on passenger cars and manufactured on or after October 1, 1972, but does not conform to all the requirements of this standard, shall be sold, offered for sale, introduced or delivered for introduction into interstate commerce, or imported into the United States, for any purpose.

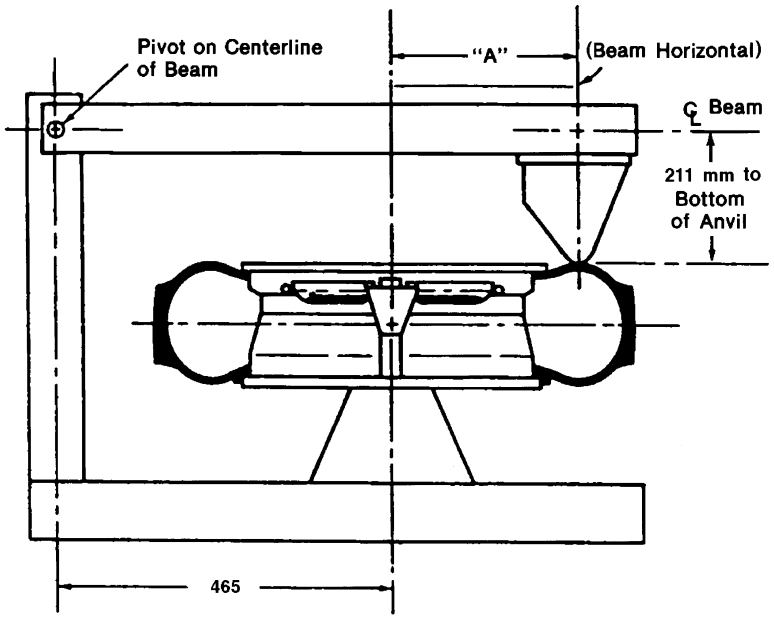
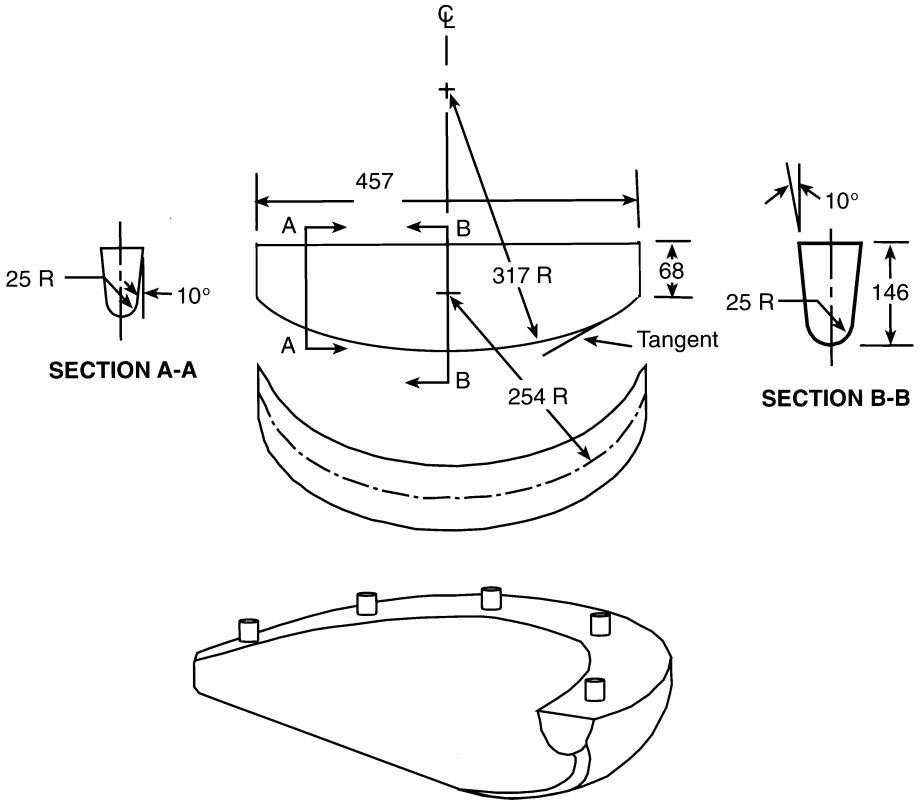


Figure 1.—Bead Unseating Fixture
All Dimensions in Millimeters (mm)

FIGURES FOR FMVSS NO. 109

Wheel size	Dimension "A" for tires with maximum inflation pressure			
	Other than 60 psi (in)	Other than 420 kPa	60 psi (in)	420 kPa
20	13.50	345		
19	13.00	330	12.00	305
18	12.50	318	11.40	290
17	12.00	305	10.60	269
16	11.50	292	9.90	251
15	11.00	279	9.40	239
14	10.50	267	8.90	226
13	10.00	254	8.40	213
12	9.50	241		
11	9.00	229		
10	8.50	216	.	
320	8.50	216		
340	9.00	229		
345	9.25	235		
365	9.75	248		
370	10.00	254		
390	11.00	279		
415	11.50	292		



MATERIAL: Cast Aluminum 355
T-6 Condition
Finish-1.3 Micrometer (um)

Figure 2. DIAGRAM OF BEAD UNSEATING BLOCK
All dimensions in millimeters (mm)

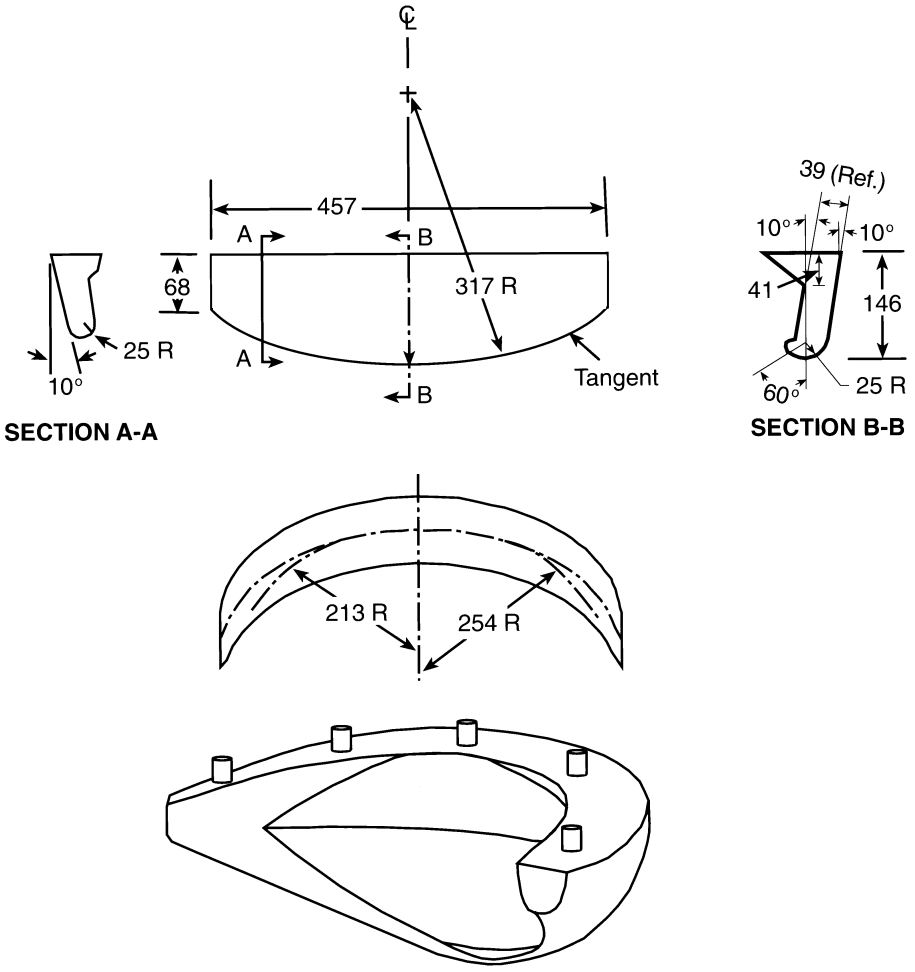


Figure 2A. DIAGRAM OF BEAD UNSEATING BLOCK
All dimensions in millimeters (mm)

APPENDIX A—FEDERAL MOTOR VEHICLE SAFETY STANDARD NO. 109

The following tables list tire sizes and tire constructions with proper load and inflation values. The tables group tires of related constructions and load/inflation values. Persons requesting the addition of new tire sizes to the tables or the addition of tables for new tire constructions may, when the additions requested are compatible with existent groupings, or when adequate justification for new tables exists, submit five (5) copies of information and data supporting the request to

the Vehicle Dynamics Division, Office of Crash Avoidance Standards, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590.

The information should contain the following:

1. The tire size designation, and a statement either that the tire is an addition to a category of tires listed in the tables or that it is in a new category for which a table has not been deloped.

2. The tire dimensions, including aspect ratio, size factor, section width, overall width, and test rim size.

3. The load-inflation schedule of the tire.

4. A statement as to whether the tire size designation and load inflation schedule has been coordinated with the Tire and Rim Association, the European Tyre and Rim Technical Organisation, the Japan Automobile Tire Manufacturers' Association, Inc., the Deutsche Industrie Norm, the British Standards Institution, the Scandinavian Tire and Rim Organization, and the Tyre and Rim Association of Australia.

5. Copies of test data sheets showing test conditions, results and conclusions obtained for individual tests specified in §571.109.

6. Justification for the additional tire sizes.

TABLE I-A—FOR BIAS PLY TIRES WITH DESIGNATED SECTION WIDTH OF 152 MM (6 INCHES) AND ABOVE

Cord material	32 psi	36 psi	40 psi	240 kPa	280 kPa	300 kPa	340 kPa
Rayon:							
(in-lbs)	1,650	2,574	3,300	1,650	3,300	1,650	3,300
(joules)	186	291	373	186	373	186	373
Nylon or polyester:							
(in-lbs)	2,600	3,900	5,200	2,600	5,200	2,600	5,200
(joules)	294	441	588	294	588	294	588

TABLE I-B—FOR BIAS PLY TIRES WITH DESIGNATED SECTION WIDTH BELOW 152 MM (6 INCHES)

Cord material	32 psi	36 psi	40 psi	240 kPa	280 kPa	300 kPa	340 kPA
Rayon:							
(in-lbs)	1,000	1,875	2,500	1,000	2,500	1,000	2,500
(joules)	113	212	282	113	282	113	282
Nylon or polyester:							
(in-lbs)	1,950	2,925	3,900	1,950	3,900	1,950	3,900
(joules)	220	330	441	220	441	220	441

TABLE I–C—FOR RADIAL PLY TIRES

Size designation	Maximum permissible inflation							
	PSI			kPa				
	32	36	40	240	280	300	340	350
Below 160 mm:								
(in-lbs)	1,950	2,925	3,900	1,950	3,900	1,950	3,900	1,950
(joules)	220	330	441	220	441	220	441	220
160 mm or above:								
(in-lbs)	2,600	3,900	5,200	2,600	5,200	2,600	5,200	2,600
(joules)	294	441	588	294	588	294	588	294

TABLE I-D—FOR TIRES WITH 420 KPA (60 PSI) MAXIMUM PERMISSIBLE INFLATION PRESSURE AND MAXIMUM LOAD RATING 399 KG (880 LB) AND ABOVE

Cord material	Inch-pounds joules (J)
Rayon	1,650 inch pounds 186 joules (J).
Nylon or Polyester	2,600 inch pounds 294 joules (J).

TABLE I-E—FOR TIRES WITH 420 KPA (60 PSI) MAXIMUM PERMISSIBLE INFLATION PRESSURE AND MAXIMUM LOAD RATING BELOW 399 KG (880 LB)

Cord material	Inch-pounds joules (J)
Rayon	1,000 inch pounds 113 joules (J).
Nylon or Polyester	1,950 inch pounds 220 joules (J).

TABLE II—TEST INFLATION PRESSURES

[Maximum permissible inflation pressure to be used for the following test]

Test type	psi				kPa				
	32	36	40	60	240	280	300	340	350
Physical dimensions	24	28	32	60	180	220	180	220	180
Bead unseating, tire strength, and tire endurance	24	28	32	52	180	220	180	220	180
High speed performance	30	34	38	58	220	260	220	260	220

APPENDIX TO § 571.109

Persons requesting the addition of new tire sizes not included in S4.4.1(b) organizations may, upon approval, submit five (5) copies of information and data supporting the request to the Vehicle Dynamics Division, Office of Crash Avoidance Standards, National Highway Traffic Safety Administration, West Building, 1200 New Jersey Ave. SE., Washington, DC 20590.

The information should contain the following:

1. The tire size designation, and a statement either that the tire is an addition to a category of tires listed in the tables or that it is in a new category for which a table has not been developed.
2. The tire dimensions, including aspect ratio, size factor, section width, overall width, and test rim size.
3. The load-inflation schedule of the tire.
4. A statement as to whether the tire size designation and load inflation schedule has been coordinated with the Tire and Rim Association, the European Tyre and Rim Technical Organization, the Japan Automobile Tyre Manufacturers Association, Inc., the Tyre and Rim Association of Australia, the Associacao Latino Americana de Pneus e Aros (Brazil), or the South African Bureau of Standards.
5. Copies of test data sheets showing test conditions, results and conclusions obtained for individual tests specified in § 571.109.
6. Justification for the additional tire sizes.

[38 FR 30235, Nov. 1, 1973]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 571.109, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 571.110 Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information for motor vehicles with a GVWR of 4,536 kilograms (10,000 pounds) or less.

S1. *Purpose and scope.* This standard specifies requirements for tire selection to prevent tire overloading and for motor home/recreation vehicle trailer load carrying capacity information.

S2. *Application.* This standard applies to motor vehicles with a gross vehicle weight rating (GVWR) of 4,536 kilograms (10,000 pounds) or less, except for motorcycles, and to non-pneumatic spare tire assemblies for those vehicles.

S3. *Definitions.*

Accessory weight means the combined weight (in excess of those standard items which may be replaced) of automatic transmission, power steering, power brakes, power windows, power seats, radio, and heater, to the extent that these items are available as factory-installed equipment (whether installed or not).

Curb weight means the weight of a motor vehicle with standard equipment including the maximum capacity of fuel, oil, and coolant, and, if so equipped, air conditioning and additional weight optional engine.

Maximum loaded vehicle weight means the sum of—

(a) Curb weight;
(b) Accessory weight;
(c) Vehicle capacity weight; and
(d) Production options weight.

Light truck (LT) tire means a tire designated by its manufacturer as primarily intended for use on lightweight trucks or multipurpose passenger vehicles.

Non-pneumatic rim is used as defined in § 571.129.

Non-pneumatic spare tire assembly means a non-pneumatic tire assembly intended for temporary use in place of one of the pneumatic tires and rims that are fitted to a passenger car in compliance with the requirements of this standard.

Non-pneumatic tire and *non-pneumatic tire assembly* are used as defined in § 571.129.

Normal occupant weight means 68 kilograms times the number of occupants specified in the second column of Table I.

Occupant distribution means distribution of occupants in a vehicle as specified in the third column of Table I.

Passenger car tire means a tire intended for use on passenger cars, multipurpose passenger vehicles, and trucks, that have a gross vehicle weight rating (GVWR) of 10,000 pounds or less.

Production options weight means the combined weight of those installed regular production options weighing over 2.3 kilograms in excess of those standard items which they replace, not previously considered in curb weight or accessory weight, including heavy duty brakes, ride levelers, roof rack, heavy duty battery, and special trim.

Rim is used as defined in §571.109.

Rim diameter means nominal diameter of the bead seat.

Rim size designation means rim diameter and width.

Rim type designation means the industry of manufacturer's designation for a rim by style or code.

Rim width means nominal distance between rim flanges.

Vehicle capacity weight means the rated cargo and luggage load plus 68 kilograms times the vehicle's designated seating capacity.

Vehicle maximum load on the tire means that load on an individual tire that is determined by distributing to each axle its share of the maximum loaded vehicle weight and dividing by two.

Vehicle normal load on the tire means that load on an individual tire that is determined by distributing to each axle its share of the curb weight, accessory weight, and normal occupant weight (distributed in accordance with Table I) and dividing by 2.

Wheel center member is used as defined in §571.129.

S4. *Requirements.*

S4.1 *General* (a) Subject to the exceptions set forth in S4.1(b), vehicles shall be equipped with tires that meet the requirements of §571.139.

(b) Notwithstanding the requirement in S4.1(a),

(1) Passenger cars may be equipped with pneumatic T-type temporary spare tire assemblies that meet the requirements of §571.109 or non-pneumatic spare tire assemblies that meet the requirements of §571.129 and S6 and S8 of this standard. Passenger cars equipped with a non-pneumatic spare tire assembly shall also meet the requirements of S4.3(e), S5, and S7 of this standard.

(2) Trailers may be equipped with ST tires, FI tires, or tires with a rim diameter code of 12 or below that meet the requirements of §571.119.

S4.2 *Tire load limits.*

S4.2.1 Tire load limits for passenger cars.

S4.2.1.1 The vehicle maximum load on the tire shall not be greater than the applicable maximum load rating as marked on the sidewall of the tire.

S4.2.1.2 The vehicle normal load on the tire shall not be greater than 94 percent of the load rating at the vehicle manufacturer's recommended cold inflation pressure for that tire.

S4.2.2 Tire load limits for multipurpose passenger vehicles, trucks, buses, and trailers.

S4.2.2.1 Except as provided in S4.2.2.2, the sum of the maximum load ratings of the tires fitted to an axle shall not be less than the GAWR of the axle system as specified on the vehicle's certification label required by 49 CFR part 567. If the certification label shows more than one GAWR for the axle system, the sum shall be not less than the GAWR corresponding to the size designation of the tires fitted to the axle.

S4.2.2.2 When passenger car tires are installed on an MPV, truck, bus, or trailer, each tire's load rating is reduced by dividing it by 1.10 before determining, under S4.2.2.1, the sum of the maximum load ratings of the tires fitted to an axle.

S4.2.2.3 (a) For vehicles, except trailers with no designated seating positions, equipped with passenger car tires, the vehicle normal load on the tire shall be no greater than 94 percent of the derated load rating at the vehicle manufacturer's recommended cold inflation pressure for that tire.

(b) For vehicles, except trailers with no designated seating positions,

equipped with LT tires, the vehicle normal load on the tire shall be no greater than 94 percent of the load rating at the vehicle manufacturer's recommended cold inflation pressure for that tire.

S4.3 *Placard.* Each vehicle, except for a trailer or incomplete vehicle, shall show the information specified in S4.3 (a) through (g), and may show, at the manufacturer's option, the information specified in S4.3 (h) and (i), on a placard permanently affixed to the driver's side B-pillar. In each vehicle without a driver's side B-pillar and with two doors on the driver's side of the vehicle opening in opposite directions, the placard shall be affixed on the forward edge of the rear side door. If the above locations do not permit the affixing of a placard that is legible, visible and prominent, the placard shall be permanently affixed to the rear edge of the driver's side door. If this location does not permit the affixing of a placard that is legible, visible and prominent, the placard shall be affixed to the inward facing surface of the vehicle next to the driver's seating position. This information shall be in the English language and conform in color and format, not including the border surrounding the entire placard, as shown in the example set forth in Figure 1 in this standard. At the manufacturer's option, the information specified in S4.3 (c), (d), and, as appropriate, (h) and (i) may be shown, alternatively to being shown on the placard, on a tire inflation pressure label which must conform in color and format, not including the border surrounding the entire label, as shown in the example set forth in Figure 2 in this standard. The label shall be permanently affixed and proximate to the placard required by this paragraph. The information specified in S4.3 (e) shall be shown on both the vehicle placard and on the tire inflation pressure label (if such a label is affixed to provide the information specified in S4.3 (c), (d), and, as appropriate, (h) and (i)) may be shown in the format and color scheme set forth in Figures 1 and 2. If the vehicle is a motor home and is equipped with a propane supply, the weight of full propane tanks must be included in the vehicle's unloaded vehicle weight. If the vehicle is a motor home and is equipped with an on-board potable water supply, the weight of such on-board water must be treated as cargo.

(a) Vehicle capacity weight expressed as ''The combined weight of occupants and cargo should never exceed XXX kilograms or XXX pounds'';

(b) Designated seated capacity (expressed in terms of total number of occupants and number of occupants for each front and rear seat location);

(c) Vehicle manufacturer's recommended cold tire inflation pressure for front, rear and spare tires, subject to the limitations of S4.3.4. For full size spare tires, the statement ''see above'' may, at the manufacturer's option replace manufacturer's recommended cold tire inflation pressure. If no spare tire is provided, the word ''none'' must replace the manufacturer's recommended cold tire inflation pressure.

(d) Tire size designation, indicated by the headings ''size'' or ''original tire size'' or ''original size,'' and ''spare tire'' or ''spare,'' for the tires installed at the time of the first purchase for purposes other than resale. For full size spare tires, the statement ''see above'' may, at the manufacturer's option replace the tire size designation. If no spare tire is provided, the word ''none'' must replace the tire size designation;

(e) On the vehicle placard, ''Tire and Loading Information and, on the tire inflation pressure label, ''Tire Information'';

(f) ''See Owner's Manual for Additional Information'';

(g) For a vehicle equipped with a nonpneumatic spare tire assembly, the tire identification code with which that assembly is labeled pursuant to the requirements of S4.3(a) of 571.129, New Non-Pneumatic Tires for Passenger Cars;

(h) At the manufacturer's option, identifying information provided in any alphanumeric and or barcode form, located vertically, along the right edge or the left edge of the placard or the label, or horizontally, along the bottom edge of the placard or the label; and

(i) At the manufacturer's option, the load range identification symbol, load index, and speed rating, located immediately to the right of the tire size designation listed in accordance with S4.3(d) above.

S4.3.1 *Requirements for vehicles manufactured in two or more stages.* A placard or placard and label shall be affixed to the completed vehicle by the final-stage manufacturer in accordance with S4.3 and with the vehicle capacity weight and seating designations as finally manufactured.

S4.3.2 *Requirements for altered vehicles.* Except as provided in S10, a new placard or placard and label shall be affixed, so as to obscure the original placard, to an altered vehicle that has previously been certified in accordance with §567.4 or §567.5, other than by the addition, substitution, or removal of readily attachable components such as mirrors or tire and rim assemblies, or minor finishing operations such as painting, or who alters the vehicle in such a manner that its stated weight ratings are no longer valid, before the first purchase of the vehicle in good faith for purposes other than resale, containing accurate information for the altered vehicle, in accordance with S4.3.

S4.3.3 *Additional labeling information for vehicles other than passenger cars.* Each vehicle shall show the size designation and, if applicable, the type designation of rims (not necessarily those on the vehicle) appropriate for the tire appropriate for use on that vehicle, including the tire installed as original equipment on the vehicle by the vehicle manufacturer, after each GAWR listed on the certification label required by §567.4 or §567.5 of this chapter. This information shall be in the English language, lettered in block capitals and numerals not less than 2.4 millimeters high and in the following format:

Truck Example—Suitable Tire-Rim Choice

GVWR: 2,441 kilograms (5381 pounds).

GAWR: Front—1,299 kilograms (2,864 pounds) with P265/70R16 tires, 16 × 8.0 rims at 248 kPa (36 psi) cold single.

GAWR: Rear—1,299 kilograms (2,864 pounds) with P265/70R16 tires, 16 × 8.00 rims, at 248 kPa (36 psi) cold single.

S4.3.4 No inflation pressure other than the maximum permissible inflation pressure may be shown on the placard and, if any, tire inflation pressure label unless—

(a) It is less than the maximum permissible inflation pressure;

(b) It is appropriate for the load limits as calculated in accordance with S4.2; and

(c) The tire load rating specified in a submission by an individual manufacturer, pursuant to S4.1.1(a) of §571.139 or contained in one of the publications described in S4.1.1(b) of §571.139, for the tire size at that inflation pressure is not less than the vehicle maximum load and the vehicle normal load on the tire for those vehicle loading conditions.

S4.3.5 *Requirements for trailers.* Each trailer, except for an incomplete vehicle, must show the information specified in S4.3 (c) through (g), and may show the information specified in S4.3 (h) and (i), on a placard permanently affixed proximate to the certification label specified in 49 CFR part 567. Additionally, each trailer must on its placard contain a cargo capacity statement expressed as ''The weight of cargo should never exceed XXX kilograms or XXX pounds'' in the same location on the placard specified for the ''vehicle capacity weight'' statement required by this standard. At the manufacturer's option, the information specified in S4.3 (c), (d), (h) and (i) may be shown, alternatively, on a tire inflation pressure label, and conform in color and format, not including the border surrounding the entire label, as specified in the example set forth in Figure 2 in this standard. The label shall be permanently affixed and proximate to the placard required by this paragraph. The information specified in S4.3 (e) shall be shown on both the vehicle placard and on the tire inflation pressure label (if such a label is affixed to provide the information specified in S4.3 (c), (d), (h) and (i)) in the format and color scheme set forth in Figures 1 and 2. If the vehicle is a recreation vehicle trailer and is equipped with a propane supply, the weight of full propane tanks must be

included in the vehicle's unloaded vehicle weight. If the vehicle is a recreation vehicle trailer and is equipped with an on-board potable water supply, the weight of such on-board water must be treated as cargo.

S4.4 *Rims.*

S4.4.1 *Requirements.* Each rim shall:

(a) Be constructed to the dimensions of a rim that is listed by the manufacturer of the tires as suitable for use with those tires, in accordance with S4 of § 571.139.

(b) Except for trailers, in the event of rapid loss of inflation pressure with the vehicle traveling in a straight line at a speed of 97 km/h (60 mph), retain the deflated tire until the vehicle can be stopped with a controlled braking application.

TABLE I—OCCUPANT LOADING AND DISTRIBUTION FOR VEHICLE NORMAL LOAD FOR VARIOUS DESIGNATED SEATING CAPACITIES

Designated seating capacity, number of occupants	Vehicle normal load, number of occupants	Occupant distribution in a normally loaded vehicle
2 through 4	2	2 in front.
5 through 10	3	2 in front, 1 in second seat.
11 through 15	5	2 in front, 1 in second seat, 1 in third seat, 1 in fourth seat.
16 through 22	7	2 in front, 2 in second seat, 2 in third seat, 1 in fourth seat.

S4.4.2. *Rim markings for vehicles other than passenger cars.* Each rim or, at the option of the manufacturer in the case of a single-piece wheel, each wheel disc shall be marked with the information listed in S4.4.2 (a) through (e), in lettering not less than 3 millimeters in height, impressed to a depth or, at the option of the manufacturer, embossed to a height of not less than 0.125 millimeters. The information listed in S4.4.2 (a) through (c) shall appear on the outward side. In the case of rims of multi piece construction, the information listed in S4.4.2 (a) through (e) shall appear on the rim base and the information listed in S4.4.2 (b) and (d) shall also appear on each other part of the rim.

(a) A designation that indicates the source of the rim's published nominal dimensions, as follows:

(1) ''T'' indicates The Tire and Rim Association.

(2) ''E'' indicates The European Tyre and Rim Technical Organization.

(3) ''J'' indicates Japan Automobile Tire Manufacturers'' Association, Inc.

(4) ''L'' indicates ABPA (Brazil), a.k.a. Associacao Latino Americana De Pneus E Aros.

(5) ''F'' indicates Tire and Rim Engineering Data Committee of South Africa (Tredco).

(6) ''S'' indicates Scandinavian Tire and Rim Organization (STRO).

(7) ''A'' indicates The Tyre and Rim Association of Australia.

(8) ''I'' indicates Indian Tyre Technical Advisory Committee (ITTAC).

(9) ''R'' indicates Argentine Institute of Rationalization of Materials, a.k.a. Instituto Argentino de Racionalización de Materiales, (ARAM).

(10) ''N'' indicates an independent listing pursuant to S4.1 of § 571.139 or S5.1(a) of § 571.119.

(b) The rim size designation, and in case of multipiece rims, the rim type designation. For example: 20 × 5.50, or 20 × 5.5.

(c) The symbol DOT, constituting a certification by the manufacturer of the rim that the rim complies with all applicable Federal motor vehicle safety standards.

(d) A designation that identifies the manufacturer of the rim by name, trademark, or symbol.

(e) The month, day and year or the month and year of manufacture, expressed either numerically or by use of a symbol, at the option of the manufacturer. For example: ''September 4, 2001'' may be expressed numerically as: ''90401'', ''904, 01'' or ''01, 904''; ''September 2001'' may be expressed as: ''901'', ''9, 01'' or ''01, 9''.

(1) Any manufacturer that elects to express the date of manufacture by means of a symbol shall notify NHTSA in writing of the full names and addresses of all manufacturers and brand name owners utilizing that symbol and the name and address of the trademark owner of that symbol, if any. The notification shall describe in narrative form and in detail how the month, day, and year or the month and year are depicted by the symbol. Such description

shall include an actual size graphic depiction of the symbol, showing and/or explaining the interrelationship of the component parts of the symbol as they will appear on the rim or single piece wheel disc, including dimensional specifications, and where the symbol will be located on the rim or single piece wheel disc. The notification shall be received by NHTSA not less than 60 calendar days before the first use of the symbol. The notification shall be mailed to National Highway Traffic Safety Administration, West Building, 1200 New Jersey Ave. SE, Washington, DC 20590. All information provided to NHTSA under this paragraph will be placed in the public docket.

(2) Each manufacturer of wheels shall provide an explanation of its date of manufacture symbol to any person upon request.

S5. *Load Limits for Non-Pneumatic Spare Tires*. The highest vehicle maximum load on the tire for the vehicle shall not be greater than the load rating for the non-pneumatic spare tire.

S6 *Labeling Requirements for Non-Pneumatic Spare Tires or Tire Assemblies*. Each non-pneumatic tire or, in the case of a non-pneumatic tire assembly in which the non-pneumatic tire is an integral part of the assembly, each non-pneumatic tire assembly shall include, in letters or numerals not less than 4 millimeters high, the information specified in paragraphs S6 (a) and (b). The information shall be permanently molded, stamped, or otherwise permanently marked into or onto the non-pneumatic tire or non-pneumatic tire assembly, or shall appear on a label that is permanently attached to the tire or tire assembly. If a label is used, it shall be subsurface printed, made of material that is resistant to fade, heat, moisture and abrasion, and attached in such a manner that it cannot be removed without destroying or defacing the label on the non-pneumatic tire or tire assembly. The information specified in paragraphs S6 (a) and (b) shall appear on both sides of the non-pneumatic tire or tire assembly, except, in the case of a non-pneumatic tire assembly which has a particular side that must always face outward when mounted on a vehicle, in which case the information specified in paragraphs S6 (a) and (b) shall only be required on the outward facing side. The information shall be positioned on the tire or tire assembly such that it is not placed on the tread or the outermost edge of the tire and is not obstructed by any portion of any non-pneumatic rim or wheel center member designated for use with that tire in this standard or in Standard No. 129.

(a) FOR TEMPORARY USE ONLY; and

(b) MAXIMUM 80 KM/H (50 M.P.H.).

S7. *Requirements for Passenger Cars Equipped with Non-Pneumatic Spare Tire Assemblies*

S7.1 *Vehicle Placarding Requirements*. A placard, permanently affixed to the inside of the vehicle trunk or an equally accessible location adjacent to the non-pneumatic spare tire assembly, shall display the information set forth in S6 in block capitals and numerals not less than 6 millimeters high preceded by the words ''IMPORTANT—USE OF SPARE TIRE'' in letters not less than 9 millimeters high.

S7.2 *Supplementary Information*. The owner's manual of the passenger car shall contain, in writing in the English language and in not less than 10 point type, the following information under the heading ''IMPORTANT—USE OF SPARE TIRE'':

(a) A statement indicating the information related to appropriate use for the non-pneumatic spare tire including at a minimum the information set forth in S6 (a) and (b) and either the information set forth in S4.3(g) or a statement that the information set forth in S4.3(g) is located on the vehicle placard and on the non-pneumatic tire;

(b) An instruction to drive carefully when the non-pneumatic spare tire is in use, and to install the proper pneumatic tire and rim at the first reasonable opportunity; and

(c) A statement that operation of the passenger car is not recommended with more than one non-pneumatic spare tire in use at the same time.

S8. *Non-Pneumatic Rims and Wheel Center Members*

S8.1 *Non-Pneumatic Rim Requirements*. Each non-pneumatic rim that is part of a separable non-pneumatic

spare tire assembly shall be constructed to the dimensions of a non-pneumatic rim that is listed pursuant to S4.4 of § 571.129 for use with the non-pneumatic tire, designated by its non-pneumatic tire identification code, with which the vehicle is equipped.

S8.2 *Wheel Center Member Requirements.* Each wheel center member that is part of a separable non-pneumatic spare tire assembly shall be constructed to the dimensions of a wheel center member that is listed pursuant to S4.4 of § 571.129 for use with the non-pneumatic tire, designated by its non-pneumatic tire identification code, with which the vehicle is equipped.

Vehicle Placard

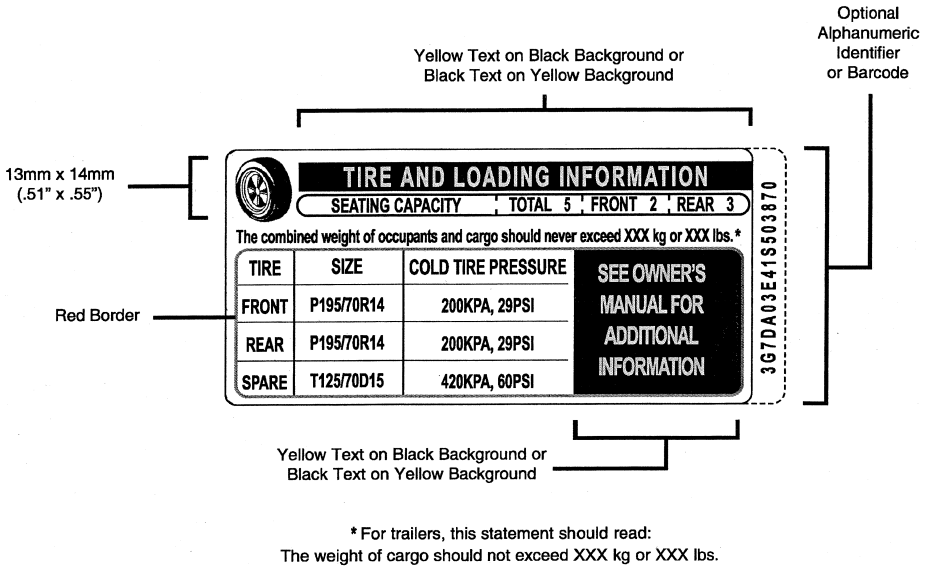


Figure 1

Tire Inflation Pressure Label

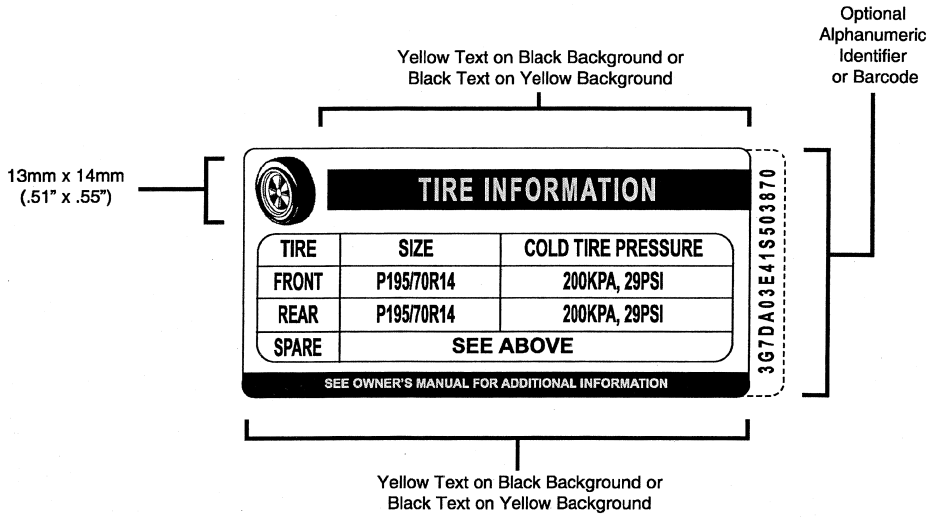


Figure 2

S9. Each motor home and recreation vehicle (RV) trailer must meet the applicable requirements in S9.

S9.1 On motor homes, the sum of the gross axle weight ratings (GAWR) of all axles on the vehicle must not be less than the gross vehicle weight rating (GVWR).

S9.2 On RV trailers, the sum of the GAWRs of all axles on the vehicle plus the vehicle manufacturer's recommended tongue weight must not be less than the GVWR. If tongue weight is specified as a range, the minimum value must be used.

S9.3 Each motor home and RV trailer single stage or final stage manufacturer must affix either a motor home occupant and cargo carrying capacity (OCCC) label (Figure 3) or a RV trailer cargo carrying capacity (CCC) label (Figure 4) to its vehicles that meets the following criteria:

S9.3.1 The RV load carrying capacity labels (Figures 3 and 4) and the RV supplemental labels (Figures 5 and 6) required by S9.3.3(b) must be legible, visible, moisture resistant, presented in the English language, have a minimum print size of 2.4 millimeters (3/32 inches) high and be printed in black print on a yellow background.

S9.3.2 The weight value for load carrying capacity on the RV load carrying capacity labels (Figures 3 and 4) must be displayed to the nearest kilogram with conversion to the nearest pound and must be such that the vehicle does not exceed its GVWR when loaded with the stated load carrying capacity. The UVW and the GVWR used to determine the RV's load carrying capacity must reflect the weights and design of the motor home or RV trailer as configured for delivery to the dealer/service facility. If applicable, the weight of full propane tanks must be included in the RV's UVW and the weight of on-board potable water must be treated as cargo.

S9.3.3 An RV load carrying capacity label (Figures 3 or 4) must be:

(a) Permanently affixed and must be visibly located on the interior of the forward-most exterior passenger door

on the right side of the vehicle or; at the option of the manufacturer,

(b) A temporary version of the RV load carrying capacity label (Figures 3 or 4) must be visibly located on the interior of the forward-most exterior passenger door on the right side of the vehicle. A permanent motor home or RV trailer supplemental label (Figures 5 or 6) must be permanently affixed within 25 millimeters of the placard specified in S4.3 for motor homes and S4.3.5 for RV trailers.

S9.3.4 Permanent and temporary motor home OCCC labels must contain the following information in accordance with Figure 3:

(a) The statement: ''MOTOR HOME OCCUPANT AND CARGO CARRYING CAPACITY'' in block letters.

(b) The Vehicle Identification Number (VIN).

(c) The statement ''THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED: XXX kg or XXX lbs'' in block letters with appropriate values included.

(d) The statement ''Safety belt equipped seating capacity: XXX'' with the appropriate value included. This is the total number of safety belt equipped seating positions.

(e) The statement ''CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal) and the tongue weight of a towed trailer counts as cargo'' with appropriate values included.

S9.3.5 Permanent and temporary RV trailer CCC labels must contain the following information in accordance with Figure 4:

(a) The statement: ''RECREATION VEHICLE TRAILER CARGO CARRYING CAPACITY'' in block letters.

(b) The Vehicle Identification Number (VIN).

(c) The statement ''THE WEIGHT OF CARGO SHOULD NEVER EXCEED: XXX kg or XXX lbs'' in block letters with appropriate values included.

(d) The statement ''CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal)'' with appropriate values included.

S9.3.6 For RVs, the vehicle capacity weight values and the seating capacity values (motor homes only) on the placard required by S4.3 or S4.3.5 must agree with the load carrying capacity weight values and the safety belt equipped seating capacity (motor homes only) on the RV load carrying capacity labels (Figures 3 and 4).

S9.3.7 The permanent motor home supplemental label must contain the following information in accordance with Figure 5:

(a) The statement ''CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal) and the tongue weight of a towed trailer counts as cargo'' with appropriate values included.

S9.3.8 The permanent RV trailer supplemental label must contain the following information in accordance with Figure 6:

(a) The statement ''CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal)'' with appropriate values included.

S10. *Weight added to vehicles between final vehicle certification and first retail sale of the vehicle.*

S10.1 If weight exceeding the lesser of 1.5 percent of GVWR or 45.4 kg (100 pounds) is added to a vehicle between final vehicle certification and first retail sale of the vehicle, the vehicle capacity weight values on the placard required by S4.3 or S4.3.5 and the load carrying capacity weight values on the RV load carrying capacity labels (Figures 3 and 4) required by S9.3 must be corrected using one or a combination of the following methods:

(a) Permanently affix load carrying capacity modification labels (Figure 7), which display the amount the load carrying capacity is reduced to the nearest kilogram with conversion to the nearest pound, within 25 millimeters of the original, permanent RV load carrying capacity label (Figure 3 or 4) and the original placard (Figure 1). The load carrying capacity modification labels must be legible, visible, permanent, moisture resistant, presented in the English language, have a minimum print size of 2.4 millimeters (3/32 inches) high and be printed in black print on a yellow background, or

(b) If the manufacturer selects S9.3.3(b), apply a temporary version of the load carrying capacity modification label (Figure 7) within 25 millimeters of the original, temporary RV load

carrying capacity label (Figure 3 or 4) on the interior of the forward-most exterior passenger door on the right side of the vehicle, in addition to applying a permanent version of the same label within 25 mm of the placard required by S4.3 or S4.3.5. Both temporary and permanent versions of the load carrying capacity modification label (Figure 7) may be printed without values and values may be legibly applied to the label with a black, fine point, indelible marker. The label must contain the statements ''CAUTION—LOAD CARRYING CAPACITY REDUCED'' in block letters and ''Modifications to this vehicle have reduced the original load carrying capacity by XXX kg or XXX lbs'' in accordance with Figure 7. If two load carrying capacity modification labels are required (one permanent and one temporary), the weight values on each must agree, or

(c) Modify the original, permanent RV load carrying capacity labels (Figures 3 and 4) and the placard (Figure 1) with correct vehicle capacity weight values. If the manufacturer selects S9.3.3(b), the temporary RV load carrying capacity labels (Figures 3 and 4) must also be modified with correct vehicle capacity weight values. Modification of labels requires a machine printed overlay with printed corrected values or blanks for corrected values that may be entered with a black, fine-point, indelible marker. Crossing out old values and entering corrected values on the original label is not permissible, or

(d) Replace the original, permanent RV load carrying capacity labels (Figures 3 and 4) and the placard (Figure 1) with the same labels/placard containing correct vehicle capacity weight values. If the manufacturer selects S9.3.3(b), the temporary RV load carrying capacity labels (Figures 3 and 4) must also be replaced with the same labels containing correct vehicle capacity weight values.

S10.2 Corrected load carrying capacity weight values or the weight amount the load carrying capacity is reduced, must reflect the total weight added between final vehicle certification and first retail sale and must be accurate within one percent of the actual added weight. No action is required if the weight of the vehicle is reduced between final vehicle certification and first retail sale.

MOTOR HOME OCCUPANT AND CARGO CARRYING CAPACITY
VIN: ##################
THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED:
XXX kg or XXX lbs
Safety belt equipped seating capacity: XXX
CAUTION:
A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal) and the tongue weight of a towed trailer counts as cargo

Figure 3 - Motor Home Occupant and Cargo Carrying Capacity Label

RECREATION VEHICLE TRAILER CARGO CARRYING CAPACITY
VIN: ##################
THE WEIGHT OF CARGO SHOULD NEVER EXCEED:
XXX kg or XXX lbs
CAUTION:
A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal)

Figure 4 - RV Trailer Cargo Carrying Capacity Label

CAUTION:
A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal) and the tongue weight of a towed trailer counts as cargo

Figure 5 - Motor Home Supplemental Label

CAUTION:
A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal)

Figure 6 - RV Trailer Supplemental Label

CAUTION: LOAD CARRYING CAPACITY REDUCED
Modifications to this vehicle have reduced the original load carrying capacity by _____kg or _____lbs

Figure 7 - Load Carrying Capacity Modification Label

[36 FR 22902, Dec. 2, 1971]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.110, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.111 Standard No. 111; Rear visibility.

S1. *Scope*. This standard specifies requirements for rear visibility devices and systems.

S2. *Purpose*. The purpose of this standard is to reduce the number of deaths and injuries that occur when the driver of a motor vehicle does not have a clear and reasonably unobstructed view to the rear.

S3. *Application*. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, buses, school buses, motorcycles and low-speed vehicles.

S4. *Definitions*.

Backing event means an amount of time which starts when the vehicle's direction selector is placed in reverse, and ends at the manufacturer's choosing, when the vehicle forward motion reaches:

(a) a speed of 10 mph,

(b) a distance of 10 meters traveled, or

(c) a continuous duration of 10 seconds.

Convex mirror means a mirror having a curved reflective surface whose shape is the same as that of the exterior surface of a section of a sphere.

Effective mirror surface means the portions of a mirror that reflect images, excluding the mirror rim or mounting brackets.

Environmental test fixture means a device designed to support the external components of the rear visibility system for testing purposes, using any factory seal which would be used during normal vehicle operation, in a manner that simulates the on-vehicle component orientation during normal vehicle operation, and prevents the exposure of any test conditions to portions of the external component which are not exposed to the outside of the motor vehicle.

External component means any part of the rear visibility system which is exposed to the outside of the motor vehicle.

Key means a physical device or an electronic code which, when inserted into the starting system (by physical or electronic means), enables the vehicle operator to activate the engine or motor.

Limited line manufacturer means a manufacturer that sells three or fewer carlines, as that term is defined in 49 CFR 583.4, in the United States during a production year, as that term is defined in S15.

Rearview image means a visual image, detected by means of a single source, of the area directly behind a vehicle that is provided in a single location to the vehicle operator and by means of indirect vision.

Rear visibility system means the set of devices or components which together perform the function of producing the rearview image as required under this standard.

Small manufacturer means an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States.

Starting system means the vehicle system used in conjunction with the key to activate the engine or motor.

Unit magnification mirror means a plane or flat mirror with a reflective surface through which the angular height and width of the image of an object is equal to the angular height and width of the object when viewed directly at the same distance except for flaws that do not exceed normal manufacturing tolerances. For the purposes of this regulation a prismatic day-night adjustment rearview mirror one of whose positions provides unit magnification is considered a unit magnification mirror.

S5. *Requirements for passenger cars*.

S5.1 *Inside rearview mirror*. Each passenger car shall have an inside rearview mirror of unit magnification.

S5.1.1 *Field of view*. Except as provided in S5.3, the mirror shall provide a field of view with an included horizontal angle measured from the projected eye point of at least 20 degrees, and a sufficient vertical angle to provide a view of a level road surface extending to the horizon beginning at a point not greater than 61 m to the rear of the vehicle when the vehicle is occupied by the driver and four passengers or the designated occupant capacity, if less, based on an average occupant weight of 68 kg. The line of sight may be partially obscured by seated occupants or by head restraints. The location of the driver's eye reference points

shall be those established in Motor Vehicle Safety Standard No. 104 (§ 571.104) or a nominal location appropriate for any 95th percentile male driver.

S5.1.2 *Mounting.* The mirror mounting shall provide a stable support for the mirror, and shall provide for mirror adjustment by tilting in both the horizontal and vertical directions. If the mirror is in the head impact area, the mounting shall deflect, collapse or break away without leaving sharp edges when the reflective surface of the mirror is subjected to a force of 400 N in any forward direction that is not more than 45° from the forward longitudinal direction.

S5.2 *Outside rearview mirror—driver's side.*

S5.2.1 *Field of view.* Each passenger car shall have an outside mirror of unit magnification. The mirror shall provide the driver a view of a level road surface extending to the horizon from a line, perpendicular to a longitudinal plane tangent to the driver's side of the vehicle at the widest point, extending 2.4 m out from the tangent plane 10.7 m behind the driver's eyes, with the seat in the rearmost position. The line of sight may be partially obscured by rear body or fender contours. The location of the driver's eye reference points shall be those established in Motor Vehicle Safety Standard No. 104 (§ 571.104) or a nominal location appropriate for any 95th percentile male driver.

S5.2.2 *Mounting.* The mirror mounting shall provide a stable support for the mirror, and neither the mirror nor the mounting shall protrude farther than the widest part of the vehicle body except to the extent necessary to produce a field of view meeting or exceeding the requirements of S5.2.1. The mirror shall not be obscured by the unwiped portion of the windshield, and shall be adjustable by tilting in both horizontal and vertical directions from the driver's seated position. The mirror and mounting shall be free of sharp points or edges that could contribute to pedestrian injury.

S5.3 *Outside rearview mirror passenger's side.* Each passenger car whose inside rearview mirror does not meet the field of view requirements of S5.1.1 shall have an outside mirror of unit magnification or a convex mirror installed on the passenger's side. The mirror mounting shall provide a stable support and be free of sharp points or edges that could contribute to pedestrian injury. The mirror need not be adjustable from the driver's seat but shall be capable of adjustment by tilting in both horizontal and vertical directions.

S5.4 *Convex mirror requirements.* Each motor vehicle using a convex mirror to meet the requirements of S5.3 shall comply with the following requirements:

S5.4.1 When each convex mirror is tested in accordance with the procedures specified in S12. of this standard, none of the radii of curvature readings shall deviate from the average radius of curvature by more than plus or minus 12.5 percent.

S5.4.2 Each convex mirror shall have permanently and indelibly marked at the lower edge of the mirror's reflective surface, in letters not less than 4.8 mm nor more than 6.4 mm high the words ''Objects in Mirror Are Closer Than They Appear.''

S5.4.3 The average radius of curvature of each such mirror, as determined by using the procedure in S12., shall be not less than 889 mm and not more than 1,651 mm.

S5.5 *Rear visibility.*

(a) *Phase-in period requirements.* For passenger cars with a GVWR of 4,536 kg or less manufactured on or after May 1, 2016, but not later than April 30, 2018, a percentage of each manufacturer's production, as specified in S15, shall display a rearview image meeting the requirements of S5.5.1.

(b) *Final requirements.* Each passenger car with a GVWR of 4,536 kg or less manufactured on or after May 1, 2018, shall display a rearview image meeting the requirements of S5.5.1 through S5.5.7.

S5.5.1 *Field of view.* When tested in accordance with the procedures in S14.1, the rearview image shall include:

(a) A minimum of a 150-mm wide portion along the circumference of each test object located at positions F and G specified in S14.1.4; and

(b) The full width and height of each test object located at positions A through E specified in S14.1.4.

S5.5.2 *Size*. When the rearview image is measured in accordance with the procedures in S14.1, the calculated visual angle subtended by the horizontal width of

(a) All three test objects located at positions A, B, and C specified in S14.1.4 shall average not less than 5 minutes of arc; and

(b) Each individual test object (A, B, and C) shall not be less than 3 minutes of arc.

S5.5.3 *Response time*. The rearview image meeting the requirements of S5.5.1 and S5.5.2, when tested in accordance with S14.2, shall be displayed within 2.0 seconds of the start of a backing event.

S5.5.4 *Linger time*. The rearview image meeting the requirements of S5.5.1 and S5.5.2 shall not be displayed after the backing event has ended.

S5.5.5 *Deactivation*. The rearview image meeting the requirements of S5.5.1 and S5.5.2 shall remain visible during the backing event until either, the driver modifies the view, or the vehicle direction selector is removed from the reverse position.

S5.5.6 *Default view*. The rear visibility system must default to the rearview image meeting the requirements of S5.5.1 and S5.5.2 at the beginning of each backing event regardless of any modifications to the field of view the driver has previously selected.

S5.5.7 *Durability*. The rear visibility system shall meet the field of view and image size requirements of S5.5.1 and S5.5.2 after each durability test specified in S14.3.1, S14.3.2, and S14.3.3.

S6. *Requirements for multipurpose passenger vehicles, low-speed vehicles, trucks, buses, and school buses with GVWR of 4,536 kg or less.*

S6.1 Each multipurpose passenger vehicle, truck and bus, other than a school bus, with a GVWR of 4,536 kg or less shall have either—

(a) Mirrors that conform to the requirements of S5.; or

(b) Outside mirrors of unit magnification, each with not less than 126 cm^2 of reflective surface, installed with stable supports on both sides of the vehicle, located so as to provide the driver a view to the rear along both sides of the vehicle, and adjustable in both the horizontal and vertical directions to view the rearward scene.

S6.2 *Rear visibility*.

(a) *Phase-in period requirements*. For multipurpose passenger vehicles, low-speed vehicles, trucks, buses, and school buses with a GVWR of 4,536 kg or less manufactured on or after May 1, 2016, but not later than April 30, 2018, a percentage of each manufacturer's production, as specified in S15, shall display a rearview image meeting the requirements of S6.2.1.

(b) *Final requirements*. Each multipurpose passenger vehicle, low-speed vehicle, truck, bus, and school bus with a GVWR of 4,536 kg or less manufactured on or after May 1, 2018, shall display a rearview image meeting the requirements of S6.2.1 through S6.2.7.

S6.2.1 *Field of view*. When tested in accordance with the procedures in S14.1, the rearview image shall include:

(a) A minimum of a 150-mm wide portion along the circumference of each test object located at positions F and G specified in S14.1.4; and

(b) The full width and height of each test object located at positions A through E specified in S14.1.4.

S6.2.2 *Size*. When the rearview image is measured in accordance with the procedures in S14.1, the calculated visual angle subtended by the horizontal width of

(a) All three test objects located at positions A, B, and C specified in S14.1.4 shall average not less than 5 minutes of arc; and

(b) Each individual test object (A, B, and C) shall not be less than 3 minutes of arc.

S6.2.3 *Response time*. The rearview image meeting the requirements of S6.2.1 and S6.2.2, when tested in accordance with S14.2, shall be displayed within 2.0 seconds of the start of a backing event.

S6.2.4 *Linger time*. The rearview image meeting the requirements of S6.2.1 and S6.2.2 shall not be displayed after the backing event has ended.

S6.2.5 *Deactivation*. The rearview image meeting the requirements of S6.2.1 and S6.2.2 shall remain visible during the backing event until either, the driver modifies the view, or the vehicle direction selector is removed from the reverse position.

S6.2.6 *Default view*. The rear visibility system must default to the rearview image meeting the requirements of S6.2.1 and S6.2.2 at the beginning of each backing event regardless of any modifications to the field of view the driver has previously selected.

S6.2.7 *Durability*. The rear visibility system shall meet the field of view and image size requirements of S6.2.1 and S6.2.2 after each durability test specified in S14.3.1, S14.3.2, and S14.3.3.

S7. *Requirements for multipurpose passenger vehicles and trucks with a GVWR of more than 4,536 kg and less than 11,340 kg and buses, other than school buses, with a GVWR of more than 4,536 kg.*

S7.1 Each multipurpose passenger vehicle and truck with a GVWR of more than 4,536 kg and less than 11,340 kg and each bus, other than a school bus, with a GVWR of more than 4,536 kg shall have outside mirrors of unit magnification, each with not less than 323 cm^2 of reflective surface, installed with stable supports on both sides of the vehicle. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the vehicle and shall be adjustable both in the horizontal and vertical directions to view the rearward scene.

S8. *Requirements for multipurpose passenger vehicles and trucks with a GVWR of 11,340 kg or more.*

S8.1 Each multipurpose passenger vehicle and truck with a GVWR of 11,340 kg or more shall have outside mirrors of unit magnification, each with not less than 323 cm^2 of reflective surface, installed with stable supports on both sides of the vehicle. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the vehicle and shall be adjustable both in the horizontal and vertical directions to view the rearward scene.

S9. *Requirements for School Buses.* When a school bus is tested in accordance with the procedures of S13, it shall meet the requirements of S9.1 through S9.4.

S9.1 Outside Rearview Mirrors. Each school bus shall have two outside rearview mirror systems: System A and System B.

S9.2. System A shall be located with stable supports so that the portion of the system on the bus's left side, and the portion on its right side, each:

(a) Includes at least one mirror of unit magnification with not less than 323 cm^2 of reflective surface; and

(b) Includes one or more mirrors which together provide, at the driver's eye location, a view of:

(1) For the mirror system on the right side of the bus, the entire top surface of cylinder N in Figure 2, and that area of the ground which extends rearward from cylinder N to a point not less than 61 meters from the mirror surface.

(2) For the mirror system on the left side of the bus, the entire top surface of cylinder M in Figure 2, and that area of the ground which extends rearward from cylinder M to a point not less than 61 meters from the mirror surface.

S9.3(a) For each of the cylinders A through P whose entire top surface is not directly visible from the driver's eye location, System B shall provide, at that location:

(1) A view of the entire top surface of that cylinder.

(2) A view of the ground that overlaps with the view of the ground provided by System A.

(b) Each mirror installed in compliance with S9.3(a) shall meet the following requirements:

(1) Each mirror shall have a projected area of at least 258 cm^2, as measured on a plane at a right angle to the mirror's axis.

(2) Each mirror shall be located such that the distance from the center point of the eye location of a 25th percentile adult female seated in the driver's seat to the center of the mirror shall be at least 95 cm.

(3) Each mirror shall have no discontinuities in the slope of the surface of the mirror.

(4) Each mirror shall be installed with a stable support.

(c) Each school bus which has a mirror installed in compliance with S9.3(a) that has an average radius of curvature of less than 889 mm, as determined under S12, shall have a label visible to the seated driver. The label shall be printed in a type face and color that are clear and conspicuous. The label shall state the following:

''USE CROSS VIEW MIRRORS TO VIEW PEDESTRIANS WHILE BUS IS STOPPED. DO NOT USE THESE MIRRORS TO VIEW TRAFFIC WHILE BUS IS MOVING. IMAGES IN SUCH MIRRORS DO NOT ACCURATELY SHOW ANOTHER VEHICLE'S LOCATION.''

S9.4(a) Each image required by S9.3(a)(1) to be visible at the driver's eye location shall be separated from the edge of the effective mirror surface of the mirror providing that image by a distance of not less than 3 minutes of arc.

(b) The image required by S9.3(a)(1) of cylinder P shall meet the following requirements:

(1) The angular size of the shortest dimension of that cylinder's image shall be not less than 3 minutes of arc; and

(2) The angular size of the longest dimension of that cylinder's image shall be not less than 9 minutes of arc.

S10. *Requirements for motorcycles.*

S10.1 Each motorcycle shall have either a mirror of unit magnification with not less than 8065 mm^2 of reflective surface, or a convex mirror with not less than 6450 mm^2 of reflective surface and an average radius of curvature not less than 508 mm and not greater than 1524 mm, installed with a stable support, and mounted so that the horizontal center of the reflective surface is at least 279 mm outward of the longitudinal centerline of the motorcycle. The mirror shall be adjustable by tilting in both the horizontal and vertical directions.

S11. *Mirror Construction.* The average reflectance of any mirror required by this standard shall be determined in accordance with SAE Standard J964 OCT84 (incorporated by reference, see §571.5). All single reflectance mirrors shall have an average reflectance of at least 35 percent. If a mirror is capable of multiple reflectance levels, the minimum reflectance level in the day mode shall be at least 35 percent and the minimum reflectance level in the night mode shall be at least 4 percent. A multiple reflectance mirror shall either be equipped with a means for the driver to adjust the mirror to a reflectance level of at least 35 percent in the event of electrical failure, or achieve such reflectance level automatically in the event of electrical failure.

S12. *Determination of radius of curvature.*

S12.1 To determine the average radius of curvature of a convex mirror, use a 3-point linear spherometer, which meets the requirements of S12.2, at the 10 test positions shown in Figure 1 and record the readings for each position.

S12.2 The 3-point linear spherometer has two outer fixed legs 38 mm apart and one inner movable leg at the midpoint. The spherometer has a dial indicator with a scale that can be read accurately to .0025 mm, with the zero reading being a flat surface.

S12.3 The 10 test positions on the image display consist of two positions at right angles to each other at each of five locations as shown in Figure 1. The locations are at the center of the mirror, at the left and right ends of a horizontal line that bisects the mirror and at the top and bottom ends of a vertical line that bisects the mirror. None of the readings are within a 6.4 mm border on the edge of the image display.

S12.4 At each position, the spherometer is held perpendicular to the convex mirror-surface and a record is made of the reading on the dial indicator to the nearest .0025 mm.

S12.5 Convert the dial reading data for each of the 10 test positions to radius of curvature calculations using Table I. Consider the change as linear for dial readings that fall between two numbers in Table I.

S12.6 Calculate the average radius of curvature by adding all 10 radius of curvature calculations and dividing by ten.

S12.7 Determine the numerical difference between the average radius of curvature and each of the 10 individual radius of curvature calculations determined in S12.5.

S12.8 Calculate the greatest percentage deviation by dividing the greatest numerical difference determined in S12.7 by the average radius of curvature and multiply by 100.

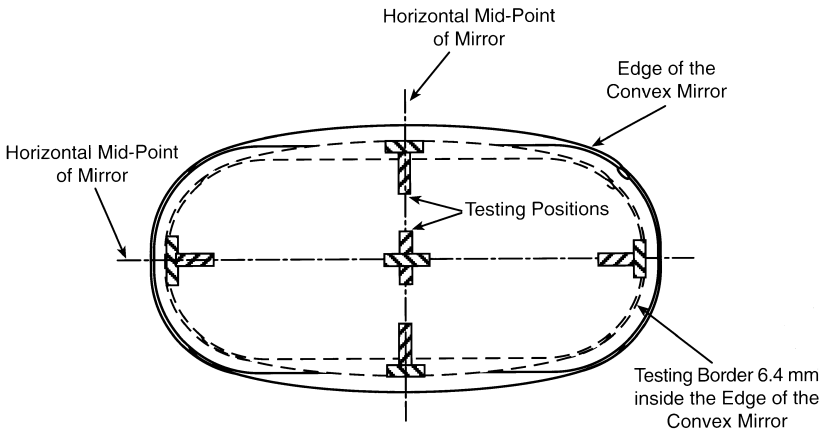


Figure 1–LOCATION OF TEN CONVEX MIRROR TESTING POSITIONS
All dimensions in millimeters (mm)

TABLE I—CONVERSION TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

Dial reading	Radius of curvature (Inches)	Radius of curvature (mm)
.00330	85.2	2164.1
.00350	80.4	2042.92
.00374	75.2	1910.1
.00402	70.0	1778.0
.00416	67.6	1717.0
.00432	65.1	1653.5
.00450	62.5	1587.5
.00468	60.1	1526.5
.00476	59.1	1501.1
.00484	58.1	1475.7
.00492	57.2	1452.9
.00502	56.0	1422.4
.00512	54.9	1394.5
.00522	53.9	1369.1
.00536	52.5	1333.5
.00544	51.7	1313.2
.00554	50.8	1290.3
.00566	49.7	1262.4
.00580	48.5	1231.9
.00592	47.5	1206.5
.00606	46.4	1178.6
.00622	45.2	1148.1
.00636	44.2	1122.7
.00654	43.0	1092.2
.00668	42.1	1069.3
.00686	41.0	1041.4
.00694	40.5	1028.7
.00720	39.1	993.1
.00740	38.0	965.2
.00760	37.0	939.8
.00780	36.1	916.9
.00802	35.1	891.5
.00822	34.2	868.7
.00850	33.1	840.7

TABLE I—CONVERSION TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE—Continued

Dial reading	Radius of curvature (Inches)	Radius of curvature (mm)
.00878	32.0	812.8
.00906	31.0	787.4
.00922	30.5	774.7
.00938	30.0	762.0
.00960	29.3	744.2
.00980	28.7	729.0
.01004	28.0	711.2
.01022	27.5	698.5
.01042	27.0	685.8
.01060	26.5	673.1
.01080	26.0	660.4
.01110	25.3	642.6
.01130	24.9	632.5
.01170	24.0	609.6
.01200	23.4	594.4
.01240	22.7	576.6
.01280	22.0	558.8
.01310	21.5	546.1
.01360	20.7	525.8
.01400	20.1	510.5
.01430	19.7	500.4
.01480	19.0	482.6
.01540	18.3	464.8
.01570	17.9	454.7
.01610	17.5	444.5
.01650	17.1	434.3
.01700	16.6	421.6
.01750	16.1	408.9
.01800	15.6	396.2
.01860	15.1	383.5
.01910	14.7	373.4
.01980	14.2	360.7
.02040	13.8	350.5
.02100	13.4	340.4

TABLE I—CONVERSION TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE—Continued

Dial reading	Radius of curvature (Inches)	Radius of curvature (mm)
.02160	13.0	330.2
.02250	12.5	317.5
.02340	12.0	304.8
.02450	11.5	292.1
.02560	11.0	279.4
.02680	10.5	266.7
.02810	10.0	254.0
.02960	9.5	241.3
.03130	9.0	228.6
.03310	8.5	215.9

S13. *School bus mirror test procedures.* The requirements of S9.1 through S9.4 shall be met when the vehicle is tested in accordance with the following conditions.

S13.1 The cylinders shall be a color which provides a high contrast with the surface on which the bus is parked.

S13.2 The cylinders are 0.3048 m high and 0.3048 m in diameter, except for cylinder P which is 0.9144 m high and 0.3048 m in diameter.

S13.3 Place cylinders at locations as specified in S13.3(a) through S13.3(g) and illustrated in Figure 2. Measure the distances shown in Figure 2 from a cylinder to another object from the center of the cylinder as viewed from above.

(a) Place cylinders G, H, and I so that they are tangent to a transverse vertical plane tangent to the forwardmost surface of the bus's front bumper. Place cylinders D, E, F so that their centers are located in a transverse vertical plane that is 1.8288 meters (6 feet) forward of a transverse vertical plane passing through the centers of cylinders G, H, and I. Place cylinders A, B, and C so that their centers are located in a transverse vertical plane that is 3.6576 meters (12 feet) forward of the transverse vertical plane passing through the centers of cylinders G, H, and I.

(b) Place cylinders B, E, and H so that their centers are in a longitudinal vertical plane that passes through the bus's longitudinal centerline.

(c) Place cylinders A, D, and G so that their centers are in a longitudinal vertical plane that is tangent to the most outboard edge of the left side of the bus's front bumper.

(d) Place cylinders C, F, and I so that their centers are in a longitudinal vertical plane that is tangent to the most outboard edge of the right side of the bus's front bumper.

(e) Place cylinder J so that its center is in a longitudinal vertical plane 0.3048 meters (1 foot) to the left of the longitudinal vertical plane passing through the centers of cylinders A, D, and G, and is in the transverse vertical plane that passes through the centerline of the bus's front axle.

(f) Place cylinder K so that its center is in a longitudinal vertical plane 0.3048 meters (1 foot) to the right of the longitudinal vertical plane passing through the centers of cylinders C, F, and I, and is in the transverse vertical plane that passes through the centerline of the bus's front axle.

(g) Place cylinders L, M, N, O, and P so that their centers are in the transverse vertical plane that passes through the centerline of the bus's rear axle. Place cylinder L so that its center is in a longitudinal vertical plane that is 1.8288 meters (6 feet) to the left of the longitudinal vertical plane tangent to the bus's most outboard left surface (excluding the mirror system). Place cylinder M so that its center is in a longitudinal vertical plane that is 0.3048 meters (1 foot) to the left of the longitudinal vertical plane tangent to the left side of the bus. Place cylinder N so that its center is in a longitudinal vertical plane that is 0.3048 meters (1 foot) to the right of the longitudinal vertical plane tangent to the right side of the bus. Place cylinder O so that its center is in a longitudinal vertical plane that is 1.8288 meters (6 feet) to the right of the longitudinal vertical plane tangent to the right side of the bus. Place cylinder P so that its center is in a longitudinal vertical plane that is 3.6576 meters (12 feet) to the right of the longitudinal vertical plane tangent to the right side of the bus.

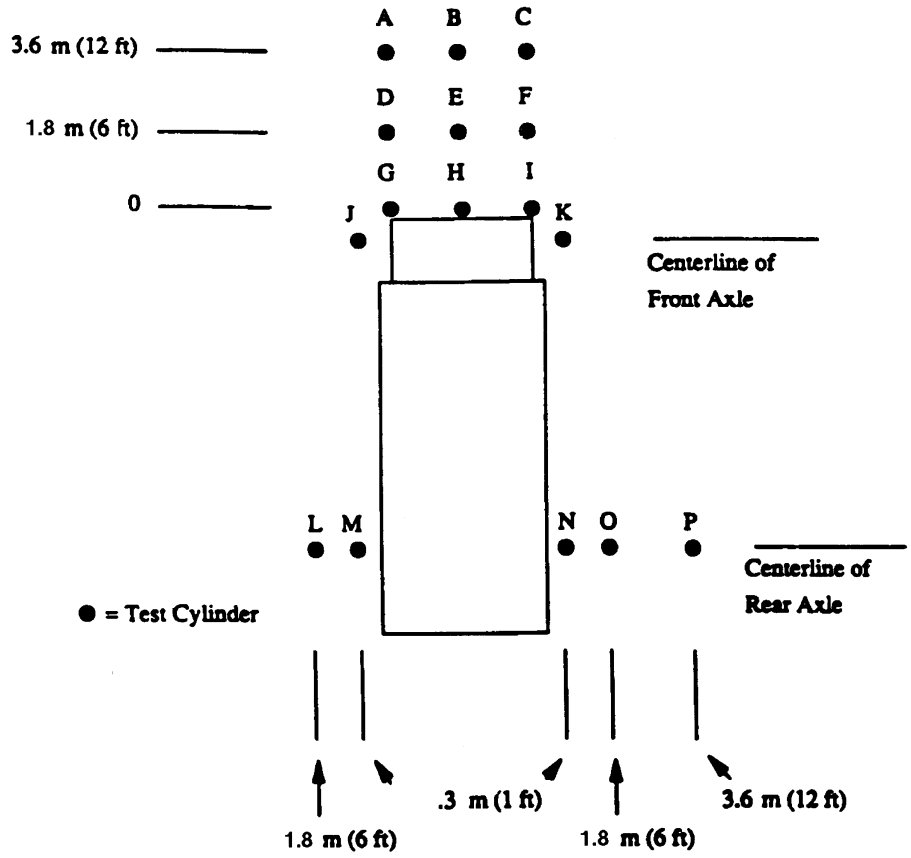


Figure 2.—Location of Test Cylinders for School Bus Field-of-View Test
All Dimensions in Meters (m)

81

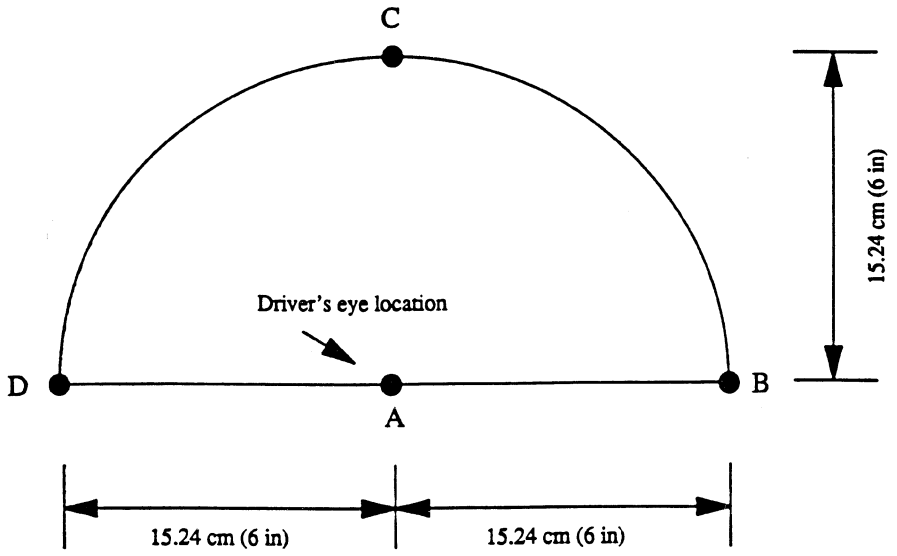


Figure 3.

Camera Locations for School Bus Field-of-View Test

S13.4 The driver's eye location is the eye location of a 25th percentile adult female, when seated in the driver's seat as follows:

(a) The center point of the driver's eye location is the point located 68.58 centimeters (27 inches) vertically above the intersection of the seat cushion and the seat back at the longitudinal centerline of the seat.

(b) Adjust the driver's seat to the midway point between the forward-most and rear-most positions, and if separately adjustable in the vertical direction, adjust to the lowest position. If an adjustment position does not

exist at the midway point, use the closest adjustment position to the rear of the midpoint. If a seat back is adjustable, adjust the seat back angle to the manufacturer's nominal design riding position in accordance with the manufacturer's recommendations.

S13.5 Adjustable mirrors are adjusted before the test in accordance with the manufacturer's recommendations. Such mirrors are not moved or readjusted at any time during the test.

13.6 Place a 35 mm or larger format camera, or video camera, so that its image plane is located at the center point of the driver's eye location or at any single point within a semicircular area established by a 15.24 centimeter (6 inch) radius parallel to and forward of the center point (see figure 3). With the camera at any single location on or within that semicircle look through the camera and the windows of the bus and determine whether the entire top surface of each cylinder is directly visible.

S13.7 For each cylinder whose entire top surface is determined under paragraph 13.4 of this section not to be directly visible at the driver's eye location,

(a) Place a comparison chart (see figure 4) above the mirror that provides the fullest view of the cylinder in situations where a cylinder is partially visible through more than one mirror.

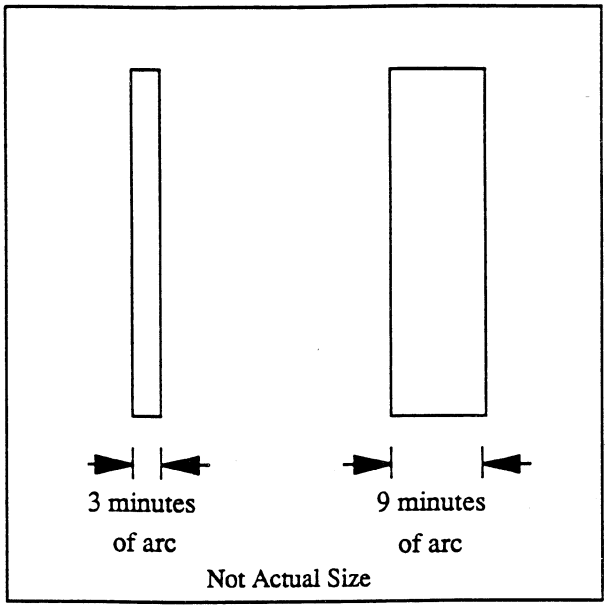


Figure 4.

Comparison Chart for Indirect Field-of-View Measurements

The width of the bars in Figure 4 indicating three minutes of arc and nine minutes of arc are derived from the following formula:

For 3 minutes of arc:

$X = D \times 0.000873$,

Where:

X = the width of a line, in the unit of measurement D, representing 3 minutes of arc;

D = distance from center point of driver's eye location to the center of the mirror's surface; and

0.000873 = tangent of 3 minutes of arc.

For 9 minutes of arc:

$X = D \times 0.002618$,

Where:

X = the width of a line, in the unit of measurement D, representing 9 minutes of arc;

D = distance from center point of driver's eye location to the center of the mirror's surface; and

0.002618 = tangent of 9 minutes of arc.

(b) Photograph each cylinder through the mirror(s) that provides a view of the cylinder. Photograph each cylinder with the camera located so that the view through its film or image plane is located at any single location within the semicircle established under 13.4, [POINT A,B,C, OR D] ensuring that the image of the mirror and comparison chart fill the camera's view finder to the extent possible.

13.8 Make all observations and take all photographs with the service/entry door in the closed position and the stop signal arm(s) in the fully retracted position.

S14. *Rear visibility test procedure.*

S14.1 *Field of view and image size test procedure.*

S14.1.1 *Lighting.* The ambient illumination conditions in which testing is conducted consists of light that is evenly distributed from above and is at an intensity of between 7,000 lux and 10,000 lux, as measured at the center of the exterior surface of the vehicle's roof.

S14.1.2 *Vehicle conditions.*

S14.1.2.1 *Tires.* The vehicle's tires are set to the vehicle manufacturer's recommended cold inflation pressure.

S14.1.2.2 *Fuel tank loading.* The fuel tank is full.

S14.1.2.3 *Vehicle load.* The vehicle is loaded to simulate the weight of the driver and four passengers or the designated occupant capacity, if less. The weight of each occupant is represented by 45 kg resting on the seat pan and 23 kg resting on the vehicle floorboard placed in the driver's designated seating position and any other available designated seating position.

S14.1.2.4 *Rear hatch and trunk lids.* If the vehicle is equipped with rear hatches or trunk lids, they are closed and latched in their normal vehicle operating condition.

S14.1.2.5 *Driver's seat positioning.*

S14.1.2.5.1 Adjust the driver's seat to the midpoint of the longitudinal adjustment range. If the seat cannot be adjusted to the midpoint of the longitudinal adjustment range, the closest adjustment position to the rear of the midpoint shall be used.

S14.1.2.5.2 Adjust the driver's seat to the lowest point of all vertical adjustment ranges present.

S14.1.2.5.3 Using the three dimensional SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin, adjust the driver's seat back angle at the vertical portion of the H-point machine's torso weight hanger to 25 degrees. If this adjustment setting is not available, adjust the seat-back angle to the positional detent setting closest to 25 degrees in the direction of the manufacturer's nominal design riding position.

S14.1.3 *Test object.* Each test object is a right circular cylinder that is 0.8 m high and 0.3 m in external diameter. There are seven test objects, designated A through G, and they are marked as follows.

(a) Test objects A, B, C, D, and E are marked with a horizontal band encompassing the uppermost 150 mm of the side of the cylinder.

(b) Test objects F and G are marked on the side with a solid vertical stripe of 150 mm width extending from the top to the bottom of each cylinder.

(c) Both the horizontal band and vertical stripe shall be of a color that contrasts with both the rest of the cylinder and the test surface.

S14.1.4 *Test object locations and orientation.* Place the test objects at locations specified in S14.1.4(a)-(f) and illustrated in Figure 5. Measure the distances shown in Figure 5 from a test object to another test object or other object from the cylindrical center (axis) of the test object as viewed from above. Each test object is oriented so that its axis is vertical.

(a) Place test objects F and G so that their centers are in a transverse vertical plane that is 0.3 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

(b) Place test objects D and E so that their centers are in a transverse vertical plane that is 3.05 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

(c) Place test objects A, B and C so that their centers are in a transverse vertical plane that is 6.1 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

(d) Place test object B so that its center is in a longitudinal vertical plane passing through the vehicle's longitudinal centerline.

(e) Place test objects C, E, and G so that their centers are in a longitudinal vertical plane located 1.52 m, measured laterally and horizontally, to the right of the vehicle longitudinal center line.

(f) Place test objects A, D, and F so that their centers are in a longitudinal vertical plane located 1.52 m, measured laterally and horizontally, to the left of the vehicle longitudinal center line.

S14.1.5 *Test reference point.* Obtain the test reference point using the following procedure.

(a) Locate the center of the forward-looking eye midpoint (M_f) illustrated in Figure 6 so that it is 635 mm vertically above the H point (H) and 96 mm aft of the H point.

(b) Locate the head/neck joint center (J) illustrated in Figure 6 so that it is 100 mm rearward of M_f and 588 mm vertically above the H point.

(c) Draw an imaginary horizontal line between M_f and a point vertically above J, defined as J_2.

(d) Rotate the imaginary line about J_2 in the direction of the rearview image until the straight-line distance between M_f and the center of the display used to present the rearview image required in this standard reaches the shortest possible value.

(e) Define this new, rotated location of M_f to be M_r (eye midpoint rotated).

S14.1.6 *Display adjustment.* If the display is mounted with a rotational adjustment mechanism, adjust the display such that the surface of the display is normal to the imaginary line traveling through M_r and J_2 or as near to normal as the display adjustment will allow.

S14.1.7 *Steering wheel adjustment.* The steering wheel is adjusted to the position where the longitudinal centerline of all vehicle tires are parallel to the longitudinal centerline of the vehicle. If no such position exists, adjust the steering wheel to the position where the longitudinal centerline of all vehicle tires are closest to parallel to the longitudinal centerline of the vehicle.

S14.1.8 *Measurement procedure.*

(a) Locate a 35 mm or larger format still camera, video camera, or digital equivalent such that the center of the camera's image plane is located at M_r and the camera lens is directed at the center of the display's rearview image.

(b) Affix a ruler at the base of the rearview image in an orientation perpendicular with a test object cylinder centerline. If the vehicle head restraints obstruct the camera's view of the display, they may be adjusted or removed.

(c) Photograph the image of the visual display with the ruler included in the frame and the rearview image displayed.

S14.1.8.1 *Extract photographic data.*

(a) Using the photograph, measure the apparent length, of a 50 mm delineated section of the in-photo ruler, along the ruler's edge, closest to the rearview image and at a point near the horizontal center of the rearview image.

(b) Using the photograph, measure the horizontal width of the colored band at the upper portion of each of the three test objects located at positions A, B, and C in Figure 5.

(c) Define the measured horizontal widths of the colored bands of the three test objects as d_a, d_b, and d_c.

S14.1.8.2 *Obtain scaling factor.* Using the apparent length of the 50 mm portion of the ruler as it appears in the photograph, divide this apparent length by 50 mm to obtain a scaling factor. Define this scaling factor as s_{scale}.

S14.1.8.3 *Determine viewing distance.* Determine the actual distance from the rotated eye midpoint location (M_r) to

the center of the rearview image. Define this viewing distance as a_{eye}.

S14.1.8.4 *Calculate visual angle subtended by test objects.* Use the following equation to calculate the subtended visual angles:

$$\theta_i = 60 \sin^{-1}\left(\frac{d_i}{a_{eye} s_{scale}}\right)$$

where i can take on the value of either *test object A*, *B*, or *C*, and arcsine is calculated in units of degrees.

S14.2 *Image response time test procedure.* The temperature inside the vehicle during this test is any temperature between 15 °C and 25 °C. Immediately prior to commencing the actions listed in subparagraphs (a)–(c) of this paragraph, all components of the rear visibility system are in a powered off state. Then:

(a) Open the driver's door to any width,

(b) Close the driver's door

(c) Activate the starting system using the key, and

(d) Select the vehicle's reverse direction at any time not less than 4.0 seconds and not more than 6.0 seconds after the driver's door is opened. The driver door is open when the edge of the driver's door opposite of the door's hinge is no longer flush with the exterior body panel.

S14.3 *Durability test procedures.* For the durability tests specified in S14.3.1, S14.3.2, and S14.3.3, the external components are mounted on an environmental test fixture.

S14.3.1 *Corrosion test procedure.* The external components are subjected to two 24-hour corrosion test cycles. In each corrosion test cycle, the external components are subjected to a salt spray (fog) test in accordance with ASTM B117–03 (incorporated by reference, see §571.5) for a period of 24 hours. Allow 1 hour to elapse without spray between the two test cycles.

S14.3.2 *Humidity exposure test procedure.* The external components are subjected to 24 consecutive 3-hour humidity test cycles. In each humidity test cycle, external components are subjected to a temperature of 100° + 7° − 0 °F (38° + 4° − 0 °C) with a relative humidity of not less than 90% for a period of 2 hours. After a period not to exceed 5 minutes, the external components are subjected to a temperature of 32° + 5° − 0 °F (0° + 3° − 0 °C) and a humidity of not more than 30% ±10% for 1 hour. Allow no more than 5 minutes to elapse between each test cycle.

S14.3.3 *Temperature exposure test procedure.* The external components are subjected to 4 consecutive 2-hour temperature test cycles. In each temperature test cycle, the external components are first subjected to a temperature of 176° ±5 °F (80° ±3 °C) for a period of one hour. After a period not to exceed 5 minutes, the external components are subjected to a temperature of 32° + 5° − 0 °F (0° + 3° − 0 °C) for 1 hour. Allow no more than 5 minutes to elapse between each test cycle.

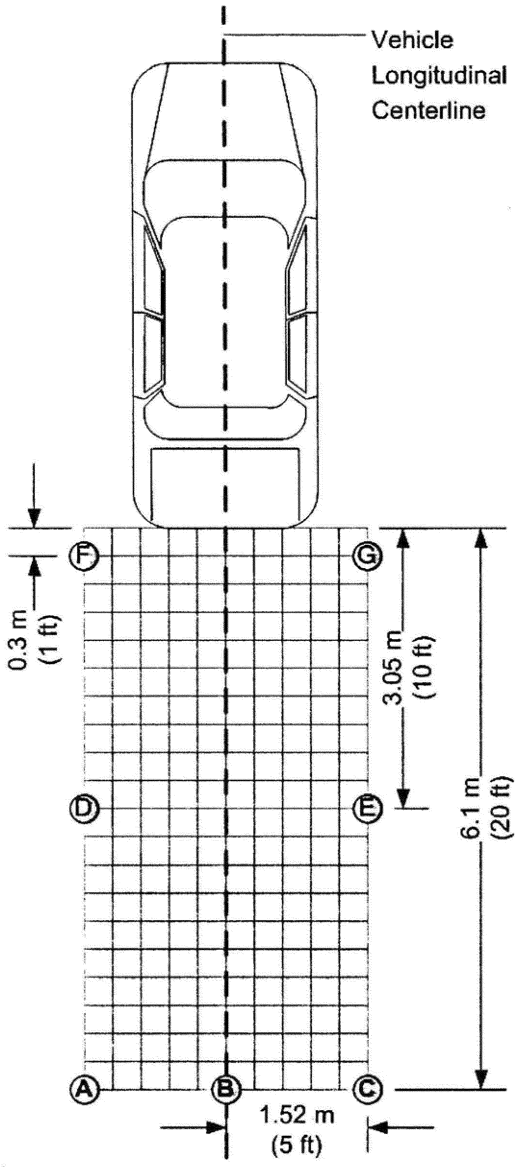


FIGURE 5: TEST CYLINDER LOCATIONS

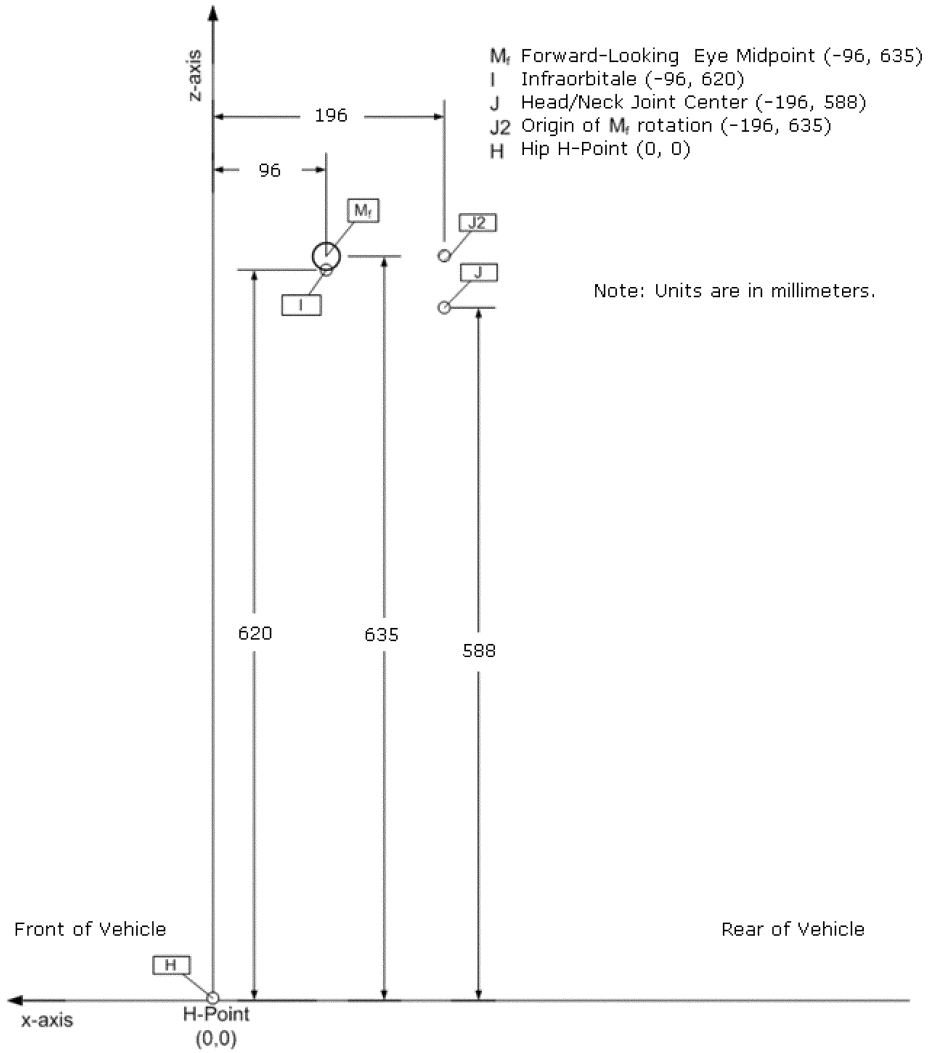


FIGURE 6: EYE MIDPOINT LOCATION (M_f) IN THE MID-SAGITTAL PLANE WITH RESPECT TO H POINT FOR FORWARD-LOOKING 50TH PERCENTILE MALE DRIVER SEATED WITH 25 DEGREE SEAT BACK ANGLE

S15 *Rear visibility phase-in schedule.* For the purposes of the requirements in S15.1 through S15.7, production year means the 12-month period between May 1 of one year and April 30 of the following year, inclusive.

S15.1 *Vehicles manufactured on or after May 1, 2016 and before May 1, 2018.* At any time during or after the production years ending April 30, 2017 and April 30, 2018, each manufacturer shall, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles (by make, model and vehicle identification number) that have been certified as complying with S5.5.1 or S6.2.1 of this

standard. The manufacturer's designation of a vehicle as a certified vehicle is irrevocable.

S15.2 *Vehicles manufactured on or after May 1, 2016 and before May 1, 2017.* Except as provided in S15.4, for passenger cars, multipurpose passenger vehicles, trucks, buses, and low-speed vehicles with a GVWR of 4,536 kg or less, manufactured by a manufacturer on or after May 1, 2016, and before May 1, 2017, the number of such vehicles complying with S5.5.1 or S6.2.1 shall be not less than 10 percent of the manufacturer's—

(a) Production of such vehicles during that period; or

(b) Average annual production of such vehicles manufactured in the three previous production years.

S15.3 *Vehicles manufactured on or after May 1, 2017 and before May 1, 2018.* Except as provided in S15.4, for passenger cars, multipurpose passenger vehicles, trucks, buses, and low-speed vehicles with a GVWR of 4,536 kg or less, manufactured by a manufacturer on or after May 1, 2017, and before May 1, 2018, the number of such vehicles complying with S5.5.1 or S6.2.1 shall be not less than 40 percent of the manufacturer's—

(a) Production of such vehicles during that period; or

(b) Average annual production of such vehicles manufactured in the three previous production years.

S15.4 *Exclusions from phase-in.* The following vehicles shall not be subject to the requirements in S15.1 through S15.3 but shall achieve full compliance with this standard at the end of the phase-in period in accordance with S5.5(b) and S6.2(b):

(a) Vehicles that are manufactured by small manufacturers or by limited line manufacturers.

(b) Vehicles that are altered (within the meaning of *49 CFR 567.7*) before May 1, 2017, after having been previously certified in accordance with part 567 of this chapter, and vehicles manufactured in two or more stages before May 1, 2018.

S15.5 *Vehicles produced by more than one manufacturer.* For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S15.1 through S15.3, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S15.6—

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S15.6 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S15.5.

S15.7 *Calculation of complying vehicles.*

(a) For the purposes of calculating the vehicles complying with S15.2, a manufacturer may count a vehicle if it is manufactured on or after May 1, 2016 but before May 1, 2017.

(b) For purposes of complying with S15.3, a manufacturer may count a vehicle if it is manufactured on or after May 1, 2017 but before May 1, 2018 and,

(c) For the purposes of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer, each vehicle that is excluded from having to meet the applicable requirement is not counted.

[41 FR 36025, Aug. 26, 1976, as amended at 41 FR 56813, Dec. 30, 1976; 47 FR 38700, Sept. 2, 1982; 48 FR 38844, Aug. 26, 1983; 48 FR 40262, Sept. 6, 1983; 56 FR 58516, Nov. 20, 1991; 57 FR 57015, Dec. 2, 1992; 58 FR 60402, Nov. 16, 1993; 60 FR 15692, Mar. 27, 1995; 63 FR 28929, May 27, 1998; 63 FR 51000, Sept. 24, 1998; 69 FR 18497, Apr. 8, 2004; 77 FR 758, Jan. 6, 2012; 79 FR 19243, Apr. 7, 2014]

§ 571.112 [Reserved]

§ 571.113 Standard No. 113; Hood latch system.

S1. *Purpose and scope.* This standard establishes the requirement for providing a hood latch system or hood latch systems.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. *Definitions. Hood* means any exterior movable body panel forward of the

windshield that is used to cover an engine, luggage, storage, or battery compartment.

S4. *Requirements.*

S4.1 Each hood must be provided with a hood latch system.

S4.2 A front opening hood which, in any open position, partially or completely obstructs a driver's forward view through the windshield must be provided with a second latch position on the hood latch system or with a second hood latch system.

§571.114 Standard No. 114; Theft protection and rollaway prevention.

S1. *Scope.* This standard specifies vehicle performance requirements intended to reduce the incidence of crashes resulting from theft and accidental rollaway of motor vehicles.

S2. *Purpose.* The purpose of this standard is to decrease the likelihood that a vehicle is stolen, or accidentally set in motion.

S3. *Application.* This standard applies to all passenger cars, and to trucks and multipurpose passenger vehicles with a GVWR of 4,536 kilograms (10,000 pounds) or less. However, it does not apply to walk-in van-type vehicles. Additionally, paragraph S5.3 of this standard applies to all motor vehicles, except trailers and motorcycles, with a GVWR of 4,536 kilograms (10,000 pounds) or less.

S4. *Definitions.*

Combination means a variation of the key that permits the starting system of a particular vehicle to be operated.

Key means a physical device or an electronic code which, when inserted into the starting system (by physical or electronic means), enables the vehicle operator to activate the engine or motor.

Open-body type vehicle means a vehicle having no occupant compartment doors or vehicle having readily detachable occupant compartment doors.

Starting system means the vehicle system used in conjunction with the key to activate the engine or motor.

Vehicle type, as used in S5.1.2, refers to passenger car, truck, or multipurpose passenger vehicle, as those terms are defined in 49 CFR 571.3.

S5 *Requirements.* Each vehicle subject to this standard must meet the requirements of S5.1, S5.2, and S5.3. Open-body type vehicles are not required to comply with S5.1.3.

S5.1 *Theft protection.*

S5.1.1 Each vehicle must have a starting system which, whenever the key is removed from the starting system prevents:

(a) The normal activation of the vehicle's engine or motor; and

(b) Either steering, or forward self-mobility, of the vehicle, or both.

S5.1.2 For each vehicle type manufactured by a manufacturer, the manufacturer must provide at least 1,000 unique key combinations, or a number equal to the total number of the vehicles of that type manufactured by the manufacturer, whichever is less. The same combinations may be used for more than one vehicle type.

S5.1.3 Except as specified below, an audible warning to the vehicle operator must be activated whenever the key is in the starting system and the door located closest to the driver's designated seating position is opened. An audible warning to the vehicle operator need not activate:

(a) After the key has been inserted into the starting system, and before the driver takes further action; or

(b) If the key is in the starting system in a manner or position that allows the engine or motor to be started or to continue operating; or

(c) For mechanical keys and starting systems, after the key has been withdrawn to a position from which it may not be turned.

S5.1.4 If a vehicle is equipped with a transmission with a ''park'' position, the means for deactivating the vehicle's engine or motor must not activate any device installed pursuant to S5.1.1(b), unless the transmission is locked in the ''park'' position.

S5.2 Rollaway prevention in vehicles equipped with transmissions with a ''park'' position.

S5.2.1 Except as specified in S5.2.3, the starting system required by S5.1 must prevent key removal when tested according to the procedures in S6, unless the transmission or gear selection control is locked in ''park'' or becomes locked in ''park'' as a direct result of key removal.

S5.2.2 Except as specified in S5.2.4, the vehicle must be designed such that the transmission or gear selection control cannot move from the ''park'' position, unless the key is in the starting system.

S5.2.3 *Key removal override option.* At the option of the manufacturer, the key may be removed from the starting system without the transmission or gear selection control in the ''park'' position under one of the following conditions:

(a) In the event of electrical failure, including battery discharge, the vehicle may permit key removal from the starting system without the transmission or gear selection control locked in the ''park'' position; or

(b) Provided that steering or self-mobility is prevented, the vehicle may have a device by which the user can remove the key from the starting system without the transmission or gear selection control locked in ''park.'' This device must require:

(i) The use of a tool, and

(ii) Simultaneous activation of the device and removal of the key; or

(c) Provided that steering or self-mobility is prevented, the vehicle may have a device by which the user can remove the key from the starting system without the transmission or gear selection control locked in ''park.'' This device must be covered by an opaque surface which, when installed:

(i) Prevents sight of and use of the device, and

(ii) Can be removed only by using a screwdriver or other tool.

S5.2.4 *Gear selection control override option.* The vehicle may have a device by which the user can move the gear selection control from ''park'' after the key has been removed from the starting system. This device must be operable by one of the three options below:

(a) By use of the key; or

(b) By a means other than the key, provided steering or forward self-mobility is prevented when the key is removed from the starting system. Such a means must require:

(i) The use of a tool, and

(ii) Simultaneous activation of this means and movement of the gear selection control from ''park;'' or

(c) By a means other than the key, provided steering or forward self-mobility is prevented when the key is removed from the starting system. This device must be covered by an opaque surface which, when installed:

(i) Prevents sight of and use of the device, and

(ii) Can be removed only by using a screwdriver or other tool.

S5.2.5 When tested in accordance with S6.2.2, each vehicle must not move more than 150 mm on a 10 percent grade when the gear selection control is locked in ''park.''

S5.3 *Brake transmission shift interlock.* Each motor vehicle manufactured on or after September 1, 2010 with a GVWR of 4,536 kilograms (10,000 pounds) or less with an automatic transmission that includes a ''park'' position shall be equipped with a system that requires the service brake to be depressed before the transmission can be shifted out of ''park.'' This system shall function in any starting system key position in which the transmission can be shifted out of ''park.'' This section does not apply to trailers or motorcycles.

S6. Compliance test procedure for vehicles with transmissions with a ''park'' position.

S6.1 Test conditions.

S6.1.1 The vehicle shall be tested at curb weight plus 91 kg (including the driver).

S6.1.2 Except where specified otherwise, the test surface shall be level.

S6.2 Test procedure.

S6.2.1

(a) Activate the starting system using the key.

(b) Move the gear selection control to any gear selection position or any other position where it will remain without assistance, including a position between any detent positions, except for the ''park'' position.

(c) Attempt to remove the key in each gear selection position.

S6.2.2

(a) Drive the vehicle forward up a 10 percent grade and stop it with the service brakes.

(b) Apply the parking brake (if present).

(c) Move the gear selection control to ''park.''

(d) Note the vehicle position.
(e) Release the parking brake. Release the service brakes.
(f) Remove the key.
(g) Verify that the gear selection control or transmission is locked in ''park.''
(h) Verify that the vehicle, at rest, has moved no more than 150 mm from the position noted prior to release of the brakes.
S6.2.3
(a) Drive the vehicle forward down a 10 percent grade and stop it with the service brakes.
(b) Apply the parking brake (if present).
(c) Move the gear selection control to ''park.''
(d) Note the vehicle position.
(e) Release the parking brake. Release the service brakes.
(f) Remove the key.
(g) Verify that the gear selection control or transmission is locked in ''park.''
(h) Verify that the vehicle, at rest, has moved no more than 150 mm from the position noted prior to release of the brakes.

[71 FR 17755, Apr. 7, 2006, as amended at 75 FR 15624, Mar. 30, 2010]

§571.115 [Reserved]

§571.116 Standard No. 116; Motor vehicle brake fluids.

S1. *Scope*. This standard specifies requirements for fluids for use in hydraulic brake systems of motor vehicles, containers for these fluids, and labeling of the containers.

S2. *Purpose*. The purpose of this standard is to reduce failures in the hydraulic braking systems of motor vehicles which may occur because of the manufacture or use of improper or contaminated fluid.

S3. *Application*. This standard applies to all fluid for use in hydraulic brake systems of motor vehicles. In addition, S5.3 applies to passenger cars, multipurpose passenger vehicles, trucks, buses, trailers, and motorcycles.

S4. *Definitions*.

Blister means a cavity or sac on the surface of a brake cup.

Brake fluid means a liquid designed for use in a motor vehicle hydraulic brake system in which it will contact elastomeric components made of styrene and butadiene rubber (SBR), ethylene and propylene rubber (EPR), polychloroprene (CR) brake hose inner tube stock or natural rubber (NR).

Chipping means a condition in which small pieces are missing from the outer surface of a brake cup.

Duplicate samples means two samples of brake fluid taken from a single packaged lot and tested simultaneously.

Hydraulic system mineral oil means a mineral-oil-based fluid designed for use in motor vehicle hydraulic brake systems in which the fluid is not in contact with components made of SBR, EPR or NR.

Packager means any person who fills containers with brake fluid that are subsequently distributed for retail sale.

Packaged lot is that quantity of brake fluid shipped by the manufacturer to the packager in a single container, or that quantity of brake fluid manufactured by a single plant run of 24 hours or less, through the same processing equipment and with no change in ingredients.

Scuffing means a visible erosion of a portion of the outer surface of a brake cup.

A *silicone base brake fluid* (SBBF) is a brake fluid which consists of not less than 70 percent by weight of a diorgano polysiloxane.

Sloughing means degradation of a brake cup as evidenced by the presence of carbon black loosely held on the brake cup surface, such that a visible black streak is produced when the cup, with a 500 ±10 gram deadweight on it, is drawn base down over a sheet of white bond paper placed on a firm flat surface.

Stickiness means a condition on the surface of a brake cup such that fibers will be pulled from a wad of U.S.P. absorbent cotton when it is drawn across the surface.

S5. *Requirements*. This section specifies performance requirements for DOT 3, DOT 4 and DOT 5 brake fluids; requirements for brake fluid certification; and requirements for container sealing, labeling and color coding for brake fluids and hydraulic system mineral oils. Where a range of tolerances is

specified, the brake fluid shall meet the requirements at all points within the range.

S5.1 *Brake fluid.* When tested in accordance with S6, brake fluids shall meet the following requirements:

S5.1.1 *Equilibrium reflux boiling point (ERBP).* When brake fluid is tested according to S6.1, the ERBP shall not be less than the following value for the grade indicated:

(a) DOT 3: 205 °C. (401 °F.).

(b) DOT 4: 230 °C. (446 °F.).

(c) DOT 5: 260 °C. (500 °F.).

S5.1.2 *Wet ERBP.* When brake fluid is tested according to S6.2, the wet ERBP shall not be less than the following value for the grade indicated:

(a) DOT 3: 140 °C. (284 °F.).

(b) DOT 4: 155 °C. (311 °F.).

(c) DOT 5: 1 180 °C. (356 °F.).

S5.1.3. *Kinematic viscosities.* When brake fluid is tested according to S6.3, the kinematic viscosities in square millimeters per second at stated temperatures shall be neither less than 1.5 mm^2/s at 100 °C. (212 °F.) nor more than the following maximum value for the grade indicated:

(a) DOT 3: 1,500 mm^2/s at minus 40 °C. (minus 40 °F.).

(b) DOT 4: 1,800 mm^2/s at minus 40 °C. (minus 40 °F.).

(c) DOT 5: 900 mm^2/s at minus 40 °C. (minus 40 °F.).

S5.1.4 *pH value.* When brake fluid, except DOT 5 SBBF, is tested according to S6.4, the pH value shall not be less than 7.0 nor more than 11.5.

S5.1.5 *Brake fluid stability.*

S5.1.5.1 *High-temperature stability.* When brake fluid is tested according to S6.5.3 the ERBP shall not change by more than 3 °C. (5.4 °F.) plus 0.05° for each degree that the ERBP of the fluid exceeds 225 °C. (437 °F.).

S5.1.5.2 *Chemical stability.* When brake fluid, except DOT 5 SBBF, is tested according to S6.5.4, the change in temperature of the refluxing fluid mixture shall not exceed 3.0 °C (5.4 °F.) plus 0.05° for each degree that the ERBP of the fluid exceeds 225 °C (437 °F.).

S5.1.6 *Corrosion.* When brake fluid is tested according to S6.6—

(a) The metal test strips shall not show weight changes exceeding the limits stated in Table I.

TABLE I

Test strip material	Maximum permissible weight change, mg./sq. cm. of surface
Steel, tinned iron, cast iron	0.2
Aluminum	.1
Brass, copper	.4

(b) Excluding the area of contact (13 ±1 mm. (½ ±1/32 inch) measured from the bolt hole end of the test strip), the metal test strips shall not show pitting or etching to an extent discernible without magnification;

(c) The water-wet brake fluid at the end of the test shall show no jelling at 23 ±5 °C (73.4 ±9 °F.);

(d) No crystalline deposit shall form and adhere to either the glass jar walls or the surface of the metal strips;

(e) At the end of the test, sedimentation of the water-wet brake fluid shall not exceed 0.10 percent by volume;

(f) The pH value of water-wet brake fluid, except DOT 5 SBBF, at the end of the test shall not be less than 7.0 nor more than 11.5;

(g) The cups at the end of the test shall show no disintegration, as evidenced by blisters or sloughing;

(h) The hardness of the cup shall not decrease by more than 15 International Rubber Hardness Degrees (IRHD); and

(i) The base diameter of the cups shall not increase by more than 1.4 mm. (0.055 inch).

S5.1.7 *Fluidity and appearance at low temperature.* When brake fluid is tested according to S6.7, at the storage temperature and for the storage times given in Table II—

(a) The fluid shall show no sludging, sedimentation, crystallization, or stratification;

(b) Upon inversion of the sample bottle, the time required for the air bubble to travel to the top of the fluid shall not exceed the bubble flow times shown in Table II; and

(c) On warming to room temperature, the fluid shall resume the appearance and fluidity that it had before chilling.

TABLE II—FLUIDITY AND APPEARANCE AT LOW TEMPERATURES

Storage temperature	Storage time (hours)	Maximum bubble flow time (seconds)
Minus 40 ±2 °C. (minus 40 ±3.6 °F.)	144 ±4.0	10
Minus 50 ±2 °C. (minus 58 ±3.6 °F.)	6 ±0.2	35

S5.1.8 [Reserved]

S5.1.9 *Water tolerance.* (a) *At low temperature.* When brake fluid is tested according to S6.9.3(a)—

(1) The fluid shall show no sludging, sedimentation, crystallization, or stratification;

(2) Upon inversion of the centrifuge tube, the air bubble shall travel to the top of the fluid in not more than 10 seconds;

(3) If cloudiness has developed, the wet fluid shall regain its original clarity and fluidity when warmed to room temperature; and

(b) *At 60 °C. (140 °F.).* When brake fluid is tested according to S6.9.3(b)—

(1) The fluid shall show no stratification; and

(2) Sedimentation shall not exceed 0.15 percent by volume after centrifuging.

S5.1.10 *Compatibility.*

(a) *At low temperature.* When brake fluid is tested according to S6.10.3(a), the test specimen shall show no sludging, sedimentation, or crystallization. In addition, fluids, except DOT 5 SBBF, shall show no stratification.

(b) *At 60 °C. (140 °F.).* When brake fluid is tested according to S6.10.3(b)—

(1) Sedimentation shall not exceed 0.05 percent by volume after centrifuging; and

(2) Fluids, except DOT 5 SBBF, shall show no stratification.

S5.1.11 *Resistance to oxidation.* When brake fluid is tested according to S6.11—

(a) The metal test strips outside the areas in contact with the tinfoil shall not show pitting or etching to an extent discernible without magnification;

(b) No more than a trace of gum shall be deposited on the test strips outside the areas in contact with the tinfoil;

(c) The aluminum strips shall not change in weight by more than 0.05 mg./sq. cm.; and

(d) The cast iron strips shall not change in weight by more than 0.3 mg./sq. cm.

S5.1.12 *Effects on cups.* When brake cups are subjected to brake fluid in accordance with S6.12—

(a) The increase in the diameter of the base of the cups shall be not less than 0.15 mm. (0.006 inch) or more than 1.40 mm. (0.055 inch);

(b) The decrease in hardness of the cups shall be not more than 10 IRHD at 70 °C. (158 °F.) or more than 15 IRHD at 120 °C. (248 °F.), and there shall be no increase in hardness of the cups; and

(c) The cups shall show no disintegration as evidenced by stickiness, blisters, or sloughing.

S5.1.13 *Stroking properties.* When brake fluid is tested according to S6.13—

(a) Metal parts of the test system shall show no pitting or etching to an extent discernible without magnification;

(b) The change in diameter of any cylinder or piston shall not exceed 0.13 mm. (0.005 inch);

(c) The average decrease in hardness of seven of the eight cups tested (six wheel cylinder and one master cylinder primary) shall not exceed 15 IRHD. Not more than one of the seven cups shall have a decrease in hardness greater than 17 IRHD;

(d) None of the eight cups shall be in an unsatisfactory operating condition as evidenced by stickiness, scuffing, blisters, cracking, chipping, or other change in shape from its original appearance;

(e) None of the eight cups shall show an increase in base diameter greater than 0.90 mm (0.035 inch);

(f) The average lip diameter set of the eight cups shall not be greater than 65 percent.

(g) During any period of 24,000 strokes, the volume loss of fluid shall not exceed 36 milliliters;

(h) The cylinder pistons shall not freeze or function improperly throughout the test;

(i) The total loss of fluid during the 100 strokes at the end of the test shall not exceed 36 milliliters;

(j) The fluid at the end of the test shall show no formation of gels;

(k) At the end of the test the amount of sediment shall not exceed 1.5 percent by volume; and

(l) Brake cylinders shall be free of deposits that are abrasive or that cannot be removed when rubbed moderately with a nonabrasive cloth wetted with ethanol.

S5.1.14 *Fluid color.* Brake fluid and hydraulic system mineral oil shall be of the color indicated:

DOT 3, DOT 4, and DOT 5.1 non-SBBF—colorless to amber.
DOT 5 SBBF—purple.
Hydraulic system mineral oil—green.

S5.2 *Packaging and labeling requirements for motor vehicle brake fluids.*

S5.2.1 *Container sealing.* Each brake fluid or hydraulic system mineral oil container with a capacity of 177 mL or more shall be provided with a resealable closure that has an inner seal impervious to the packaged brake fluid. The container closure shall include a tamper-proof feature that will either be destroyed or substantially altered when the container closure is initially opened.

S5.2.2 *Certification, marking, and labeling.*

S5.2.2.1 Each manufacturer of a DOT grade brake fluid shall furnish to each packager, distributor, or dealer to whom he delivers brake fluid, the following information:

(a) A serial number identifying the production lot and the date of manufacture of the brake fluid.

(b) The grade (DOT 3, DOT 4, DOT 5) of the brake fluid. If DOT 5 grade brake fluid , it shall be further distinguished as ''DOT 5 SILICONE BASE'' or ''DOT 5.1 NON-SILICONE BASE.''

(c) The minimum wet boiling point in Fahrenheit of the brake fluid.

(d) Certification that the brake fluid conforms to §571.116.

S5.2.2.2 Each packager of brake fluid shall furnish the information specified in paragraphs (a) through (g) of this S5.2.2.2 by clearly marking it on each brake fluid container or on a label (labels) permanently affixed to the container, in any location except a removable part such as a lid. After being subjected to the operations and conditions specified in S6.14, the information required by this section shall be legible to an observer having corrected visual acuity of 20/40 (Snellen ratio) at a distance of 305 mm, and any label affixed to the container in compliance with this section shall not be removable without its being destroyed or defaced.

(a) Certification that the brake fluid conforms to §571.116.

(b) The name of the packager of the brake fluid, which may be in code form.

(c) The name and complete mailing address of the distributor.

(d) A serial number identifying the packaged lot and date of packaging.

(e) Designation of the contents as ''DOT—MOTOR VEHICLE BRAKE FLUID'' (Fill in DOT 3, DOT 4, DOT 5 SILICONE BASE, or DOT 5.1 NON-SILICONE BASE as applicable).

(f) The minimum wet boiling point in Fahrenheit of the DOT brake fluid in the container.

(g) The following safety warnings in capital and lower case letters as indicated:

(1) FOLLOW VEHICLE MANUFACTURER'S RECOMMENDATIONS WHEN ADDING BRAKE FLUID.

(2) KEEP BRAKE FLUID CLEAN AND DRY. Contamination with dirt, water, petroleum products or other materials may result in brake failure or costly repairs.

(3) STORE BRAKE FLUID ONLY IN ITS ORIGINAL CONTAINER. KEEP CONTAINER CLEAN AND TIGHTLY CLOSED TO PREVENT ABSORPTION OF MOISTURE.

(4) *CAUTION:* DO NOT REFILL CONTAINER, AND DO NOT USE FOR OTHER LIQUIDS. (Not required for containers with a capacity in excess of 19 L.)

S5.2.2.3 Each packager of hydraulic system mineral oil shall furnish the information specified in paragraphs (a) through (e) of this S5.2.2.3 by clearly marking it on each brake fluid container or on a label (labels) permanently affixed to the container, in any location except a removable part such as a lid. After being subjected to the operations and conditions specified in S6.14, the information required by this section shall be legible to an observer having corrected visual acuity of 20/40 (Snellen ratio) at a distance of 305 mm and any label affixed to the container in compliance with this section shall

not be removable without its being destroyed or defaced.

(a) The name of the packager of the hydraulic system mineral oil, which may be in code form.

(b) The name and complete mailing address of the distributor.

(c) A serial number identifying the packaged lot and date of packaging.

(d) Designation of the contents as ''HYDRAULIC SYSTEM MINERAL OIL'' in capital letters at least 3 mm high.

(e) The following safety warnings in capital and lower case letters as indicated:

(1) FOLLOW VEHICLE MANUFACTURER'S RECOMMENDATIONS WHEN ADDING HYDRAULIC SYSTEM MINERAL OIL.

(2) Hydraulic System Mineral Oil is NOT COMPATIBLE with the rubber components of brake systems designed for use with DOT brake fluids.

(3) KEEP HYDRAULIC SYSTEM MINERAL OIL CLEAN. Contamination with dust or other materials may result in brake failure or costly repair.

(4) *CAUTION:* STORE HYDRAULIC SYSTEM MINERAL OIL ONLY IN ITS ORIGINAL CONTAINER. KEEP CONTAINER CLEAN AND TIGHTLY CLOSED. DO NOT REFILL CONTAINER OR USE OTHER LIQUIDS. (The last sentence is not required for containers with a capacity in excess of 19 L.)

S5.2.2.4 If a container for brake fluid or hydraulic system mineral oil is not normally visible but designed to be protected by an outer container or carton during use, the outer container or carton rather than the inner container shall meet the labeling requirements of S5.2.2.2 or S5.2.2.3, as appropriate.

S5.3 *Motor vehicle requirement.* Each passenger car, multipurpose passenger vehicle, truck, bus, trailer, and motorcycle that has a hydraulic brake system shall be equipped with fluid that has been manufactured and packaged in conformity with the requirements of this standard.

S6. *Test procedures.*

S6.1 *Equilibrium reflux boiling point.* Determine the ERBP of a brake fluid by running duplicate samples according to the following procedure and averaging the results.

S6.1.1 *Summary of procedure.* Sixty milliliters (ml.) of brake fluid are boiled under specified equilibrium conditions (reflux) at atmospheric pressure in a 100-ml. flask. The average temperature of the boiling fluid at the end of the reflux period, corrected for variations in barometric pressure if necessary, is the ERBP.

S6.1.2 *Apparatus.* (See Figure 1) The test apparatus shall consist of—

(a) *Flask.* (See Figure 2) A 100-ml. round-bottom, short-neck heat-resistant glass flask having a neck with a 19/38 standard taper, female ground-glass joint and a side-entering tube, with an outside diameter of 10 millimeters (mm.), which centers the thermometer bulb in the flask 6.5 mm. from the bottom;

(b) *Condenser.* A water-cooled, reflux, glass-tube type, condenser having a jacket 200 mm. in length, the bottom end of which has a 19/38 standard-taper, drip-tip, male ground-glass joint;

(c) *Boiling stones.* Three clean, unused silicon carbide grains (approximately 2 mm. (0.08 inch) in diameter, grit No. 8);

(d) *Thermometer.* Standardized calibrated partial immersion (76 mm.), solid stem, thermometers conforming to the requirements for an ASTM 2C or 2F, and an ASTM 3C or 3F thermometer; and

(e) *Heat source.* Variable autotransformer-controlled heating mantle designed to fit the flask, or an electric heater with rheostat heat control.

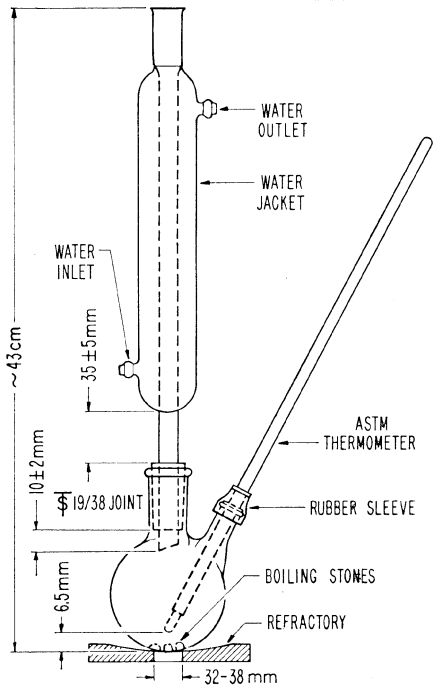


FIG. 1—BOILING POINT TEST APPARATUS

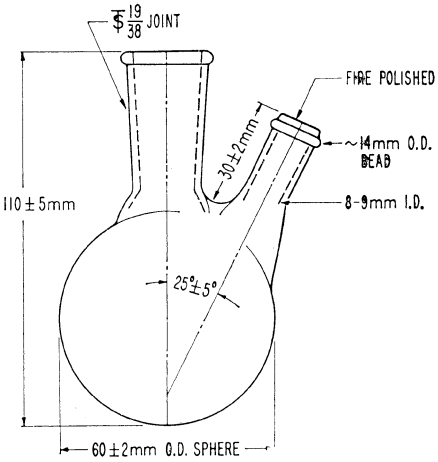


FIG. 2—DETAIL OF 100 ML SHORT-NECK FLASK

S6.1.3 *Preparation of apparatus.* (a) Thoroughly clean and dry all glassware.

(b) Insert thermometer through the side tube until the tip of the bulb is 6.5 mm. (¼ inch) from the bottom center of the flask. Seal with a short piece of natural rubber, EPDM, SBR, or butyl tubing.

(c) Place 60 ±1 ml. of brake fluid and the silicon carbide grains into the flask.

(d) Attach the flask to the condenser. When using a heating mantle, place the mantle under the flask and support it with a ring-clamp and laboratory-type stand, holding the entire assembly in place by a clamp. When using a rheostat-controlled heater, center a standard porcelain or hard asbestos refractory, having a diameter opening 32 to 38 mm., over the heating element and mount the flask so that direct heat is applied only through the opening in the refractory. Place the assembly in an area free from drafts or other types of sudden temperature changes. Connect the cooling water inlet and outlet tubes to the condenser. Turn on the cooling water. The water supply temperature shall not exceed 28 °C. (82.4 °F.) and the temperature rise through the condenser shall not exceed 2 °C. (3.6 °F.).

S6.1.4 *Procedure.* Apply heat to the flask so that within 10 ±2 minutes the fluid is refluxing in excess of 1 drop per second. The reflux rate shall not exceed 5 drops per second at any time. Immediately adjust the heating rate to obtain an equilibrium reflux rate of 1 to 2 drops per second over the next 5 ±2 minutes. Maintain this rate for an additional 2 minutes, taking four temperature readings at 30–second intervals. Record the average of these as the observed ERBP. If no reflux is evident when the fluid temperature reaches 260 °C (500 °F), discontinue heating and report ERBP as in excess of 260 °C (500 °F).

S6.1.5 *Calculation.* (a) *Thermometer inaccuracy.* Correct the observed ERBP by applying any correction factor obtained in standardizing the thermometer.

(b) *Variation from standard barometric pressure.* Apply the factor shown in Table III to calculate the barometric pressure correction to the ERBP.

TABLE III—CORRECTION FOR BAROMETRIC PRESSURE

Observed ERBP corrected for thermometer inaccuracy	Correction per 1 mm difference in pressure [a]	
	°C.	(°F.)
100 °C. (212 °F.) to 190 °C. (374 °F.)	0.039	(0.07)
Over 190 °C. (374 °F.)	0.04	(0.08)

[a] To be added in case barometric pressure is below 760 mm.; to be subtracted in case barometric pressure is above 670 mm.

(c) If the two corrected observed ERBP's agree within 2 °C. (4 °C. for brake fluids having an ERBP over 230 °C./446 °F.) average the duplicate runs as the ERBP; otherwise, repeat the entire test, averaging the four corrected observed values to determine the original ERBP.

S6.2 *Wet ERBP.* Determine the wet ERBP of a brake fluid by running duplicate samples according to the following procedure.

S6.2.1. *Summary of procedure.* A 350 ml. sample of the brake fluid is humidified under controlled conditions; 350 ml. of SAE triethylene glycol monomethyl ether, brake fluid grade, referee material (TEGME) as described in appendix E of SAE Standard J1703 NOV83 (incorporated by reference, see §571.5), is used to establish the end point for humidification. After humidification, the water content and ERBP of the brake fluid are determined.

S6.2.2 *Apparatus for humidification.* (See Figure 3).

Test apparatus shall consist of—

(a) *Glass jars.* Four SAE RM–49 corrosion test jars or equivalent screwtop, straight-sided, round glass jars each having a capacity of about 475 ml. and approximate inner dimensions of 100 mm. in height by 75 mm. in diameter, with matching lids having new, clean inserts providing water-vapor-proof seals;

(b) *Desiccator and cover.* Two bowl-form glass desiccators, 250-mm. inside diameter, having matching tubulated covers fitted with No. 8 rubber stoppers; and

(c) *Desiccator plate.* Two 230-mm. diameter, perforated porcelain desiccator plates, without feet, glazed on one side.

S6.2.3 *Reagents and materials.* (a) Distilled water, see S7.1.

(b) SAE TEGME referee material (see appendix E of SAE Standard J1703 NOV83 (incorporated by reference, see §571.5)).

S6.2.4 *Preparation of apparatus.* Lubricate the ground-glass joint of the desiccator. Pour 450 ±10 ml. of distilled water into each desiccator and insert perforated porcelain desiccator plates. Place the desiccators in an oven with temperature controlled at 50 ±1 °C. (122 ±1.8 °F.) throughout the humidification procedure.

S6.2.5 *Procedure.* Pour 350 ±5 ml. of brake fluid into an open corrosion test jar. Prepare in the same manner a duplicate test fluid sample and two duplicate specimens of the SAE TEGME referee material (350 ±5 ml. of TEGME in each jar). The water content of the SAE TEGME fluid is adjusted to 0.50 ±0.05 percent by weight at the start of the test in accordance with S7.2. Place one sample each of the test brake fluid and the prepared TEGME sample into the same desiccator. Repeat for the second sample of test brake fluid and TEGME in a second desiccator. Place the desiccators in the 50 °C. (122 °F.) controlled oven and replace desiccator covers. At intervals, during oven humidification, remove the rubber stoppers in the tops of desiccators. Using a long needled hypodermic syringe, take a sample of not more than 2 ml. from each TEGME sample and determine its water content. Remove no more than 10 ml. of fluid from each SAE TEGME sample during the humidification procedure. When the water content of the SAE fluid reaches 3.70 ±0.05 percent by weight (average of the duplicates). remove the two test fluid specimens from their desiccators and promptly cap each jar tightly. Allow the sealed jars to cool for 60 to 90 minutes at 23° ±5 °C. (73.4° ±9 °F.). Measure the water contents of the test fluid specimens in accordance with S7.2 and determine their ERBP's in accordance with S6.1. If the two ERBPs agree within 4 °C. (8 °F.), average them to determine the wet ERBP; otherwise repeat and average the four individual ERBPs as the wet ERBP of the brake fluid.

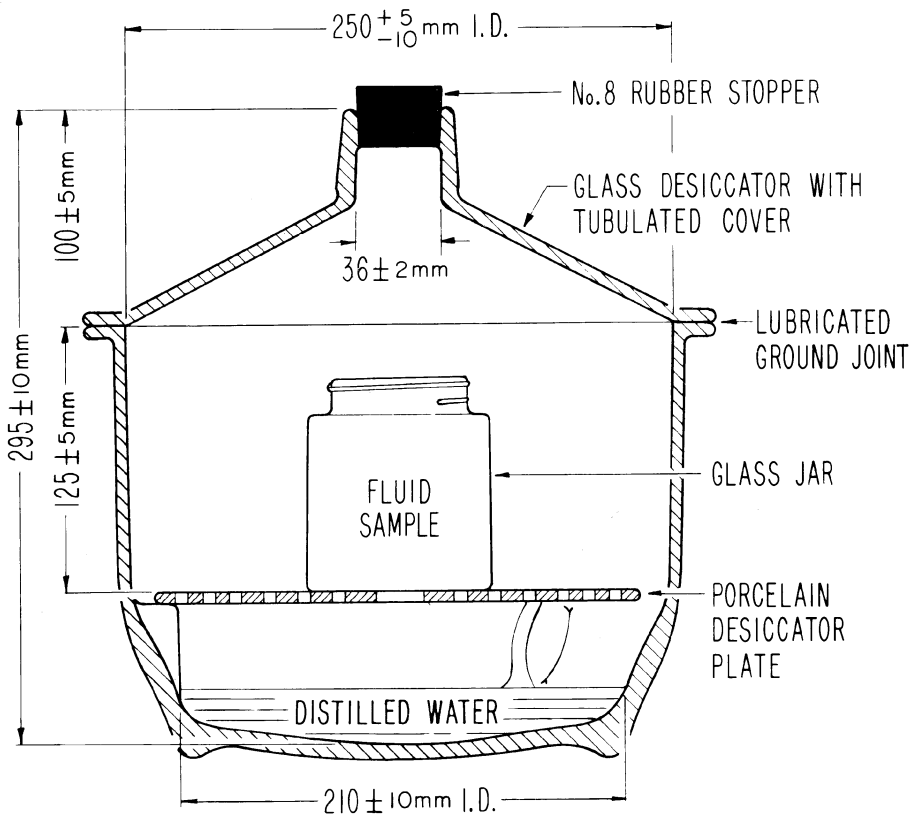


FIG. 3
HUMIDIFICATION APPARATUS

S6.3 *Kinematic viscosities.* Determine the kinematic viscosity of a brake fluid in mm^2/s by the following procedure. Run duplicate samples at each of the specified temperatures, making two timed runs on each sample.

S6.3.1 *Summary of the procedure.* The time is measured for a fixed volume of the brake fluid to flow through a calibrated glass capillary viscometer under an accurately reproducible head and at a closely controlled temperature. The kinematic viscosity is then calculated from the measured flow time and the calibration constant of the viscometer.

S6.3.2 *Apparatus.*

(a) *Viscometers.* Calibrated glass capillary-type viscometers, ASTM D2515–66 (incorporated by reference, see §571.5), measuring viscosity within the precision limits of S6.4.7. Use Cannon-Fenske Routine or other modified Ostwald viscometers at ambient temperatures and above.

(b) *Viscometer holders and frames.* Mount a viscometer in the constant-temperature bath so that the mounting tube is held within 1° of the vertical.

(c) *Viscometer bath.* A transparent liquid bath of sufficient depth such that at no time during the measurement will any portion of the sample in the

viscometer be less than 2 cm. below the surface or less than 2 cm. above the bottom. The bath shall be cylindrical in shape, with turbulent agitation sufficient to meet the temperature control requirements. For measurements within 15° to 100 °C. (60° to 212 °F.) the temperature of the bath medium shall not vary by more than 0.01 °C. (0.02 °F.) over the length of the viscometers, or between the positions of the viscometers, or at the locations of the thermometers. Outside this range, the variation shall not exceed 0.03 °C. (0.05 °F.).

(d) *Thermometers.* Liquid-in-Glass Kinematic Viscosity Test Thermometers, covering the range of test temperatures indicated in Table IV and conforming to ASTM E1–68 (incorporated by reference, see §571.5), and in the IP requirements for IP Standard Thermometers. Use two standardized thermometers in the bath.

TABLE IV—KINEMATIC VISCOSITY THERMOMETERS

Temperature range		For tests at		Subdivisions		Thermometer number	
°C.	°F.	°C.	°F.	°C.	°F.	ASTM	IP
Minus 55.3 to minus 52.5 ..	Minus 67.5 to minus 62.5	Minus 55 ..	Minus 67 ..	0.05	0.1	74 F	69 F. or C.
Minus 41.4 to minus 38.6 ..	Minus 42.5 to minus 37.5	Minus 40 ..	Minus 40 ..	0.05	0.1	73 F	68 F. or C.
98.6 to 101.4	207.5 to 212.5	100	212	0.05	0.1	30 F	32 F. or C.

(e) *Timing device.* Stop watch or other timing device graduated in divisions representing not more than 0.2 second, with an accuracy of at least ±0.05 percent when tested over intervals of 15 minutes. Electrical timing devices may be used when the current frequency is controlled to an accuracy of 0.01 percent or better.

S6.3.3 *Standardization.*

(a) *Viscometers.* Use viscometers calibrated in accordance with appendix 1 of ASTM D445–65 (incorporated by reference, see §571.5). The calibration constant, C, is dependent upon the gravitational acceleration at the place of calibration. This must, therefore, be supplied by the standardization laboratory together with the instrument constant. Where the acceleration of gravity, g, in the two locations differs by more than 0.1 percent, correct the calibration constant as follows:

$$C_2 = (g_2/g_1) \times C_1$$

where the subscripts 1 and 2 indicate respectively the standardization laboratory and the testing laboratory.

(b) *Thermometers.* Check liquid-in-glass thermometers to the nearest 0.01 °C. (0.02 °F.) by direct comparison with a standardized thermometer. Kinematic Viscosity Test Thermometers shall be standardized at ''total immersion.'' The ice point of standardized thermometers shall be determined before use and the official corrections shall be adjusted to conform to the changes in ice points. (See ASTM E77–66 (incorporated by reference, see §571.5)).

(c) *Timers.* Time signals are broadcast by the National Bureau of Standards, Station WWV, Washington, DC at 2.5, 5, 10, 15, 20, 25, 30, and 35 Mc/sec (MHz). Time signals are also broadcast by Station CHU from Ottawa, Canada, at 3.330, 7.335, and 14.670 Mc/sec, and Station MSF at Rugby, United Kingdom, at 2.5, 5, and 10 Mc/sec.

S6.3.4 *Procedure.* (a) Set and maintain the bath at the appropriate test temperature (see S5.1.3) within the limits specified in S6.3.2(c). Apply the necessary corrections, if any, to all thermometer readings.

(b) Select a clean, dry, calibrated viscometer giving a flow time not less than its specified minimum, or 200 seconds, whichever is the greater.

(c) Charge the viscometer in the manner used when the instrument was calibrated. Do not filter or dry the brake fluid, but protect it from contamination by dirt and moisture during filling and measurements.

(1) Charge the suspended level viscometers by tilting about 30° from the vertical and pouring sufficient brake fluid through the fill tube into the lower reservoir so that when the viscometer is returned to vertical position the meniscus is between the fill marks. For measurements below 0 °C.

(32 °F.), before placing the filled viscometer into the constant temperature bath, draw the sample into the working capillary and timing bulb and insert small rubber stoppers to suspend the fluid in this position, to prevent accumulation of water condensate on the walls of the critical portions of the viscometer. Alternatively, fit loosely packed drying tubes into the open ends of the viscometer to prevent water condensation, but do not restrict the flow of the sample under test by the pressures created in the instrument.

(2) If a Cannon-Fenske Routine viscometer is used, charge by inverting and immersing the smaller arm into the brake fluid and applying vacuum to the larger arm. Fill the tube to the upper timing mark, and return the viscometer to an upright position.

(d) Mount the viscometer in the bath in a true vertical position (see S6.3.2(b)).

(e) The viscometer shall remain in the bath until it reaches the test temperature.

(f) At temperatures below 0 °C. (32 °F.) conduct an untimed preliminary run by allowing the brake fluid to drain through the capillary into the lower reservoir after the test temperature has been established.

(g) Adjust the head level of the brake fluid to a position in the capillary arm about 5 mm. above the first timing mark.

(h) With brake fluid flowing freely measure to within 0.2 second the time required for the meniscus to pass from the first timing mark to the second. If this flow time is less than the minimum specified for the viscometer, or 200 seconds, whichever is greater, repeat using a viscometer with a capillary of smaller diameter.

(i) Repeat S6.3.4 (g) and (h). If the two timed runs do not agree within 0.2 percent, reject and repeat using a fresh sample of brake fluid.

S6.3.5 *Cleaning the viscometers.* (a) Periodically clean the instrument with chromic acid to remove organic deposits. Rinse thoroughly with distilled water and acetone, and dry with clean dry air.

(b) Between successive samples rinse the viscometer with ethanol (isopropanol when testing DOT 5 fluids) followed by an acetone or ether rinse. Pass a slow stream of filtered dry air through the viscometer until the last trace of solvent is removed.

S6.3.6 *Calculation.* (a) The following viscometers have a fixed volume charged at ambient temperature, and as a consequence *C* varies with test temperature: Cannon-Fenske Routine, Pinkevitch, Cannon-Manning Semi-Micro, and Cannon Fenske Opaque. To calculate C at test temperatures other than the calibration temperature for these viscometers, see ASTM D2515–66 (incorporated by reference, see §571.5) or follow instructions given on the manufacturer's certificate of calibration.

(b) Average the four timed runs on the duplicate samples to determine the kinematic viscosities.

S6.3.7 *Precision* (*at 95 percent confidence level*).

(a) *Repeatability.* If results on duplicate samples by the same operator differ by more than 1 percent of their mean, repeat the tests.

S6.4 *pH value.* Determine the pH value of a brake fluid by running one sample according to the following procedure.

S6.4.1 *Summary of the procedure.* Brake fluid is diluted with an equal volume of an ethanol-water solution. The pH of the resultant mixture is measured with a prescribed pH meter assembly at 23 °C. (73.4 °F.).

S6.4.2 *Apparatus.* The pH assembly consists of the pH meter, glass electrode, and calomel electrode, as specified in Appendices A1.1, A1.2, and A1.3 of ASTM D1121–67 (incorporated by reference, see §571.5). The glass electrode is a full range type (pH 0–14), with low sodium error.

S6.4.3 *Reagents.* Reagent grade chemicals conforming to the specifications of the Committee on Analytical Reagents of the American Chemical Society.

(a) *Distilled water.* Distilled water (S7.1) shall be boiled for about 15 minutes to remove carbon dioxide, and protected with a soda-lime tube or its equivalent while cooling and in storage. (Take precautions to prevent contamination by the materials used for protection against carbon dioxide.) The

pH of the boiled distilled water shall be between 6.2 and 7.2 at 25 °C. (77 °F.).

(b) *Standard buffer solutions.* Prepare buffer solutions for calibrating the pH meter and electrode pair from salts sold specifically for use, either singly or in combination, as pH standards. Dry salts for 1 hour at 110 °C. (230 °F.) before use except for borax which shall be used as the decahydrate. Store solutions with pH less than 9.5 in bottles of chemically resistant glass or polyethylene. Store the alkaline phosphate solution in a glass bottle coated inside with paraffin. Do not use a standard with an age exceeding three months.

(1) Potassium hydrogen phthalate buffer solution (0.05 M, pH = 4.01 at 25 °C. (77 °F.)). Dissolve 10.21 g. of potassium hydrogen phthalate ($KHC_8 H_4 O_4$) in distilled water. Dilute to 1 liter.

(2) Neutral phosphate buffer solution (0.025 M with respect to each phosphate salt, pH = 6.86 at 25 °C. (77 °F.)). Dissolve 3.40 g. of potassium dihydrogen phosphate ($KH_2 PO_4$) and 3.55 g. of anhydrous disodium hydrogen phosphate ($Na_2 HPO_4$) in distilled water.

(3) Borax buffer solution (0.01 M, pH = 9.18 at 25 °C. (77 °F.)). Dissolve 3.81 g. of disodium tetraborate decahydrate ($Na_2 B_4 O_7°10H_2O$) in distilled water, and dilute to 1 liter. Stopper the bottle except when actually in use.

(4) Alkaline phosphate buffer solution (0.01 M trisodium phosphate, pH = 11.72 at 25 °C. (77 °F.)). Dissolve 1.42 g. of anhydrous disodium hydrogen phosphate ($Na_2 HPO_4$) in 100 ml. of a 0.1 M carbonate-free solution of sodium hydroxide. Dilute to 1 liter with distilled water.

(5) Potassium chloride electrolyte. Prepare a saturated solution of potassium chloride (KCl) in distilled water.

(c) *Ethanol-water mixture.* To 80 parts by volume of ethanol (S7.3) add 20 parts by volume of distilled water. Adjust the pH of the mixture to 7 ±0.1 using 0.1 N sodium hydroxide (NaOH) solution. If more than 4 ml. of NaOH solution per liter of mixture is required for neutralization, discard the mixture.

S6.4.4 *Preparation of electrode system.*

(a) *Maintenance of electrodes.* Clean the glass electrode before using by immersing in cold chromic-acid cleaning solution. Drain the calomel electrode and fill with KCl electrolyte, keeping level above that of the mixture at all times. When not in use, immerse the lower halves of the electrodes in distilled water, and do not immerse in the mixture for any appreciable period of time between determinations.

(b) *Preparation of electrodes.* Condition new glass electrodes and those that have been stored dry as recommended by the manufacturer. Before and after using, wipe the glass electrode thoroughly with a clean cloth, or a soft absorbent tissue, and rinse with distilled water. Before each pH determination, soak the prepared electrode in distilled water for at least 2 minutes. Immediately before use, remove any excess water from the tips of the electrode.

S6.4.5 *Standardization of the pH assembly and testing of the electrodes.* (a) Immediately before use, standardize the pH assembly with a standard buffer solution. Then use a second standard buffer solution to check the linearity of the response of the electrodes at different pH values, and to detect a faulty glass electrode or incorrect temperature compensation. The two buffer solutions bracket the anticipated pH value of the test brake fluid.

(b) Allow instrument to warm up, and adjust according to the manufacturer's instructions. Immerse the tips of the electrodes in a standard buffer solution and allow the temperature of the buffer solution and the electrodes to equalize. Set the temperature knob at the temperature of the buffer solution. Adjust the standardization or asymmetry potential control until the meter registers a scale reading, in pH units, equal to the known pH of the standardizing buffer solution.

(c) Rinse the electrodes with distilled water and remove excess water from the tips. Immerse the electrodes in a second standard buffer solution. The reading of the meter shall agree with the known pH of the second standard buffer solution within ±0.05 unit without changing the setting of the standardization of asymmetry potential control.

(d) A faulty electrode is indicated by failure to obtain a correct value for the pH of the second standard buffer solution after the meter has been standardized with the first.

S6.4.6 *Procedure.* To 50 ±1 ml. of the test brake fluid add 50 ±1 ml. of the ethanol-water (S6.4.3(c)) and mix thoroughly. Immerse the electrodes in the mixture. Allow the system to come to equilibrium, readjust the temperature compensation if necessary, and take the pH reading.

S6.5 *Fluid stability.* Evaluate the heat and chemical stability of a brake fluid by the following procedure, running duplicate samples for each test and averaging the results.

S6.5.1 *Summary of the procedure.* The degradation of the brake fluid at elevated temperature, alone or in a mixture with a reference fluid, is evaluated by determining the change in boiling point after a period of heating under reflux conditions.

S6.5.2 *Apparatus.* Use the apparatus and preparation specified in S6.1.2 and S6.1.3.

S6.5.3 *High temperature stability.*

S6.5.3.1 *Procedure.* (a) Heat a new 60 ±1 ml. sample of the brake fluid to 185° ±2 °C. (365° ±3.6 °F.). Hold at this temperature for 120 ±5 minutes. Bring to a reflux rate in excess of 1 drop per second within 5 minutes. The reflux rate should not exceed 5 drops per second at any time. Over the next 5 ±2 minutes adjust the heating rate to obtain an equilibrium reflux rate of 1 to 2 drops per second. Maintain this rate for an additional 2 minutes, taking four temperature readings at 30–second intervals. Average these as the observed ERBP. If no reflux is evident when the fluid temperature reaches 260 °C. (500 °F), discontinue heating and report ERBP as in excess of 260 °C. (500 °F.).

S6.5.3.2 *Calculation.* Correct the observed ERBP for thermometer and barometric pressure factors according to S6.1.5 (a) and (b). Average the corrected ERBP's of the duplicate samples. The difference between this average and the original ERBP obtained in S6.1 is the change in ERBP of the fluid.

S6.5.4 *Chemical stability.*

S6.5.4.1 *Materials.* SAE RM–66–04 Compatibility Fluid as described in appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see § 571.5).

S6.5.4.2 *Procedure.* (a) Mix 30 ±1 ml. of the brake fluid with 30 ±1 ml. of SAE RM–66–04 Compatibility Fluid in a boiling point flask (S6.1.2(a)). Determine the initial ERBP of the mixture by applying heat to the flask so that the fluid is refluxing in 10 ±2 minutes at a rate in excess of 1 drop per second, but not more than 5 drops per second. Note the maximum fluid temperature observed during the first minute after the fluid begins refluxing at a rate in excess of 1 drop per second. Over the next 15 ±1 minutes, adjust and maintain the reflux rate at 1 to 2 drops per second. Maintain this rate for an additional 2 minutes, recording the average value of four temperature readings taken at 30 second intervals as the final ERBP.

(b) Thermometer and barometric corrections are not required.

S6.5.4.3 *Calculation.* The difference between the initial ERBP and the final average temperature is the change in temperature of the refluxing mixture. Average the results of the duplicates to the nearest 0.5 °C (1.0 °F).

S6.6 *Corrosion.* Evaluate the corrosiveness of a brake fluid by running duplicate samples according to the following procedure.

S6.6.1 *Summary of the procedure.* Six specified metal corrosion test strips are polished, cleaned, and weighed, then assembled as described. Assembly is placed on a standard wheel cylinder cup in a corrosion test jar, immersed in the water-wet brake fluid, capped and placed in an oven at 100 °C. (212 °F.) for 120 hours. Upon removal and cooling, the strips, fluid, and cups are examined and tested.

S6.6.2 *Equipment.* (a) *Balance.* An analytical balance having a minimum capacity of 50 grams and capable of weighing to the nearest 0.1 mg.

(b) *Desiccators.* Desiccators containing silica gel or other suitable desiccant.

(c) *Oven.* Gravity convection oven capable of maintaining the desired set point within 2 °C. (3.6 °F.).

(d) *Micrometer.* A machinist's micrometer 25 to 50 mm. (1 to 2 inches) capacity, or an optical comparator, capable of measuring the diameter of the SBR wheel cylinder (WC) cups to the nearest 0.02 mm. (0.001 inch).

S6.6.3 *Materials.* (a) *Corrosion test strips.* Two sets of strips from each of the metals listed in Appendix C of SAE Standard J1703b (1970) (incorporated by reference, see § 571.5). Each strip shall

be approximately 8 cm. long, 1.3 cm. wide, not more than 0.6 cm. thick, and have a surface area of 25 ±5 sq. cm. and a hole 4 to 5 mm. (0.16 to 0.20 inch) in diameter on the centerline about 6 mm. from one end. The hole shall be clean and free from burrs. Tinned iron strips shall be unused. Other strips, if used, shall not be employed if they cannot be polished to a high finish.

(b) *SBR cups.* Two unused standard SAE SBR wheel cylinder (WC) cups, as specified in S7.6.

(c) *Corrosion test jars and lids.* Two screw-top straight-sided round glass jars, each having a capacity of approximately 475 ml. and inner dimensions of approximately 100 mm. in height and 75 mm. in diameter, and a tinned steel lid (no insert or organic coating) vented with a hole 0.8 ±0.1 mm. (0.031 ±0.004 inch) in diameter (No. 68 drill).

(d) *Machine screws and nuts.* Clean, rust and oil-free, uncoated mild steel round or fillister head machine screws, size 6 or 8–32 UNC-Class 2A, five-eighths or three-fourths inch long (or equivalent metric sizes), and matching uncoated nuts.

(e) *Supplies for polishing strips.* Waterproof silicon carbide paper, grit No. 320A and grit 1200; lint-free polishing cloth.

(f) *Distilled water* as specified in S7.1.

(g) *Ethanol* as specified in S7.3.

(h) Isopropanol as specified in S7.7.

S6.6.4 *Preparation.*

(a) *Corrosion test strips.* Except for the tinned iron strips, abrade corrosion test strips on all surface areas with 320A silicon carbide paper wet with ethanol (isopropanol when testing DOT 5 SBBF fluids) until all surface scratches, cuts and pits visible to an observer having corrected visual acuity of 20/40 (Snellen ratio) at a distance of 300 mm (11.8 inches) are removed. Use a new piece of paper for each different type of metal. Except for the tinned iron strips, further abrade the test strips on all surface areas with 1200 silicon carbide paper wet with ethanol (isopropanol when testing DOT 5 SBBF fluids), again using a new piece of paper for each different type of metal. Handle the strips with forceps after polishing. Weigh and record the weight of each strip to the nearest 0.1 mg. Assemble the strips on a clean dry machine screw, with matching plain nut, in the order of tinned iron, steel, aluminum, cast iron, brass, and copper. Bend the strips, other than the cast iron, so that there is a separation of 3 ±½ mm. (⅛ ±1/64 inch) between adjacent strips for a distance of about 5 cm. (2 inches) from the free end of the strips. (See Figure 4.) Tighten the screw on each test strip assembly so that the strips are in electrolytic contact, and can be lifted by either of the outer strips (tinned iron or copper) without any of the strips moving relative to the others when held horizontally. Immerse the strip assemblies in 90 percent ethyl alcohol. Dry with dried filtered compressed air, then desiccate at least 1 hour before use.

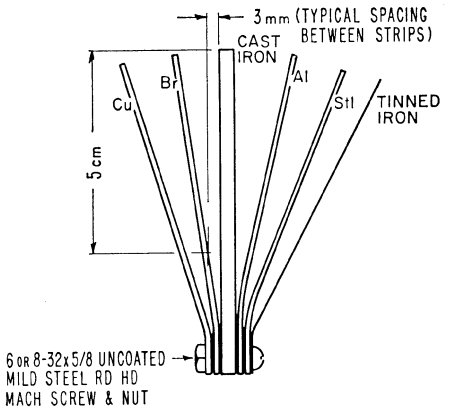


FIG. 4—CORROSION STRIP ASSEMBLY

(b) *SBR WC cups.* Measure the base diameters of the two standard SBR cups, using an optical comparator or micrometer, to the nearest 0.02 mm. (0.001 inch) along the centerline of the SAE and rubber-type identifications and at right angles to this centerline. Take the measurements at least 0.4 mm. (0.015 inch) above the bottom edge and parallel to the base of the cup. Discard any cup if the two measured diameters differ by more than 0.08 mm. (0.003 inch). Average the two readings on each cup. Determine the hardness of the cups according to S7.4.

S6.6.5 *Procedure.* Rinse the cups in ethanol (isopropanol when testing DOT 5 SBBF fluids) for not more than 30 seconds and wipe dry with a clean lint-free cloth. Place one cup with lip edge

facing up, in each jar. Insert a metal strip assembly inside each cup with the fastened end down and the free end extending upward. (See Figure 5.) When testing brake fluids, except DOT 5 SBBF, mix 760 ml. of brake fluid with 40 ml. of distilled water. When testing DOT 5 SBBF's, humidify 800 ml. of brake fluid in accordance with S6.2, eliminating determination of the ERBP. Using this water-wet mixture, cover each strip assembly to a minimum depth of 10 mm. above the tops of the strips. Tighten the lids and place the jars for 120 ±2 hours in an oven maintained at 100° ±2 °C. (212° ±3.6 °F.). Allow the jars to cool at 23° ±5 °C. (73.4° ±9 °F.) for 60 to 90 minutes. Immediately remove the strips from the jars using forceps, agitating the strip assembly in the fluid to remove loose adhering sediment. Examine the test strips and jars for adhering crystalline deposits. Disassemble the metal strips, and remove adhering fluid by flushing with water; clean each strip by wiping with a clean cloth wetted with ethanol (isopropanol when testing DOT 5 fluids). Examine the strips for evidence of corrosion and pitting. Disregard staining or discoloration. Place the strips in a desiccator containing silica gel or other suitable desiccant, maintained at 23° ±5 °C. (73.4° ±9 °F.), for at least 1 hour. Weigh each strip to the nearest 0.1 mg. Determine the change in weight of each metal strip. Average the results for the two strips of each type of metal. Immediately following the cooling period, remove the cups from the jars with forceps. Remove loose adhering sediment by agitation of the cups in the mixture. Rinse the cups in ethanol (isopropanol when testing DOT 5 fluids) and air-dry. Examine the cups for evidence of sloughing, blisters, and other forms of disintegration. Measure the base diameter and hardness of each cup within 15 minutes after removal from the mixture. Examine the mixture for gelling. Agitate the mixture to suspend and uniformly disperse sediment. From each jar, transfer a 100 ml. portion of the mixture to an ASTM cone-shaped centrifuge tube. Determine the percent sediment after centrifuging as described in S7.5. Measure the pH value of the corrosion text fluid according to S6.4.6. Measure the pH value of the test mixture according to S6.4.6.

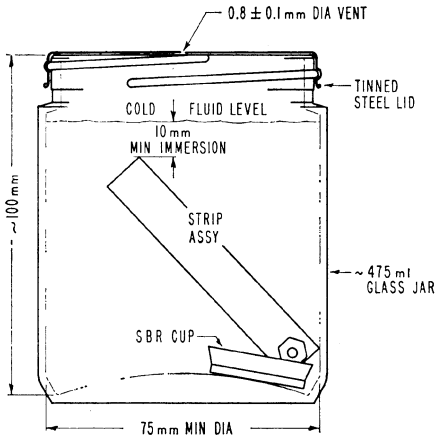


FIG. 5—CORROSION TEST APPARATUS

S6.6.6 *Calculation.* (a) Measure the area of each type of test strip to the nearest square centimeter. Divide the average change in mass for each type by the area of that type.

(b) Note other data and evaluations indicating compliance with S5.1.6. In the event of a marginal pass on inspection by attributes, or of a failure in one of the duplicates, run another set of duplicate samples. Both repeat samples shall meet all requirements of S5.1.6.

S6.7 *Fluidity and appearance at low temperatures.* Determine the fluidity and appearance of a sample of brake fluid at each of two selected temperatures by the following procedure.

S6.7.1 *Summary of procedure.* Brake fluid is chilled to expected minimum exposure temperatures and observed for clarity, gellation, sediment, separation of components, excessive viscosity or thixotropy.

S6.7.2 *Apparatus.* (a) *Oil sample bottle.* Two clear flint glass 4–ounce bottles made especially for sampling oil and other liquids, with a capacity of approximately 125 ml., an outside diameter of 37 ±0.05 mm. and an overall height of 165 ±2.5 mm.

(b) *Cold chamber.* An air bath cold chamber capable of maintaining storage temperatures down to minus 55 °C. (minus 67 °F.) with an accuracy of ±2 °C. (3.6 °F.).

(c) *Timing device.* A timing device in accordance with S6.3.2(e).

S6.7.3 *Procedure.* (a) Place 100 ±1 ml. of brake fluid at room temperature in an oil sample bottle. Stopper the bottle with an unused cork and place in the cold chamber at the higher storage temperature specified in Table II (S5.1.7(c)). After 144 ±4 hours remove the bottle from the chamber, quickly wipe it with a clean, lint-free cloth, saturated with ethanol (isopropanol when testing DOT 5 fluids) or acetone. Examine the fluid for evidence of sludging, sedimentation, crystallization, or stratification. Invert the bottle and determine the number of seconds required for the air bubble to travel to the top of the fluid. Let sample warm to room temperature and examine.

(b) Repeat S6.7.3(a), substituting the lower cold chamber temperature specified in Table II, and a storage period of 6 hours ±12 minutes.

NOTE: Test specimens from either storage temperature may be used for the other only after warming up to room temperature.

S6.8 [Reserved]

S6.9 *Water tolerance.* Evaluate the water tolerance characteristics of a brake fluid by running one test specimen according to the following procedure.

S6.9.1 *Summary of the procedure.*

Brake fluid, except DOT 5 SBBF, is diluted with 3.5 percent water (DOT 5 SBBF is humidified), then stored at minus 40 °C. (minus 40 °F.) for 120 hours. The cold, water-wet fluid is first examined for clarity, stratification, and sedimentation, then placed in an oven at 60 °C. (140 °F.) for 24 hours. On removal, it is again examined for stratification, and the volume percent of sediment determined by centrifuging.

S6.9.2 *Apparatus.*

(a) *Centrifuge tube.* See S7.5.1(a).

(b) *Centrifuge.* See S7.5.1(b).

(c) *Cold chamber.* See S6.7.2(b).

(d) *Oven.* Gravity or forced convection oven.

(e) *Timing device.* See S6.3.2(e).

S6.9.3 *Procedure.*

(a) *At low temperature.* Humidify 100 ±1 ml. of DOT 5 SBBF brake fluid in accordance with S6.2 eliminating determination of the ERBP. When testing brake fluids except DOT 5 SBBF, mix 3.5 ±0.1 ml. of distilled water with 100 ±1 ml. of the brake fluid; pour into a centrifuge tube. Stopper the tube with a clean cork and place in the cold chamber maintained at minus 40 ±2 °C. (minus 40 ±3.6 °F.). After 120 hours ±2 hours remove the tube, quickly wipe with clean lint-free cloth saturated with ethanol or acetone and examine the fluid for evidence of sludging, sedimentation, crystallization, or stratification. Invert the tube and determine the number of seconds required for the air bubble to travel to the top of the fluid. (The air bubble is considered to have reached the top of the fluid when the top of the bubble reaches the 2 ml. graduation of the centrifuge tube.) If the wet fluid has become cloudy, warm to 23 ±5 °C. (73.4 ±9 °F.) and note appearance and fluidity.

(b) *At 60 °C. (140 °F.).* Place tube and brake fluid from S6.9.3(a) in an oven maintained at 60° ±2 °C. (140° ±3.6 °F.) for 24 ±2 hours. Remove the tube and immediately examine the contents for evidence of stratification. Determine the percent sediment by centrifuging as described in S7.5.

S6.10 *Compatibility.* The compatibility of a brake fluid with other brake fluids shall be evaluated by running one test sample according to the following procedure.

S6.10.1 *Summary of the procedure.*

Brake fluid is mixed with an equal volume of SAE RM–66–04 Compatibility Fluid, then tested in the same way as for water tolerance (S6.9) except that the bubble flow time is not measured. This test is an indication of the compatibility of the test fluid with other motor vehicle brake fluids at both high and low temperatures.

S6.10.2 *Apparatus and materials.*

(a) *Centrifuge tube.* See S7.5.1(a).

(b) *Centrifuge.* See S7.5.1(b).

(c) *Cold Chamber.* See S6.7.2(b)

(d) *Oven.* See S6.9.2(d)

(e) *SAE RM–66–04 Compatibility Fluid.* As described in appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see §571.5).

S6.10.3 *Procedure.*

(a) *At low temperature.*

Mix 50 ±0.5 mL of brake fluid with 50 ±0.5 mL of SAE RM–66–04 Compatibility Fluid. Pour this mixture into a centrifuge tube and stopper with a clean

dry cork. Place tube in the cold chamber maintained at minus 40° ±2 °C. (minus 40° ±4 °F). After 24 ±2 hours, remove tube, quickly wipe with a clean lint-free cloth saturated with ethanol (isopropanol when testing DOT 5 fluids) or acetone. Examine the test specimen for evidence of slugging, sedimentation, or crystallization. Test fluids, except DOT 5 SBBF, shall be examined for stratification.

S6.11 *Resistance to oxidation.* The stability of a brake fluid under oxidative conditions shall be evaluated by running duplicate samples according to the following procedure.

S6.11.1 *Summary of procedure.*

Brake fluids, except DOT 5 SBBF, are activated with a mixture of approximately 0.2 percent benzoyl peroxide and 5 percent water. DOT 5 SBBF is humidified in accordance with S6.2 eliminating determination of the ERBP, and then approximately 0.2 percent benzoyl peroxide is added. A corrosion test strip assembly consisting of cast iron and an aluminum strip separated by tinfoil squares at each end is then rested on a piece of SBR WC cup positioned so that the test strip is half immersed in the fluid and oven aged at 70 °C. (158 °F.) for 168 hours. At the end of this period, the metal strips are examined for pitting, etching, and loss of mass.

S6.11.2 *Equipment.*

(a) *Balance.* See S6.6.2(a).

(b) *Desiccators.* See S6.6.2(b).

(c) *Oven.* See S6.6.2(c).

(d) Three glass test tubes approximately 22 mm. outside diameter by 175 mm. in length.

S6.11.3 *Reagents and materials.*

(a) *Benzoyl peroxide, reagent grade, 96 percent.* (Benzoyl peroxide that is brownish, or dusty, or has less than 90 percent purity, must be discarded.) Reagent strength may be evaluated by ASTM E298–68 (incorporated by reference, see § 571.5).

(b) *Corrosion test strips.* Two sets of cast iron and aluminum metal test strips as described in appendix C of SAE Standard J1703b (1970) (incorporated by reference, see § 571.5).

(c) *Tinfoil.* Four unused pieces of tinfoil approximately 12 mm. (½ inch) square and between 0.02 and 0.06 mm. (0.0008 and 0.0024 inch) in thickness. The foil shall be at least 99.9 percent tin and contain not more than 0.025 percent lead.

(d) *SBR cups.* Two unused, approximately one-eighth sections of a standard SAE SBR WC cup (as described in S7.6).

(e) *Machine screw and nut.* Two clean oil-free, No. 6 or 8–32 × ⅜– or ½–inch long (or equivalent metric size), round or fillister head, uncoated mild steel machine screws, with matching plain nuts.

S6.11.4 *Preparation.*

(a) *Corrosion test strips.* Prepare two sets of aluminum and cast iron test strips according to S6.6.4(a) except for assembly. Weigh each strip to the nearest 0.1 mg. and assemble a strip of each metal on a machine screw, separating the strips at each end with a piece of tinfoil. Tighten the nut enough to hold both pieces of foil firmly in place.

(b) *Test mixture.* Place 30 ±1 ml. of the brake fluid under test in a 22 by 175 mm. test tube. For all fluids except DOT 5 SBBF, add 0.060 ±.002 grams of benzoyl peroxide, and 1.50 ±0.05 ml. of distilled water. For DOT 5 SBBF, use test fluid humidified in accordance with S6.2, and add only the benzoyl peroxide. Stopper the tube loosely with a clean dry cork, shake, and place in an oven for 2 hours at 70° ±2 °C. (158° ±3.6 °F.). Shake every 15 minutes to effect solution of the peroxide, but do not wet cork. Remove the tube from the oven and allow to cool to 23° ±5 °C. (73.4° ±9 °F.) Begin testing according to paragraph S6.11.5 not later than 24 hours after removal of tube from oven.

S6.11.5 *Procedure.* Place a one-eighth SBR cup section in the bottom of each tube. Add 10 ml. of prepared test mixture to each test tube. Place a metal-strip assembly in each, the end of the strip without the screw resting on the rubber, and the solution covering about one-half the length of the strips. Stopper the tubes with clean dry corks and store upright for 70 ±2 hours at 23° ±5 °C. (73.4° ±9 °F.). Loosen the corks and place the tubes for 168 ±2 hours in an oven maintained at 70° ±2 °C. (158° ±3.6 °F.). Afterwards remove and disassemble strips. Examine the strips and note any gum deposits. Wipe the strips with a clean cloth wet with ethanol (isopropanol when testing DOT 5 fluids) and note any pitting, etching or

roughening of surface disregarding stain or discoloration. Place the strips in a desiccator over silica gel or other suitable desiccant, at 23° ±5 °C. (73.4° ±9 °F.) for at least 1 hour. Again weigh each strip to the nearest 0.1 mg.

S6.11.6 *Calculation.* Determine corrosion loss by dividing the change in mass of each metal strip by the total surface area of each strip measured in square millimeters (mm^2), to the nearest square millimeter (mm^2). Average the results for the two strips of each type of metal, rounding to the nearest 0.05 mg. per 100 square millimeter (mm^2). If only one of the duplicates fails for any reason, run a second set of duplicate samples. Both repeat samples shall meet all requirements of S5.1.11.

S6.12 *Effect on SBR cups.* The effects of a brake fluid in swelling, softening, and otherwise affecting standard SBR WC cups shall be evaluated by the following procedure.

S6.12.1 *Summary of the procedure.* Four standard SAE SBR WC cups are measured and their hardnesses determined. The cups, two to a jar, are immersed in the test brake fluid. One jar is heated for 70 hours at 70 °C. (158 °F), and the other for 70 hours at 120 °C (248 °F). Afterwards, the cups are washed, examined for disintegration, remeasured and their hardnesses redetermined.

S6.12.2 *Equipment and supplies.*

(a) *Oven.* See S6.6.2(c).

(b) *Glass jars and lids.* Two screw-top, straight-sided round glass jars, each having a capacity of approximately 250 ml. and inner dimensions of approximately 125 mm. in height and 50 mm. in diameter, and a tinned steel lid (no insert or organic coating).

(c) *SBR cups.* See S7.6.

S6.12.3 *Preparation.* Measure the base diameters of the SBR cups as described in S6.6.4(b), and the hardness of each as described in S7.4.

S6.12.4 *Procedure.* Wash the cups in 90 percent ethanol (isopropanol when testing DOT 5 fluids) (see S7.3), for not longer than 30 seconds and quickly dry with a clean, lint-free cloth. Using forceps, place two cups into each of the two jars; add 75 ml. of brake fluid to each jar and cap tightly. Place one jar in an oven held at 70° ±2 °C. (158 ±3.6 °F.) for 70 ±2 hours. Place the other jar in an oven held at 120° ±2 °C. (248° ±3.6 °F.) for 70 ±2 hours. Allow each jar to cool for 60 to 90 minutes at 23° ±5 °C. (73.4° ±9 °F.). Remove cups, wash with ethanol (isopropanol when testing DOT 5 fluids) for not longer than 30 seconds, and quickly dry. Examine the cups for disintegration as evidenced by stickiness, blisters, or sloughing. Measure the base diameter and hardness of each cup within 15 minutes after removal from the fluid.

S6.12.5 *Calculation.* (a) Calculate the change in base diameter for each cup. If the two values, at each temperature, do not differ by more than 0.10 mm. (0.004 inch) average them to the nearest 0.02 mm. (0.001 inch). If the two values differ by more than 0.10 mm., repeat the test at the appropriate temperature and average the four values as the change in base diameter.

(b) Calculate the change in hardness for each cup. The average of the two values for each pair is the change in hardness.

(c) Note disintegration as evidenced by stickiness, blisters, or sloughing.

S6.13 *Stroking properties.* Evaluate the lubricating properties, component compatibility, resistance to leakage, and related qualities of a brake fluid by running one sample according to the following procedures.

S6.13.1 *Summary of the procedure.* Brake fluid is stroked under controlled conditions at an elevated temperature in a simulated motor vehicle hydraulic braking system consisting of three slave wheel cylinders and an actuating master cylinder connected by steel tubing. Referee standard parts are used. All parts are carefully cleaned, examined, and certain measurements made immediately prior to assembly for test. During the test, temperature, rate of pressure rise, maximum pressure, and rate of stroking are specified and controlled. The system is examined periodically during stroking to assure that excessive leakage of fluid is not occurring. Afterwards, the system is torn down. Metal parts and SBR cups are examined and remeasured. The brake fluid and any resultant sludge and debris are collected, examined, and tested.

S6.13.2 *Apparatus and equipment.*

Either the drum and shoe type of stroking apparatus (see Figure 1 of SAE Standard J1703b (1970) (incorporated by reference, see §571.5)), except using only three sets of drum and shoe assemblies, or the stroking fixture type apparatus as shown in Figure 2 of SAE Standard J1703 NOV83 (incorporated by reference, see §571.5) with the components arranged as shown in Figure 1 of SAE Standard J1703 NOV83. The following components are required.

(a) *Brake assemblies.* With the drum and shoe apparatus: three drum and shoe assembly units (SAE RM–29a) consisting of three forward brake shoes and three reverse brake shoes with linings and three front wheel brake drum assemblies with assembly component parts. With stroking fixture type apparatus: three fixture units including appropriate adapter mounting plates to hold brake wheel cylinder assemblies.

(b) *Braking pressure actuation mechanism.* An actuating mechanism for applying a force to the master cylinder pushrod without side thrust. The amount of force applied by the actuating mechanism shall be adjustable and capable of applying sufficient thrust to the master cylinder to create a pressure of at least 6895 kPa (1,000 p.s.i.) in the simulated brake system. A hydraulic gage or pressure recorder, having a range of at least 0 to 6895 kPa (0 to 1,000 p.s.i), shall be installed between the master cylinder and the brake assemblies and shall be provided with a shutoff valve and with a bleeding valve for removing air from the connecting tubing. The actuating mechanism shall be designed to permit adjustable stroking rates of approximately 1,000 strokes per hour. Use a mechanical or electrical counter to record the total number of strokes.

(c) *Heated air bath cabinet.* An insulated cabinet or oven having sufficient capacity to house the three mounted brake assemblies or stroking fixture assemblies, master cylinder, and necessary connections. A thermostatically controlled heating system is required to maintain a temperature of 70° ±5 °C (158° ±9 °F) or 120° ±5 °C (248° ±9 °F). Heaters shall be shielded to prevent direct radiation to wheel or master cylinder.

(d) *Master cylinder (MC) assembly (SAE RM–15a).* One cast iron housing hydraulic brake system cylinder having a diameter of approximately 28 mm. (1⅛ inch) and fitted for a filler cap and standpipe (see S6.13.2(e)). The MC piston shall be made from SAE CA360 copperbase alloy (half hard). A new MC assembly is required for each test.

(e) *Filler cap and standpipe.* MC filler cap provided with a glass or uncoated steel standpipe. Standpipe must provide adequate volume for thermal expansion, yet permit measurement and adjustment of the fluid level in the system to ±3 ml. Cap and standpipe may be cleaned and reused.

(f) *Wheel cylinder (WC) assemblies (SAE RM–14a).* Three unused cast iron housing straight bore hydraulic brake WC assemblies having diameters of approximately 28 mm (1⅛ inch) for each test. Pistons shall be made from unanodized SAE AA 2024 aluminum alloy.

(g) *Micrometer.* Same as S6.6.2(d).

S6.13.3 *Materials.*

(a) *Standard SBR brake cups.* Six standard SAE SBR wheel cylinder test cups, one primary MC test cup, and one secondary MC test cup, all as described in S7.6, for each test.

(b) *Steel tubing.* Double wall steel tubing meeting SAE Standard J527a (1967) (incorporated by reference, see §571.5). A complete replacement of tubing is essential when visual inspection indicates any corrosion or deposits on inner surface of tubing. Tubing from master cylinder to one wheel cylinder shall be replaced for each test (minimum length .9 m.) Uniformity in tubing size is required between master cylinder and wheel cylinder. The standard master cylinder has two outlets for tubing, both of which must be used.

S6.13.4 *Preparation of test apparatus.*

(a) *Wheel cylinder assemblies.* Use unused wheel cylinder assemblies. Disassemble cylinders and discard cups. Clean all metal parts with ethanol (isopropanol when testing DOT 5 fluids). Inspect the working surfaces of all metal parts for scoring, galling, or pitting and cylinder bore roughness, and discard all defective parts. Remove any stains on cylinder walls with crocus cloth and ethanol (isopropanol when testing DOT 5 fluids). If stains

cannot be removed, discard the cylinder. Measure the internal diameter of each cylinder at a location approximately 19 mm. (0.75 inch) from each end of the cylinder bore, taking measurements in line with the hydraulic inlet opening and at right angles to this centerline. Discard the cylinder if any of these four readings exceeds the maximum or minimum limits of 28.66 to 28.60 mm. (1.128 to 1.126 inch). Measure the outside diameter of each piston at two points approximately 90° apart. Discard any piston if either reading exceeds the maximum or minimum limits of 28.55 to 28.52 mm. (1.124 to 1.123 inch). Select parts to insure that the clearance between each piston and mating cylinder is within 0.08 to 0.13 mm. (0.003 to 0.005 inch). Use unused SBR cups. To remove dirt and debris, rinse the cups in 90 percent ethyl alcohol for not more than 30 seconds and wipe dry with a clean lint-free cloth. Discard any cups showing defects such as cuts, molding flaws, or blisters. Measure the lip and base diameters of all cups with an optical comparator or micrometer to the nearest 0.02 mm. (0.001 inch) along the centerline of the SAE and rubber-type identifications and at right angles to this centerline. Determine base diameter measurements at least 0.4 mm. (0.015 inch) above the bottom edge and parallel to the base of the cup. Discard any cup if the two measured lip or base diameters differ by more than 0.08 mm. (0.003 inch). Average the lip and base diameters of each cup. Determine the hardness of all cups according to S7.4. Dip the rubber and metal parts of wheel cylinders, except housing and rubber boots, in the fluid to be tested and install them in accordance with the manufacturer's instructions. Manually stroke the cylinders to insure that they operate easily. Install cylinders in the simulated brake system.

(b) *Master cylinder assembly.* Use an unused master cylinder and unused standard SBR primary and secondary MC cups which have been inspected, measured and cleaned in the manner specified in S6.13.4(a), omitting hardness of the secondary MC cup. However, prior to determining the lip and base diameters of the secondary cup, dip the cup in test brake fluid, assemble on the MC piston, and maintain the assembly in a vertical position at 23° ±5 °C. (73.4° ±9 °F.) for at least 12 hours. Inspect the relief and supply ports of the master cylinder; discard the cylinder if ports have burrs or wire edges. Measure the internal diameter of the cylinder at two locations (approximately midway between the relief and supply ports and approximately 19 mm. (0.75 inch) beyond the relief port toward the bottom or discharge end of the bore), taking measurements at each location on the vertical and horizontal centerline of the bore. Discard the cylinder if any reading exceeds the maximum or minimum limits of 28.65 to 28.57 mm. (1.128 to 1.125 inch). Measure the outside diameter of each end of the master cylinder piston at two points approximately 90° apart. Discard the piston if any of these four readings exceed the maximum or minimum limits of 28.55 to 28.52 mm. (1.124 to 1.123 inch). Dip the rubber and metal parts of the master cylinder, except the housing and push rod-boot assembly, in the brake fluid and install in accordance with manufacturer's instructions. Manually stroke the master cylinder to insure that it operates easily. Install the master cylinder in the simulated brake system.

(c) *Assembly and adjustment of test apparatus.*

(1) When using a shoe and drum type apparatus, adjust the brake shoe toe clearances to 1.0 ±0.1 mm (0.040 ±0.004 inch). Fill the system with brake fluid, bleeding all wheel cylinders and the pressure gage to remove entrapped air. Operate the actuator manually to apply a pressure greater than the required operating pressure and inspect the system for leaks. Adjust the actuator and/or pressure relief valve to obtain a pressure of 6895 kPa ±345 kPa (1,000 ±50 p.s.i.). A smooth pressure stroke pattern is required when using a shoe and drum type apparatus. The pressure is relatively low during the first part of the stroke and then builds up smoothly to the maximum stroking pressure at the end of the stroke, to permit the primary cup to pass the compensating hole at a relatively low pressure. Using stroking fixtures, adjust the actuator and/or pressure relief valve to obtain a pressure of 6895 kPa ±345 kPa (1,000 ±50 p.s.i.).

(2) Adjust the stroking rate to 1,000 ±100 strokes per hour. Record the fluid level in the master cylinder standpipe.

S6.13.5 *Procedure.* Operate the system for 16,000 ±1,000 cycles at 23° ±5 °C. (73.4° ±9 °F.). Repair any leakage, readjust the brake shoe clearances, and add fluid to the master cylinder standpipe to bring to the level originally recorded, if necessary. Start the test again and raise the temperature of the cabinet within 6 ±2 hours to 120° ±5 °C. (248° ±9 °F.). During the test observe operation of wheel cylinders for improper functioning and record the amount of fluid required to replenish any loss, at intervals of 24,000 strokes. Stop the test at the end of 85,000 total recorded strokes. These totals shall include the number of strokes during operation at 23° ±5 °C. (73.4° ±9 °F.) and the number of strokes required to bring the system to the operating temperature. Allow equipment to cool to room temperature. Examine the wheel cylinders for leakage. Stroke the assembly an additional 100 strokes, examine wheel cylinders for leakage and record volume loss of fluid. Within 16 hours after stopping the test, remove the master and wheel cylinders from the system, retaining the fluid in the cylinders by immediately capping or plugging the ports. Disassemble the cylinders, collecting the fluid from the master cylinder and wheel cylinders in a glass jar. When collecting the stroked fluid, remove all residue which has deposited on rubber and metal internal parts by rinsing and agitating such parts in the stroked fluid and using a soft brush to assure that all loose adhering sediment is collected. Clean SBR cups in ethanol (isopropanol when testing DOT 5 fluids) and dry. Inspect the cups for stickiness, scuffing, blistering, cracking, chipping, and change in shape from original appearance. Within 1 hour after disassembly, measure the lip and base diameters of each cylinder cup by the procedures specified in S6.13.4 (a) and (b) with the exception that lip or base diameters of cups may now differ by more than 0.08 mm. (0.003 inch). Determine the hardness of each cup according to S7.4. Note any sludge or gel present in the test fluid. Within 1 hour after draining the cylinders, agitate the fluid in a glass jar to suspend and uniformly disperse sediment and transfer a 100 ml. portion of this fluid to a centrifuge tube and determine percent sediment as described in S7.5. Allow the tube and fluid to stand for 24 hours, recentrifuge and record any additional sediment recovered. Inspect cylinder parts, note any gumming or any pitting on pistons and cylinder walls. Disregard staining or discoloration. Rub any deposits adhering to cylinder walls with a clean soft cloth wetted with ethanol (isopropanol when testing DOT 5 fluids) to determine abrasiveness and removability. Clean cylinder parts in ethanol (isopropanol when testing DOT 5 fluids) and dry. Measure and record diameters of pistons and cylinders according to S6.13.4(a) and (b). Repeat the test if mechanical failure occurs that may affect the evaluation of the brake fluid.

S6.13.6 *Calculation.* (a) Calculate the changes in diameters of cylinders and pistons (see S5.1.13(b)).

(b) Calculate the average decrease in hardness of the seven cups tested, as well as the individual values (see S5.1.13(c)).

(c) Calculate the increases in base diameters of the eight cups (see S5.1.13(e)).

(d) Calculate the lip diameter interference set for each of the eight cups by the following formula and average the eight values (see S5.1.13(f)).

$$[(D_1 - D_2)/(D_1 - D_3)] \times 100 = \text{percentage Lip Diameter Interference Set}$$

where:

D_1 = Original lip diameter.
D_2 = Final lip diameter.
D_3 = Original cylinder bore diameter.

S6.14 *Container information.* Each container with information marked directly on the container surface or on a label (labels) affixed to the container pursuant to S5.2.2.2 or S5.2.2.3 is subjected to the following procedure:

(a) If the container has a label affixed to it, make a single vertical cut all the way through the label with the container in the vertical position.

(b) Immerse the container in the same brake fluid or hydraulic system mineral oil contained therein for 15 minutes at room temperature (23 ±5 °C; 73.4 ±9 °F).

(c) Within 5 minutes after removing the container from the fluid or oil, remove excess liquid from the surface of the container by wiping with a clean dry cloth.

S7. *Auxiliary test methods and reagent standards.*

S7.1 *Distilled water.* Nonreferee reagent water as specified in ASTM D1193–70 (incorporated by reference, see §571.5) or water of equal purity.

S7.2 *Water content of motor vehicle brake fluids.* Use analytical methods based on ASTM D1123–59 (incorporated by reference, see §571.5) for determining the water content of brake fluids, or other methods of analysis yielding comparable results. To be acceptable for use, such other method must measure the weight of water added to samples of the SAE RM–66–04 (see Appendix A of SAE Standard J1703 NOV83 (incorporated by reference in §571.5)) and TEGME Compatibility Fluids (see Appendix B of SAE Standard J1703 JAN95 (incorporated by reference in §571.5)) within ±15 percent of the water added for additions up to 0.8 percent by weight, and within ±5 percent of the water added for additions greater than 0.8 percent by weight. The SAE RM–66–04 Compatibility Fluid used to prepare the samples must have an original ERBP of not less than 205 °C (401 °F) when tested in accordance with S6.1. The SAE TEGME fluid used to prepare the samples must have an original ERBP of not less than 240 °C (464 °F) when tested in accordance with S6.1.

S7.3 *Ethanol.* 95 percent (190 proof) ethyl alcohol, USP or ACS, or Formula 3–A Specially Denatured Alcohol of the same concentration (as specified at 27 CFR 21.35). For pretest washings of equipment, use approximately 90 percent ethyl alcohol, obtained by adding 5 parts of distilled water to 95 parts of ethanol.

S7.4 *Measuring the hardness of SBR brake cups.* Hardness measurements on SBR wheel cylinder cups and master cylinder primary cups shall be made by using the following apparatus and the following procedure.

S7.4.1 *Apparatus.*

(a) *Anvil.* A rubber anvil having a flat circular top 20 ±1 mm. ($^{13}/_{16}$ ±$^{1}/_{16}$ inch) in diameter, a thickness of at least 9 mm. ($^{3}/_{8}$ inch) and a hardness within 5 IRHDs of the SBR test cup.

(b) *Hardness tester.* A hardness tester meeting the requirements for the standard instrument as described in ASTM D1415–68 (incorporated by reference, see §571.5) and graduated directly in IRHD units.

S7.4.2 *Procedure.* Make hardness measurements at 23° ±2 °C. (73.4° ±4 °F.). Equilibrate the tester and anvils at this temperature prior to use. Center brake cups lip side down on an anvil of appropriate hardness. Following the manufacturer's operating instructions for the hardness tester, make one measurement at each of four points 6 mm from the center of the cup and spaced 90° apart. Average the four values, and round off to the nearest IRHD.

S7.5 *Sediment by centrifuging.* The amount of sediment in the test fluid shall be determined by the following procedure.

S7.5.1 *Apparatus.*

(a) *Centrifuge tube.* Cone-shaped centrifuge tubes conforming to the dimensions given in Figure 6, and made of thoroughly annealed glass. The graduations shall be numbered as shown in Figure 6, and shall be clear and distinct. Scale-error tolerances and smallest graduations between various calibration marks are given in Table V and apply to calibrations made with air-free water at 20 °C. (68 °F.).

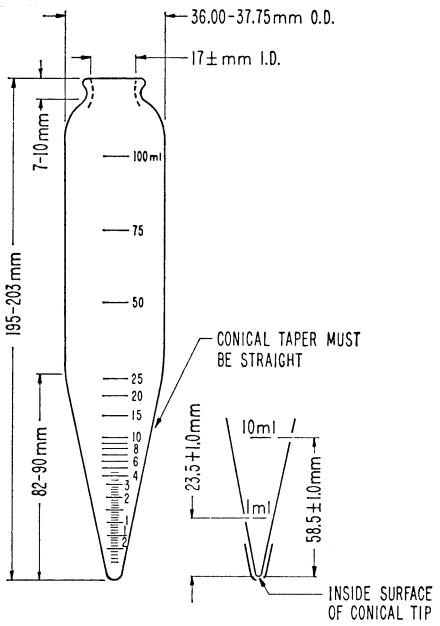


FIG. 6. ASTM 8-IN. CENTRIFUGE TUBE

TABLE V—CALIBRATION TOLERANCES FOR 8-INCH CENTRIFUGE TUBE

Range, ml	Subdivision, ml	Volume tolerance, ml
0 to 0.1	0.05	±0.02
Above 0.1 to 0.3	0.05	±0.03
Above 0.3 to 0.5	0.05	±0.05
Above 0.5 to 1	0.10	±0.05
Above 1 to 2	0.10	±0.10
Above 2 to 3	0.20	±0.10
Above 3 to 5	0.5	±0.20
Above 5 to 10	1.	±0.50
Above 10 to 25	5.	±1.00
Above 25 to 100	25.	±1.00

(b) *Centrifuge.* A centrifuge capable of whirling two or more filled centrifuge tubes at a speed which can be controlled to give a relative centrifugal force (r.c.f.) between 600 and 700 at the tip of the tubes. The revolving head, trunnion rings, and trunnion cups, including the rubber cushion, shall withstand the maximum centrifugal force capable of being delivered by the power source. The trunnion cups and cushions shall firmly support the tubes when the centrifuge is in motion. Calculate the speed of the rotating head using this equation:

$$r.p.m. = 265[\sqrt{25.4 \times r.c.f./d}]$$

Where:
r.c.f. = Relative centrifugal force, and
d = Diameter of swing, in millimeters, measured between tips of opposing tubes when in rotating position.

Table VI shows the relationship between diameter, swing, relative centrifugal force (r.c.f.), and revolutions per minute.

TABLE VI—ROTATION SPEEDS FOR CENTRIFUGES OF VARIOUS DIAMETERS

Diameter of swing in millimeters[a]	r.p.m. at 600 r.c.f	r.p.m. at 700 r.c.f.
483	1490	1610
508	1450	1570
533	1420	1530
559	1390	1500

[a] Measured in millimeters between tips of opposite tubes when in rotating position.

S7.5.2 *Procedure.* Balance the corked centrifuge tubes with their respective trunnion cups in pairs by weight on a scale, according to the centrifuge manufacturer's instructions, and place them on opposite sides of the centrifuge head. Use a dummy assembly when one sample is tested. Then whirl them for 10 minutes, at a rate sufficient to produce a r.c.f. between 600 and 700 at the tips of the whirling tubes. Repeat until the volume of sediment in each tube remains constant for three consecutive readings.

S7.5.3 *Calculation.* Read the volume of the solid sediment at the bottom of the centrifuge tube and report the percent sediment by volume. Where replicate determinations are specified, report the average value.

S7.6 *Standard styrene-butadiene rubber (SBR) brake cups.* SBR brake cups for testing motor vehicle brake fluids shall be manufactured using the following formulation:

FORMULATION OF RUBBER COMPOUND

Ingredient	Parts by weight
SBR type 1503[a]	100
Oil furnace black (NBS 378)	40
Zinc oxide (NBS 370)	5
Sulfur (NBS 371)	0.25
Stearic Acid (NBS 372)	1
n-tertiary butyl-2-benzothiazole sulfenamide (NBS 384)	1
Symmetrical dibetanaphthyl-p-phenylenediamine	1.5
Dicumyl peroxide (40 percent on precipitated $CaCO_3$)[b]	4.5

FORMULATION OF RUBBER COMPOUND—Continued

Ingredient	Parts by weight
Total	153.25

[a] Philprene 1503 has been found suitable.
[b] Use only within 90 days of manufacture and store at temperature below 27 °C. (80 °F.).

NOTE: The ingredients labeled (NBS) must have properties identical with those supplied by the National Bureau of Standards.

Compounding, vulcanization, physical properties, size of the finished cups, and other details shall be as specified in appendix B of SAE Standard J1703b (1970) (incorporated by reference, see §571.5). The cups shall be used in testing brake fluids either within 6 months from date of manufacture when stored at room temperature below 30 °C. (86 °F.) or within 36 months from date of manufacture when stored at temperatures below minus 15 °C. (+5 °F.). After removal of cups from refrigeration they shall be conditioned base down on a flat surface for at least 12 hours at room temperature in order to allow cups to reach their true configuration before measurement.

S7.7 *Isopropanol*. ACS or reagent grade.

[36 FR 22902, Dec. 2, 1971]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.116, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.117 Standard No. 117; Retreaded pneumatic tires.

S1. *Scope*. This standard specifies performance, labeling, and certification requirements for retreaded pneumatic passenger car tires.

S2. *Purpose*. The purpose of this standard is to require retreaded pneumatic passenger car tires to meet safety criteria similar to those for new pneumatic passenger car tires.

S3. *Application*. This standard applies to retreaded pneumatic tires for use on passenger cars manufactured after 1948.

S4. *Definitions*.

S4.1 *Casing* means a used tire to which additional tread may be attached for the purpose of retreading.

Retreaded means manufactured by a process in which a tread is attached to a casing.

S4.2 All terms defined in §§571.109 and 571.110 are used as defined therein.

S5. *Requirements*.

S5.1 *Retreaded tires*.

S5.1.1 Except as specified in S5.1.3, each retreaded tire, when mounted on a test rim of the width specified for the tire's size designation in appendix A of §571.109 shall comply with the following requirements of §571.109:

(a) S4.1 (Size and construction).

(b) S4.2.1 (General).

(c) S4.2.2.3 (Tubeless tire resistance to bead unseating).

(d) S4.2.2.4 (Tire strength).

S5.1.2 Except as specified in S5.1.3, each retreaded tire, when mounted on a test rim of the width specified for the tire's size designation in appendix A of §571.109, shall comply with the requirements of S4.2.2.2 of §571.109, except that the tire's section width shall not be more than 110 percent of the section width specified, and the tire's size factor shall be at least 97 percent of the size factor specified, in appendix A of §571.109 for the tire's size designation.

S5.1.3 Each retreaded tire shall be capable of meeting the requirements of S5.1.1 and S5.1.2 when mounted on any rim in accordance with those sections.

S5.1.4 No retreaded tire shall have a size designation, recommended maximum load rating, or maximum permissible inflation pressure that is greater than that originally specified on the casing pursuant to S4.3 of §571.109, or specified for the casing in Table I.

S5.2 *Casings*.

S5.2.1 No retreaded tire shall be manufactured with a casing—

(a) On which bead wire or cord fabric is exposed before processing.

(b) On which any cord fabric is exposed during processing, except that cord fabric that is located at a splice, i.e., where two or more segments of the same ply overlap, or cord fabric that is part of the belt material, may be exposed but shall not be penetrated or removed to any extent whatsoever.

S5.2.2 No retreaded tire shall be manufactured with a casing—

(a) From which a belt or ply, or part thereof, is removed during processing; or

(b) On which a belt or ply, or part thereof, is added or replaced during processing.

S5.2.3 Each retreaded tire shall be manufactured with a casing that bears, permanently molded at the time of its original manufacture into or onto the tire sidewall, each of the following:

(a) The symbol DOT;

(b) The size of the tire; and

(c) The actual number of plies or ply rating.

S5.2.4 [Reserved]

S6. *Certification and labeling.*

S6.1 Each manufacturer of a retreaded tire shall certify that its product complies with this standard pursuant to Section 30115 of Title 49, United States Code, by labeling the tire with the symbol DOT in the location specified in section 574.5 of this chapter.

S6.2 [Reserved]

S6.3. *Labeling.* Each retreaded tire shall comply, according to the phase-in schedule specified in S7 of this standard, with the requirements of S5.5 and S5.5.1 of § 571.139.

S7. *Phase-In Schedule for labeling*

S7.1. *Tires retreaded on or after September 1, 2005 and before September 1, 2006.* For tires manufactured on or after September 1, 2005 and before September 1, 2006, the number of tires complying with S6.3 of this standard must be equal to not less than 40% of the retreader's production during that period.

S7.2. *Tires retreaded on or after September 1, 2006 and before September 1, 2007.* For tires manufactured on or after September 1, 2006 and before September 1, 2007, the number of tires complying with S6.3 of this standard must be equal to not less than 70% of the retreader's production during that period.

S7.3. *Tires retreaded on or after September 1, 2007.* Each tire must comply with S6.3 of this standard.

[37 FR 5952, Mar. 23, 1972, as amended at 37 FR 11775, June 14, 1972; 38 FR 2982, Jan. 31, 1973; 38 FR 6999, Mar. 15, 1973; 38 FR 9688, Apr. 19, 1973; 39 FR 1443, Jan. 9, 1974; 39 FR 3553, Jan. 28, 1974; 39 FR 36016, Oct. 7, 1974; 39 FR 39884, Nov. 12, 1974; 61 FR 29494, June 11, 1996; 63 FR 28920, May 27, 1998; 67 FR 69627, Nov. 18, 2002; 69 FR 31319, June 3, 2004]

EDITORIAL NOTE: For an interpretation of § 571.117, see 38 FR 10940, May 3, 1973.

§ 571.118 Standard No. 118; Power-operated window, partition, and roof panel systems.

S1. *Purpose and scope.* This standard specifies requirements for power operated window, partition, and roof panel systems to minimize the likelihood of death or injury from their accidental operation.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, and trucks with a gross vehicle weight rating of 4,536 kilograms or less. This standard's inadvertent actuation performance requirements of S6(a) need not be met for vehicles manufactured before October 1, 2008. The standard's pull-to-close switch operability requirements of S6(c) need not be met for vehicles manufactured before October 1, 2010.

S3. *Definitions.*

Infrared reflectance means the ratio of the intensity of infrared light reflected and scattered by a flat sample of the test rod material to the intensity of infrared light reflected and scattered by a mirror that reflects 99.99 percent of the infrared radiation incident on its surface as measured by the apparatus show in Figure 2.

Power operated roof panel systems mean moveable panels in the vehicle roof which close by vehicle supplied power either by a sliding or hinged motion, and do not include convertible top systems.

S4. *Operating requirements.* Except as provided in S5, power operated window, partition, or roof panel systems may be closed only in the following circumstances:

(a) When the key that controls activation of the vehicle's engine is in the ''ON'', ''START'', or ''ACCESSORY'' position;

(b) By muscular force unassisted by vehicle supplied power;

(c) Upon continuous activation by a locking system on the exterior of the vehicle;

(d) Upon continuous activation of a remote actuation device, provided that the remote actuation device shall be incapable of closing the power window, partition or roof panel from a distance of more than 6 meters from the vehicle;

(e) During the interval between the time the locking device which controls the activation of the vehicle's engine is turned off and the opening of either of a two-door vehicle's doors or, in the case of a vehicle with more than two doors, the opening of either of its front doors;

(f) If the window, partition, or roof panel is in a static position before starting to close and in that position creates an opening so small that a 4 mm diameter semi-rigid cylindrical rod cannot be placed through the opening at any location around its edge in the manner described in S5(b); or

(g) Upon continuous activation of a remote actuation device, provided that the remote actuation device shall be incapable of closing the power window, partition or roof panel if the device and the vehicle are separated by an opaque surface and provided that the remote actuation device shall be incapable of closing the power window, partition or roof panel from a distance of more than 11 meters from the vehicle.

S5. *Automatic reversal systems.* A power-operated window, partition, or roof panel system that is capable of closing or of being closed under any circumstances other than those specified in S4 shall meet the requirements of S5.1, S5.2, and, if applicable, S5.3.

S5.1. While closing, the power-operated window, partition, or roof panel shall stop and reverse direction either before contacting a test rod with properties described in S8.2 or S8.3, or before exerting a squeezing force of 100 newtons (N) or more on a semi-rigid cylindrical test rod with the properties described in S8.1, when such test rod is placed through the window, partition, or roof panel opening at any location in the manner described in the applicable test under S7.

S5.2. Upon reversal, the power-operated window, partition, or roof panel system must open to one of the following positions, at the manufacturer's option:

(a) A position that is at least as open as the position at the time closing was initiated;

(b) A position that is not less than 125 millimeters (mm) more open than the position at the time the window reversed direction; or

(c) A position that permits a semi-rigid cylindrical rod that is 200 mm in diameter to be placed through the opening at the same location as the rod described in S7.1 or S7.2(b).

S5.3. If a vehicle uses proximity detection by infrared reflection to stop and reverse a power-operated window, partition, or roof panel, the infrared source shall project infrared light at a wavelength of not less than 850 nm and not more than 1050 nm. The system shall meet the requirements in S5.1 and S5.2 in all ambient light conditions from total darkness to 64,500 lux (6,000 foot candles) incandescent light intensity.

S6. *Actuation Devices.* Except as provided in paragraph S6(b), actuation devices in the occupant compartments of vehicles used to close power-operated windows, partitions, and roof panels must meet the following requirements:

(a) An actuation device must not cause a window, partition, or roof panel to begin to close from any open position when tested as follows:

(1) Using a stainless steel sphere having a surface finish between 8 and 4 micro inches and a radius of 20 mm ±0.2 mm, place the surface of the sphere against any portion of the actuation device.

(2) Apply a force not to exceed 135 Newtons (30 pounds) through the geometric center of the sphere. This force may be applied at any angle with respect to the actuation device.

(3) For actuation devices that cannot be contacted by the sphere specified in S6(a)(1) prior to the application of force, apply a force up to the level specified in S6(a)(2) at any angle in an attempt to make contact with the actuation device. The sphere is directionally applied in such a manner that, if unimpeded, it would make contact with the actuation device.

(b) The requirement in S6(a) does not apply to either—

(1) actuation devices that are mounted in a vehicle's roof, headliner, or overhead console that can close power-operated windows, partitions, or roof panels only by continuous rather than momentary switch actuation, or

(2) actuation devices for closing power-operated windows, partitions, or

roof panels which comply with paragraph S5.

(c) Any actuation device for closing a power-operated window must operate by pulling away from the surface in the vehicle on which the device is mounted. An actuation device for closing a power-operated window must operate only when pulled vertically up (if mounted on the top of a horizontal surface), or out (if mounted on a vertical surface), or down (if mounted on the underside of an overhead surface), or in a direction perpendicular to the surrounding surface if mounted in a sloped orientation, in order to cause the window to move in the closing direction.

S7. *Test procedures.*

S7.1. *Test procedure for testing power-operated window, partition, or roof panel systems designed to detect obstructions by physical contact or by light beam interruption:* Place the test rod of the type specified in S8.1 or S8.2, as appropriate, through the window, partition, or roof panel opening from the inside of the vehicle such that the cylindrical surface of the rod contacts any part of the structure with which the window, partition, or roof panel mates. Typical placements of test rods are illustrated in Figure 1. Attempt to close the power window, partition, or roof panel by operating the actuation device provided in the vehicle for that purpose.

S7.2. *Test procedure for testing power-operated window, partition, or roof panel systems designed to detect the proximity of obstructions using infrared reflectance:*

(a) Place the vehicle under incandescent lighting that projects 64,500 lux (6,000 foot candles) onto the infrared sensor. The light is projected onto the infrared sensor by aiming the optical axis of a light source outside the vehicle as perpendicular as possible to the lens of the infrared sensor. The intensity of light is measured perpendicular to the plane of the lens of the infrared sensor, as close as possible to the center of the lens of the infrared sensor.

(b) Place a test rod of the type specified in S8.3 in the window, partition, or roof panel opening, with the window, partition, or roof panel in any position. While keeping the rod stationary, attempt to close the window, partition, or roof panel by operating the actuation device provided in the vehicle for that purpose. Remove the test rod. Fully open the window, partition, or roof panel, and then begin to close it. While the window, partition, or roof panel is closing, move a test rod so that it approaches and ultimately extends through (if necessary) the window, partition, or roof panel opening, or its frame, in any orientation from the interior of the vehicle. For power partitions that have occupant compartment space on both sides of the partition, move the test rod into the partition opening from either side of the partition.

(c) Repeat the steps in S7.2(a) and (b) with other ambient light conditions within the range specified in S5.3.

S8. *Test rods.*

S8.1. *Rods for testing systems designed to detect obstructions by physical contact:*

(a) Each test rod is of cylindrical shape with any diameter in the range from 4 mm to 200 mm and is of sufficient length that it can be hand-held during the test specified in S7 with only the test rod making any contact with any part of the window, partition, or roof panel or mating surfaces of the window, partition, or roof panel.

(b) Each test rod has a force-deflection ratio of not less than 65 N/mm for rods 25 mm or smaller in diameter, and not less than 20 N/mm for rods larger than 25 mm in diameter.

S8.2. *Rods for testing systems designed to detect obstructions by light beam interruption:* Each test rod has the shape and dimensions specified in S8.1 and is, in addition, opaque to infrared, visible, and ultraviolet light.

S8.3. *Rods for testing systems designed to detect the proximity of obstructions using infrared reflection:*

(a) Each rod is constructed so that its surface has an infrared reflectance of not more than 1.0 percent when measured by the apparatus in Figure 2, in accordance with the procedure in S9.

(b) Each rod has the shape and dimensions specified in Figure 3.

S9. *Procedure for measuring infrared reflectance of test rod surface material.*

(a) The infrared reflectance of the rod surface material is measured using a flat sample and an infrared light source and sensor operating at a wavelength of 950 ±100 nm.

(b) The intensity of incident infrared light is determined using a reference mirror of nominally 100 percent reflectance mounted in place of the sample in the test apparatus in Figure 2.

(c) Infrared reflectance measurements of each sample of test rod surface material and of the reference mirror are corrected to remove the contribution of infrared light reflected and scattered by the sample holder and other parts of the apparatus before computation of the infrared reflectance ratio.

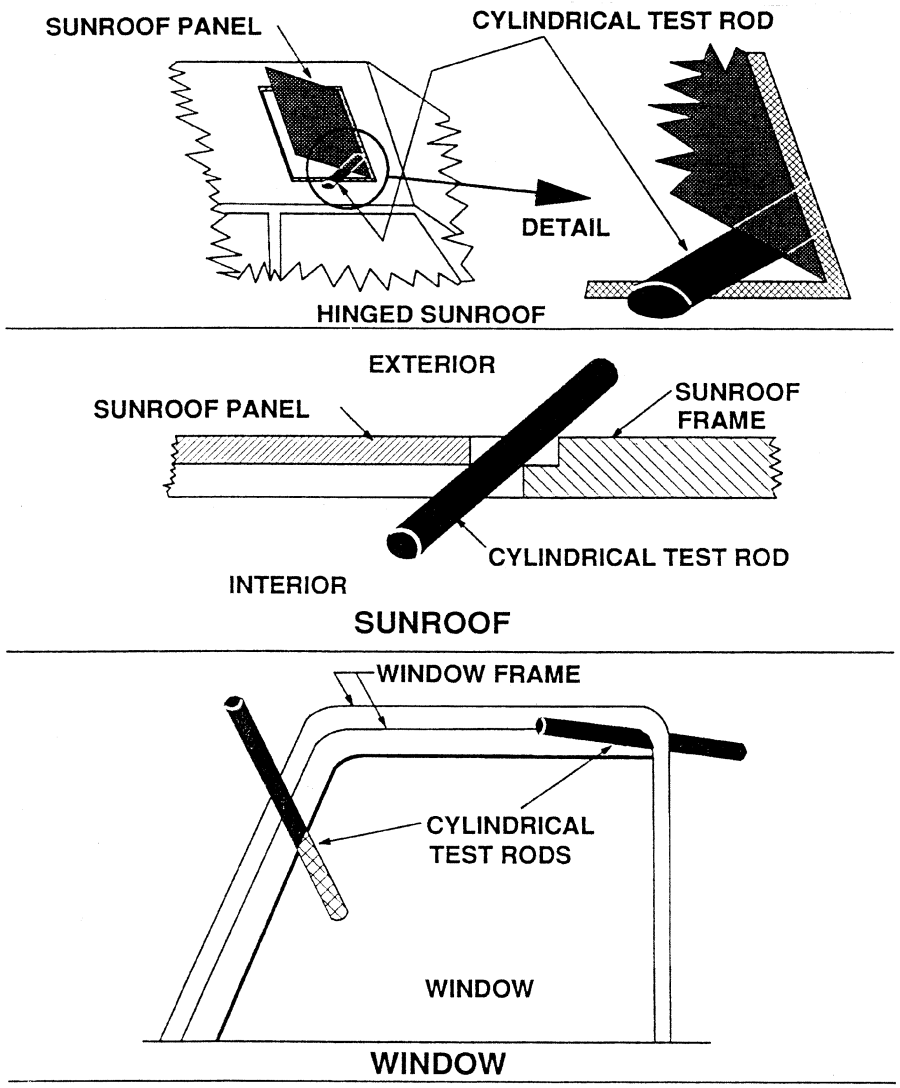


Figure 1 - Typical Cylindrical Test Rods Protruding through Sunroof and Window Daylight Openings

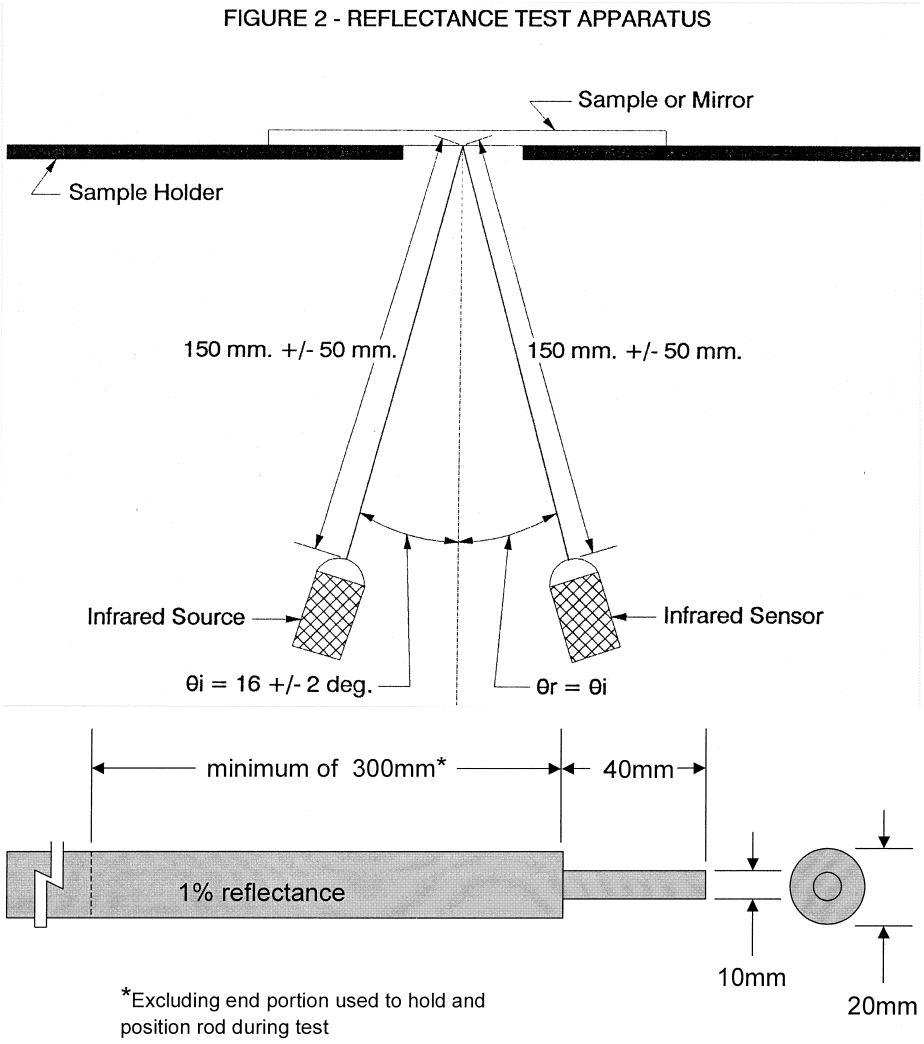


Figure 3

Cylindrical Rod

for Testing Non-Contact Infrared Reflection Systems

[56 FR 15294, Apr. 16, 1991, as amended at 57 FR 23963, June 5, 1992; 57 FR 28012, June 23, 1992; 58 FR 16785, Mar. 31, 1993; 60 FR 13644, Mar. 14, 1995; 69 FR 55531, 55544, Sept. 15, 2004; 71 FR 18683, Apr. 12, 2006; 71 FR 25285, Apr. 28, 2006; 73 FR 38339, July 7, 2008]

§571.119 Standard No. 119; New pneumatic tires for motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds), specialty tires, and tires for motorcycles.

S1. *Scope.* This standard establishes performance and marking requirements for tires for use on motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds), specialty tires, and tires for motorcycles.

S2. Purpose. The purpose of this standard is to provide safe operational performance levels for tires used on motor vehicles with a GVWR of more than 10,000 pounds, trailers, and motorcycles, and to place sufficient information on the tires to permit their proper selection and use.

S3. *Application.* This standard applies to:

(a) New pneumatic tires for use on motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds) manufactured after 1948;

(b) New pneumatic light truck tires with a tread depth of $^{18}/_{32}$ inch or greater, for use on motor vehicles with a GVWR of 4,536 kilograms (10,000 pounds) or less manufactured after 1948;

(c) Tires for use on special-use trailers (ST, FI and 8–12 rim or lower diameter code); and

(d) Tires for use on motorcycles manufactured after 1948.

S4. *Definitions.* All terms defined in the Act and the rules and standards issued under its authority are used as defined therein.

Light truck tire means a tire designated by its manuafacturer as primarily intended for use on lightweight trucks or multipurpose passenger vehicles.

Model rim assembly means a test device that (a) includes a rim which conforms to the published dimensions of a commercially available rim, (b) includes an air valve assembly when used for testing tubeless tires or an innertube and flap (as required) when used for testing tubetype tires, and (c) undergoes no permanent rim deformation and allows no loss of air through the portion that it comprises of the tire-rim pressure chamber when a tire is properly mounted on the assembly and subjected to the requirements of this standard.

S5. *Tire and rim matching information.*

S5.1 Each manufacturer of tires shall ensure that a listing of the rims that may be used with each tire that he produces is provided to the public. For purposes of this section each rim listing shall include dimensional specifications and a diagram of the rim. However a listing compiled in accordance with paragraph (a) of this section need not include dimensional specifications or a diagram of a rim if the rim's dimensional specifications and diagram are contained in each listing published in accordance with paragraph (b) of this standard. The listing shall be in one of the following forms:

(a) Listed by manufacturer name or brand name in a document furnished to dealers of the manufacturer's tires, to any person upon request, and in duplicate to: Docket Section, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590; or

(b) Contained in publications, current at the date of manufacture of the tire or any later date, of at least one of the following organizations:

The Tire and Rim Association
The European Tyre and Rim Technical Organisation
Japan Automobile Tire Manufacturers' Association, Inc.
Deutsche Industrie Norm
British Standards Institution
Scandinavian Tire and Rim Organization
The Tyre and Rim Association of Australia

S5.2 Information contained in a publication specified in S5.1(b) which lists general categories of tires and rims by size designation, type of construction, and/or intended use, shall be considered to be manufacturer's information pursuant to S5.1 for the listed tires, unless the publication itself or specific information provided according to S5.1(a) indicates otherwise.

S6. *Requirements.* Each tire shall be capable of meeting any of the applicable requirements set forth below, when

mounted on a model rim assembly corresponding to any rim designated by the tire manufacturer for use with the tire in accordance with S5. However, a particular tire need not meet further requirements after having been subjected to and met the endurance test (S6.1), strength test (S6.2), or high speed performance test (S6.3).

S6.1 *Endurance.*

S6.1.1 Prior to testing in accordance with the procedures of S7.2, a tire shall exhibit no visual evidence of tread, sidewall, ply, cord, innerliner, or bead separation, chunking, broken cords, cracking, or open splices.

S6.1.2 When tested in accordance with the procedures of S7.2:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, innerliner, or bead separation, chunking, broken cords, cracking, or open splices.

(b) The tire pressure at the end of the test shall be not less than the initial pressure specified in S7.2(a).

S6.2 *Strength.* When tested in accordance with the procedures of S7.3 a tire's average breaking energy value shall be not less than the value specified in Table II for that tire's size and load range.

S6.3 *High speed performance.* When tested in accordance with the procedures of S7.4, a tire shall meet the requirements set forth in S6.1.1 and S6.1.2(a) and (b). However, this requirement applies only to motorcycle tires and to non-speed-restricted tires of nominal rim diameter code 14.5 or less marked load range A, B, C, or D.

S6.4 *Treadwear indicators.* Except as specified in this paragraph, each tire shall have at least six treadwear indicators spaced approximately equally around the circumference of the tire that enable a person inspecting the tire to determine visually whether the tire has worn to a tread depth of 1.6 mm (one-sixteenth of an inch). Tires with a rim diameter code of 12 or smaller shall have at least three such treadwear indicators. Motorcycle tires shall have at least three such indicators which permit visual determination that the tire has worn to a tread depth of 0.8 mm (one-thirty-second of an inch).

S6.5 *Tire markings.* Except as specified in this paragraph, each tire shall be marked on each sidewall with the information specified in paragraphs (a) through (j) of this section. The markings shall be placed between the maximum section width (exclusive of sidewall decorations or curb ribs) and the bead on at least one sidewall, unless the maximum section width of the tire is located in an area which is not more than one-fourth of the distance from the bead to the shoulder of the tire. If the maximum section width falls within that area, the markings shall appear between the bead and a point one-half the distance from the bead to the shoulder of the tire, on at least one sidewall. The markings shall be in letters and numerals not less than 2 mm (0.078 inch) high and raised above or sunk below the tire surface not less that 0.4 mm (0.015 inch), except that the marking depth shall be not less than 0.25mm (0.010 inch) in the case of motorcycle tires. The tire identification and the DOT symbol labeling shall comply with part 574 of this chapter. Markings may appear on only one sidewall and the entire sidewall area may be used in the case of motorcycle tires and recreational, boat, baggage, and special trailer tires.

(a) The symbol DOT, which shall constitute a certification that the tire conforms to applicable Federal motor vehicle safety standards. This symbol may be marked on only one sidewall.

(b) The tire identification number required by part 574 of this chapter. This number may be marked on only one sidewall.

(c) The tire size designation as listed in the documents and publications designated in S5.1.

(d) The maximum load rating and corresponding inflation pressure of the tire, shown as follows:

(Mark on tires rated for single and dual load): Max load single ____kg (____lb) at ____kPa (____psi) cold. Max load dual ____kg (____lb) at ____kPa (____psi) cold.

(Mark on tires rated only for single load): Max load ____kg (____lb) at ____kPa (____psi) cold.

(e) The speed restriction of the tire, if 90 km/h (55 mph) or less, shown as follows:

Max speed ____km/h (____mph).

(f) The actual number of plies and the composition of the ply cord material in the sidewall and, if different, in the tread area;

(g) The words ''tubeless'' or ''tube type'' as applicable.

(h) The word ''regroovable'' if the tire is designed for regrooving.

(i) The word ''radial'' if a radial tire.

(j) The letter designating the tire load range.

S6.6 *Maximum load rating.* If the maximum load rating for a particular tire size is shown in one or more of the publications described in S5.1(b), each tire of that size designation shall have a maximum load rating that is not less than the published maximum load rating, or if there are differing published ratings for the same tire size designation, not less than the lowest published maximum load rating for the size designation.

S7. *Test procedures.*

S7.1 *General conditions.*

S7.1.1 The tests are performed using an appropriate new tube, tube valve and flap assembly (as required) that allows no loss of air for testing of tube-type tires under S7.2, S7.3, and S7.4, and tubeless tires under S7.3.

S7.1.2 The tire must be capable of meeting the requirements of S7.2 and S7.4 when conditioned to a temperature of 35 °C (95 °F) for 3 hours before the test is conducted, and with an ambient temperature maintained at 35 °C (95 °F) during all phases of testing. The tire must be capable of meeting the requirements of S7.3 when conditioned at a temperature of 21 °C (70 °F) for 3 hours before the test is conducted.

S7.2 *Endurance.* (a) Mount the tire on a model rim assembly and inflate it to the inflation pressure corresponding to the maximum load rating marked on the tire. Use a single maximum load value when the tire is marked with both single and dual maximum load.

(b) After conditioning the tire-rim assembly in accordance with S7.1.2, adjust the tire pressure to that specified in (a) immediately before mounting the tire rim assembly.

(c) Mount the tire-rim assembly on an axle and press it against a flat-faced steel test wheel that is 1708 mm (67.23 inches) in diameter and at least as wide as the tread of the tire.

(d) Apply the test load and rotate the test wheel as indicated in Table III for the type of tire tested conducting each successive phase of the test without interruption.

(e) Immediately after running the tire the required time, measure the tire inflation pressure. Remove the tire from the model rim assembly, and inspect the tire.

S7.3 *Strength.* (a) Mount the tire on a model rim assembly and inflate it to the pressure corresponding to the maximum load, or maximum dual load where there is both a single and dual load marked on the tire. If the tire is tubeless, a tube may be inserted to prevent loss of air during the test in the event of puncture.

(b) After conditioning the tire-rim assembly in accordance with S7.1.2, adjust the tire pressure to that specified in (a).

(c) Force a cylindrical steel plunger, with a hemispherical end and of the diameter specified in Table I for the tire size, perpendicularly into a raised tread element as near as possible to the centerline of the tread, at a rate of 50 mm (2 inches) per minute, until the tire breaks or the plunger is stopped by the rim.

(d) Record the force and the distance of penetration just before the tire breaks, or if it fails to break, just before the plunger is stopped by the rim.

(e) Repeat the plunger application at 72° intervals around the circumference of the tire, until five measurements are made. However, in the case of tires of 12 inch rim diameter code or smaller, repeat the plunger application at 120° intervals around the circumference of the tire, until three measurements are made.

(f) Compute the breaking energy for each test point by one of the two following formulas:

(1) $W = [(F \times P)/2] \times 10^{-3}$

Where:

W = Breaking energy in joules (J),
F = Force in newtons (N), and
P = Penetration in millimeters (mm),

or;

(2) $W = (F \times P)/2$

Where:

W = Breaking energy in inch-pounds (in-lb),
F = Force in pounds (lb), and

P = Penetration in inches (in).

(g) Determine the average breaking energy value for the tire by computing the average of the values obtained in accordance with paragraph (f).

S7.4 *High speed performance.* (a) Perform steps (a) through (c) of S7.2.

(b) Apply a force of 88 percent of the maximum load rating marked on the tire (use single maximum load value when the tire is marked with both single and dual maximum loads), and rotate the test wheel at 250 rpm for 2 hours.

(c) Remove the load, allow the tire to cool to 35 °C (95 °F), and then adjust the pressure to that marked on the tire for single tire use.

(d) Reapply the same load, and without interruption or readjustment of inflation pressure, rotate the test wheel at 375 rpm for 30 minutes, then at 400 rpm for 30 minutes, and then at 425 rpm for 30 minutes.

(e) Immediately after running the tire the required time, measure the tire inflation pressure. Remove the tire from the model rim assembly, and inspect the tire.

TABLE I—STRENGTH TEST PLUNGER DIAMETER

Tire type	Plunger diameter	
	(mm)	(inches)
Light truck	19.05	3/4
Motorcycle	7.94	5/16
≤12 rim diameter code (except motorcycle)	19.05	3/4
Tubeless:		
≤17.5 rim diameter code	19.05	3/4
>17.5 rim diameter code, load range F or less	31.75	1 1/4
>17.5 rim diameter code, load range over F	38.10	1 1/2
Tube-type:		
Load range F or less	31.75	1 1/4
Load range over F	38.10	1 1/2

TABLE II—MINIMUM STATIC BREAKING ENERGY

[Joules (J) and Inch-Pounds (in-lb)]

Tire characteristic	Motorcycle		All 12 rim diameter code or smaller except motorcycle		Light Truck greater than 12 rim diameter code		Tires other than light truck, motorcycle, 12 rim diameter code or smaller									
Plunger diameter (mm and inches)	7.94 mm	5/16″	19.05 mm	3/4″	19.05 mm	3/4″	Tube type greater than 12 rim diameter code				Tubeless 17.5 rim diameter code or smaller		Tubeless greater than 17.5 rim diameter code			
							31.75 mm	1 1/4″	38.10 mm	1 1/2″	19.05 mm	3/4″	31.75 mm	1 1/4″	38.10 mm	1 1/2″
Breaking Energy	J	in-lb	J	in-lb	J	in-lb	J	in-lb	J	in-lb	J	in-lb	J	in-lb	J	in-lb
Load Range:																
A	16	150	67	600	225	2,000	.....	.....	.....	.....	225	2,000	.....	.....	.....	.....
B	33	300	135	1,200	293	2,600	.....	.....	.....	.....	293	2,600	.....	.....	.....	.....
C	45	400	203	1,800	361	3,200	768	6,800	.....	.....	361	3,200	576	5,100	.....	.....
D	.....	.....	271	2,400	514	4,550	892	7,900	.....	.....	514	4,550	734	6,500	.....	.....
E	.....	.....	338	3,000	576	5,100	1,412	12,500	.....	.....	576	5,100	971	8,600	.....	.....
F	.....	.....	406	3,600	644	5,700	1,785	15,800	.....	.....	644	5,700	1,412	12,500	.....	.....
G	.....	.....	.....	.....	711	6,300	.....	.....	2,282	20,200	711	6,300	.....	.....	1,694	15,000
H	.....	.....	.....	.....	768	6,800	.....	.....	2,598	23,000	768	6,800	.....	.....	2,090	18,500
J	.....	.....	.....	.....	.....	.....	.....	.....	2,824	25,000	.....	.....	.....	.....	2,203	19,500
L	.....	.....	.....	.....	.....	.....	.....	.....	3,050	27,000	.....	.....	.....	.....	.....	.....
M	.....	.....	.....	.....	.....	.....	.....	.....	3,220	28,500	.....	.....	.....	.....	.....	.....
N	.....	.....	.....	.....	.....	.....	.....	.....	3,389	30,000	.....	.....	.....	.....	.....	.....

Note: For rayon cord tires, applicable energy values are 60 percent of those in table.

TABLE III—ENDURANCE TEST SCHEDULE

Description	Load range	Test wheel speed		Test load: Percent of maximum load rating			Total test revolution (thousands)
		km/h	r/m	Step I (7 hours)	Step II (16 hours)	Step III (24 hours)	
Speed-restricted service:							
90 km/h (55 mph).	All	40	125	66	84	101	352.5
80 km/h (50 mph).	C, D	48	150	75	97	114	423.0
	E, F, G, H, J, L, M, N.	32	100	66	84	101	282.0
56 km/h (35 mph).	All	24	75	66	84	101	211.5
Motorcycle	All	80	250	[a]100	[b]108	117	510.0
All other	A, B, C, D	80	250	[a]75	[b]97	114	510.0
	E	64	200	70	88	106	564.0
	F	64	200	66	84	101	564.0
	G	56	175	66	84	101	493.5
	H, J, L, M, N	48	150	66	84	101	423.0

[a] 4 hours for tire sizes subject to high speed requirements S6.3.
[b] 6 hours for tire sizes subject to high speed requirements S6.3.

(Authority: Secs. 113, 201, 80 Stat. 718 (15 U.S.C. 1402, 1421); secs. 103, 112, 119, 201, 203, Pub. L. 89–563, 80 Stat. 718 (15 U.S.C. 1392, 1401, 1421, 1423); delegation of authority at 49 CFR 1.50)

[38 FR 31301, Nov. 13, 1973]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.119, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 571.120 Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information for motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds).

S1. *Scope*. This standard specifies tire and rim selection requirements, rim marking requirements and motor home/recreation vehicle trailer load carrying capacity information.

S2. *Purpose*. The purpose of this standard is to provide safe operational performance by ensuring that vehicles to which it applies are equipped with tires of adequate size and load rating and with rims of appropriate size and type designation, and by ensuring that consumers are informed of motor home/recreation vehicle trailer load carrying capacity.

S3. *Application*. This standard applies to motor vehicles with a gross vehicle weight rating (GVWR) of more than 4,536 kilograms (10,000 pounds and motorcycles, to rims for use on those vehicles, and to non-pneumatic spare tire assemblies for use on those vehicles.

S4. *Definitions*. All terms defined in the Act and the rules and standards issued under its authority are used as defined therein.

Rim base means the portion of a rim remaining after removal of all split or continuous rim flanges, side rings, and locking rings that can be detached from the rim.

Rim size designation means rim diameter and width.

Rim diameter means nominal diameter of the bead seat.

Rim width means nominal distance between rim flanges.

Rim type designation means the industry or manufacturer's designation for a rim by style or code.

Weather side means the surface area of the rim not covered by the inflated tire.

S5. *Requirements*.

S5.1 *Tire and rim selection*.

S5.1.1 Except as specified in S5.1.3, each vehicle equipped with pneumatic tires for highway service shall be equipped with tires that meet the requirements of §571.109, §571.119 or §571.139, and rims that are listed by the manufacturer of the tires as suitable for use with those tires, in accordance with S4.4 of §571.109 or S5.1 of §571.119,

as applicable, except that vehicles may be equipped with a non-pneumatic spare tire assembly that meets the requirements of §571.129, New non-pneumatic tires for passenger cars, and S8 of this standard. Vehicles equipped with such an assembly shall meet the requirements of S5.3.3, S7, and S9 of this standard.

S5.1.2 Except in the case of a vehicle which has a speed attainable in 3.2 kilometers of 80 kilometers per hour or less, the sum of the maximum load ratings of the tires fitted to an axle shall be not less than the gross axle weight rating (GAWR) of the axle system as specified on the vehicle's certification label required by 49 CFR part 567. Except in the case of a vehicle which has a speed attainable in 2 miles of 50 mph or less, the sum of the maximum load ratings of the tires fitted to an axle shall be not less than the gross axle weight rating (GAWR) of the axle system as specified on the vehicle's certification label required by 49 CFR part 567. If the certification label shows more than one GAWR for the axle system, the sum shall be not less than the GAWR corresponding to the size designation of the tires fitted to the axle. If the size designation of the tires fitted to the axle does not appear on the certification label, the sum shall be not less than the lowest GAWR appearing on the label. When a passenger car tire is installed on a multipurpose passenger vehicle, truck, bus, or trailer, the tire's load rating shall be reduced by dividing by 1.10 before calculating the sum (i.e., the sum of the load ratings of the tires on each axle, when the tires' load carrying capacity at the recommended tire cold inflation pressure is reduced by dividing by 1.10, must be appropriate for the GAWR).

S5.1.3 In place of tires that meet the requirements of Standard No. 119, a truck, bus, or trailer may at the request of a purchaser be equipped at the place of manufacture of the vehicle with retreaded or used tires owned or leased by the purchaser, if the sum of the maximum load ratings meets the requirements of S5.1.2. Used tires employed under this provision must have been originally manufactured to comply with Standard No. 119, as evidenced by the DOT symbol.

S5.2 *Rim marking.* Each rim or, at the option of the manufacturer in the case of a single-piece wheel, wheel disc shall be marked with the information listed in paragraphs (a) through (e) of this paragraph, in lettering not less than 3 millimeters high, impressed to a depth or, at the option of the manufacturer, embossed to a height of not less than 0.125 millimeters. The information listed in paragraphs (a) through (c) of this paragraph shall appear on the weather side. In the case of rims of multi piece construction, the information listed in paragraphs (a) through (e) of this paragraph shall appear on the rim base and the information listed in paragraphs (b) and (d) of this paragraph shall also appear on each other part of the rim.

(a) A designation which indicates the source of the rim's published nominal dimensions, as follows:

(1) ''T'' indicates The Tire and Rim Association.

(2) ''E'' indicates The European Tyre and Rim Technical Organisation

(3) ''J'' indicates Japan Automobile Tire Manufacturers' Association, Inc.

(4) ''D'' indicates Deutsche Industrie Norm.

(5) ''B'' indicates British Standards Institution.

(6) ''S'' indicates Scandinavian Tire and Rim Organization.

(7) ''A'' indicates The Tyre and Rim Association of Australia.

(8) ''N'' indicates an independent listing pursuant to S4.4.1(a) of Standard No. 109 or S5.1(a) of Standard No. 119.

(b) The rim size designation, and in case of multipiece rims, the rim type designation. For example: 20×5.50, or 20×5.5.

(c) The symbol DOT, constituting a certification by the manufacturer of the rim that the rim complies with all applicable motor vehicle safety standards.

(d) A designation that identifies the manufacturer of the rim by name, trademark, or symbol.

(e) The month, day and year or the month and year of manufacture, expressed either numerically or by use of a symbol, at the option of the manufacturer. For example:

''September 4, 1976'' may be expressed numerically as:

90476, 904, or 76
76 904

''September 1976'' may be expressed as:

976, 9, or 76
76 9

(1) Any manufacturer that elects to express the date of manufacture by means of a symbol shall notify NHTSA in writing of the full names and addresses of all manufacturers and brand name owners utilizing that symbol and the name and address of the trademark owner of that symbol, if any. The notification shall describe in narrative form and in detail how the month, day, and year or the month and year are depicted by the symbol. Such description shall include an actual size graphic depiction of the symbol, showing and/or explaining the interrelationship of the component parts of the symbol as they will appear on the rim or single piece wheel disc, including dimensional specifications, and where the symbol will be located on the rim or single piece wheel disc. The notification shall be received by NHTSA at least 60 calendar days prior to first use of the symbol. The notification shall be mailed to the Office of Vehicle Safety Compliance, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590. All information provided to NHTSA under this paragraph will be placed in the public docket.

(2) Each manufacturer of wheels shall provide an explanation of its date of manufacture symbol to any person upon request.

S5.3 Each vehicle shall show the information specified in S5.3.1 and S5.3.2 and, in the case of a vehicle equipped with a non-pneumatic spare tire, the information specified in S5.3.3, in the English language, lettered in block capitals and numerals not less than 2.4 millimeters high and in the format set forth following this paragraph. This information shall appear either—

(a) After each GAWR listed on the certification label required by §567.4 or §567.5 of this chapter; or at the option of the manufacturer,

(b) On the tire information label affixed to the vehicle in the manner, location, and form described in §567.4 (b) through (f) of this chapter as appropriate of each GVWR–GAWR combination listed on the certification label.

S5.3.1 *Tires.* The size designation (not necessarily for the tires on the vehicle) and the recommended cold inflation pressure for those tires such that the sum of the load ratings of the tires on each axle (when the tires' load carrying capacity at the specified pressure is reduced by dividing by 1.10, in the case of a tire subject to FMVSS No. 109) is appropriate for the GAWR as calculated in accordance with S5.1.2.

S5.3.2. *Rims.* The size designation and, if applicable, the type designation of Rims (not necessarily those on the vehicle) appropriate for those tires.

TRUCK EXAMPLE—SUITABLE TIRE-RIM CHOICE

GVWR: 7,840 KG (17,289 LB)
GAWR: FRONT—2,850 KG (6,280 LB) WITH 7.50–20(D) TIRES, 20 × 6.00 RIMS AT 520 KPA (75 PSI) COLD SINGLE
GAWR: REAR—4,990 KG (11,000 LB) WITH 7.50–20(D) TIRES, 20 × 6.00 RIMS, AT 450 KPA (65 PSI) COLD DUAL
GVWR: 13,280 KG (29,279 LB)
GAWR: FRONT—4,826 KG (10,640 LB) WITH 10.00–20(F) TIRES, 20 × 7.50 RIMS, AT 620 KPA (90 PSI) COLD SINGLE
GAWR: REAR—8,454 KG (18,639 LB) WITH 10.00–20(F) TIRES, 20 × 2.70 RIMS, AT 550 KPA (80 PSI) COLD DUAL

S5.3.3 The non-pneumatic tire identification code, with which that assembly is labeled pursuant to S4.3(a) of §571.129.

S6. *Load Limits for Non-Pneumatic Spare Tires.* The highest vehicle maximum load on the tire for the vehicle shall not be greater than the load rating for the non-pneumatic spare tire.

S7 *Labeling Requirements for Non-Pneumatic Spare Tires or Tire Assemblies.* Each non-pneumatic tire or, in the case of a non-pneumatic tire assembly in which the non-pneumatic tire is an integral part of the assembly, each non-pneumatic tire assembly shall include, in letters or numerals not less than 4 millimeters high, the information specified in paragraphs S7 (a) and (b). The information shall be permanently molded, stamped, or otherwise permanently marked into or onto the non-pneumatic tire or non-pneumatic tire assembly, or shall appear on a label that is permanently attached to the tire or tire assembly. If a label is used,

it shall be subsurface printed, made of material that is resistant to fade, heat, moisture and abrasion, and attached in such a manner that it cannot be removed without destroying or defacing the label on the non-pneumatic tire or tire assembly. The information specified in paragraphs S7 (a) and (b) shall appear on both sides of the non-pneumatic tire or tire assembly, except, in the case of a non-pneumatic tire assembly which has a particular side that must always face outward when mounted on a vehicle, in which case the information specified in paragraphs S7 (a) and (b) shall only be required on the outward facing side. The information shall be positioned on the tire or tire assembly such that it is not placed on the tread or the outermost edge of the tire and is not obstructed by any portion of any non-pneumatic rim or wheel center member designated for use with that tire in this standard or in Standard No. 129.

(a) FOR TEMPORARY USE ONLY; and

(b) MAXIMUM 80 KM/H (50 M.P.H.).

S8. *Requirements for Vehicles Equipped with Non-Pneumatic Spare Tire Assemblies*

S8.1 *Vehicle Placarding Requirements.* A placard, permanently affixed to the inside of the spare tire stowage area or equally accessible location adjacent to the non-pneumatic spare tire assembly, shall display the information set forth in S7 in block capitals and numerals not less than 6 millimeters high preceded by the words ''IMPORTANT—USE OF SPARE TIRE'' in letters not less than 9 millimeters high.

S8.2 *Supplementary Information.* The owner's manual of the vehicle shall contain, in writing in the English language and in not less than 10 point type, the following information under the heading ''IMPORTANT—USE OF SPARE TIRE'':

(a) A statement indicating the information related to appropriate use for the non-pneumatic spare tire including at a minimum the information set forth in S8 (a) and (b) and either the information set forth in S5.3.6 or a statement that the information set forth in S5.3.6 is located on the vehicle placard and on the non-pneumatic tire;

(b) An instruction to drive carefully when the non-pneumatic spare tire is in use, and to install the proper pneumatic tire and rim at the first reasonable opportunity; and

(c) A statement that operation of the vehicle is not recommended with more than one non-pneumatic spare tire in use at the same time.

S9 *Non-Pneumatic Rims and Wheel Center Members*

S9.1 *Non-Pneumatic Rim Requirements.* Each non-pneumatic rim that is part of a separable non-pneumatic spare tire assembly shall be constructed to the dimensions of a non-pneumatic rim that is listed pursuant to S4.4 of §571.129 for use with the non-pneumatic tire, designated by its non-pneumatic tire identification code, with which the vehicle is equipped.

S9.2 *Wheel Center Member Requirements.* Each wheel center member that is part of a separable non-pneumatic spare tire assembly shall be constructed to the dimensions of a wheel center member that is listed pursuant to S4.4 of §571.129 for use with the non-pneumatic tire, designated by its non-pneumatic tire identification code, with which the vehicle is equipped.

S10. Each motor home and recreation vehicle (RV) trailer must meet the applicable requirements in S10.

S10.1 On motor homes, the sum of the gross axle weight ratings (GAWR) of all axles on the vehicle must not be less than the gross vehicle weight rating (GVWR).

S10.2 On RV trailers, the sum of the GAWRs of all axles on the vehicle plus the vehicle manufacturer's recommended tongue weight must not be less than the GVWR. If tongue weight is specified as a range, the minimum value must be used.

S10.3 The tires on each motor home and RV trailer at first retail sale must be the same size as the tire size on the labeling required by S5.3.

S10.4 Each motor home and RV trailer single stage or final stage manufacturer must affix either a motor home occupant and cargo carrying capacity (OCCC) label (Figure 1) or a RV trailer cargo carrying capacity (CCC) label (Figure 2) to its vehicles that meets the following criteria:

S10.4.1 The RV load carrying capacity labels (Figures 1 and 2) must be legible, visible, moisture resistant, presented in the English language, have a minimum print size of 2.4 millimeters (3⁄32 inches) high and be printed in black print on a yellow background.

S10.4.2 The weight value for load carrying capacity on the RV load carrying capacity labels (Figures 1 and 2) must be displayed to the nearest kilogram with conversion to the nearest pound and must be such that the vehicle's weight does not exceed its GVWR when loaded with the stated load carrying capacity. The UVW and the GVWR used to determine the RV's load carrying capacity must reflect the weights and design of the motor home or RV trailer as configured for delivery to the dealer/service facility. If applicable, the weight of full propane tanks must be included in the RV's UVW and the weight of on-board potable water must be treated as cargo.

S10.4.3 The RV load carrying capacity labels (Figures 1 and 2) must be:

(a) Permanently affixed and must be visibly located on the interior of the forward-most exterior passenger door on the right side of the vehicle; or

(b) If a permanent RV load carrying capacity label (Figure 1 or 2) is affixed in the location specified at S5.3(b), a temporary version of the RV load carrying capacity label (Figure 1 or 2) may be visibly located on the interior of the forward-most exterior passenger door on the right side of the vehicle.

S10.4.4 Permanent and temporary motor home OCCC labels must contain the following information in accordance with Figure 1:

(a) The statement: ''MOTOR HOME OCCUPANT AND CARGO CARRYING CAPACITY'' in block letters.

(b) The Vehicle Identification Number (VIN).

(c) The statement ''THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED: XXX kg or XXX lbs'' in block letters with appropriate values included.

(d) The statement ''Safety belt equipped seating capacity: XXX'' with the appropriate value included. This is the total number of safety belt equipped seating positions.

(e) The statement: ''CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal) and the tongue weight of a towed trailer counts as cargo'' with appropriate values included.

S10.4.5 Permanent and temporary RV trailer CCC labels must contain the following information in accordance with Figure 2:

(a) The statement: ''RECREATION VEHICLE TRAILER CARGO CARRYING CAPACITY'' in block letters.

(b) The Vehicle Identification Number (VIN).

(c) The statement: ''THE WEIGHT OF CARGO SHOULD NEVER EXCEED: XXX kg or XXX lbs'' in block letters with appropriate values included.

(d) The statement: ''CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal)'' with appropriate values included.

S10.5 *Weight added to motor homes and RV trailers between final vehicle certification and first retail sale of the vehicle.*

S10.5.1 If weight exceeding 45.4 kg (100 pounds) is added to a motor home or RV trailer between final vehicle certification and first retail sale of the vehicle, the load carrying capacity values on the RV load carrying capacity labels (Figures 1 and 2) required by S10.4 must be corrected using one or a combination of the following methods:

(a) Permanently affix the load carrying capacity modification label (Figure 3) which displays the amount the load carrying capacity is reduced to the nearest kilogram with conversion to the nearest pound, within 25 millimeters of the original, permanent RV load carrying capacity label (Figure 1 or 2). The load carrying capacity modification label must be legible, visible, permanent, moisture resistant, presented in the English language, have a minimum print size of 2.4 millimeters (3/32 inches) high and be printed in black print on a yellow background. If the manufacturer selects S10.4.3(b), apply a temporary version of the load carrying capacity modification label (Figure 3) within 25 millimeters of the original, temporary RV load carrying

capacity label (Figure 1 or 2) on the interior of the forward-most exterior passenger door on the right side of the vehicle. Both temporary and permanent versions of the load carrying capacity modification label (Figure 3) may be printed without values and values may be legibly applied to the label with a black, fine point, indelible marker. The label must contain the statements ''CAUTION—LOAD CARRYING CAPACITY REDUCED'' in block letters and ''Modifications to this vehicle have reduced the original load carrying capacity by XXX kg or XXX lbs'' in accordance with Figure 3 with appropriate values in place of XXX. If two load carrying capacity modification labels are required (one permanent and one temporary), the weight values on each must agree, or

(b) Modify the original permanent RV load carrying capacity label (Figure 1 or 2) with correct load carrying capacity weight values. If the manufacturer selects S10.4.3(b), the temporary RV load carrying capacity label (Figure 1 or 2) must also be modified with correct load carrying capacity weight values. Modification of labels requires a machine printed overlay with printed corrected values or blanks for corrected values that may be entered with a black, fine-point, indelible marker. Crossing out old values and entering corrected values on the original label is not permissible, or

(c) Replace the original, permanent RV load carrying capacity label (Figure 1 or 2) with the same label containing correct load carrying capacity weight values. If the manufacturer selects S10.4.3(b), the temporary RV load carrying capacity label (Figure 1 or 2) must also be replaced with the same label containing correct load carrying capacity weight values.

S10.5.2 Corrected load carrying capacity weight values or the weight amount the load carrying capacity is reduced, must reflect the total weight added between final vehicle certification and first retail sale and must be accurate within one percent of the actual added weight. No re-labeling is required if the weight of the vehicle is reduced between final vehicle certification and the first retail sale.

MOTOR HOME OCCUPANT AND CARGO CARRYING CAPACITY
VIN: ##################
THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED:
XXX kg or XXX lbs
Safety belt equipped seating capacity: XXX
CAUTION:
A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal) and the tongue weight of a towed trailer counts as cargo

Figure 1 - Motor Home Occupant and Cargo Carrying Capacity Label

RECREATION VEHICLE TRAILER CARGO CARRYING CAPACITY
VIN: ##################
THE WEIGHT OF CARGO SHOULD NEVER EXCEED:
XXX kg or XXX lbs
CAUTION:
A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal)

Figure 2 - RV Trailer Cargo Carrying Capacity Label

CAUTION: LOAD CARRYING CAPACITY REDUCED
Modifications to this vehicle have reduced the original load carrying capacity by _____ kg or _____lbs

Figure 3 - Load Carrying Capacity Modification Label

(Authority: Secs. 102, 119, and 202, Pub. L. 89–563, 80 Stat. 718 (15 U.S.C. 1392, 1407, and 1422); delegation of authority at 49 CFR 1.50)

[42 FR 7144, Feb. 7, 1977]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 571.120, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 571.121 Standard No. 121; Air brake systems.

S1. *Scope*. This standard establishes performance and equipment requirements for braking systems on vehicles equipped with air brake systems.

S2. *Purpose*. The purpose of this standard is to insure safe braking performance under normal and emergency conditions.

S3. *Application*. This standard applies to trucks, buses, and trailers equipped with air brake systems. However, it does not apply to:

(a) Any trailer that has a width of more than 102.36 inches with extendable equipment in the fully retracted position and is equipped with two short track axles in a line across the width of the trailer.

(b) Any vehicle equipped with an axle that has a gross axle weight rating (GAWR) of 29,000 pounds or more;

(c) Any truck or bus that has a speed attainable in 2 miles of not more than 33 mph;

(d) Any truck that has a speed attainable in 2 miles of not more than 45 mph, an unloaded vehicle weight that is not less than 95 percent of its gross vehicle weight rating (GVWR), and no capacity to carry occupants other than the driver and operating crew;

(e) Any trailer that has a GVWR of more than 120,000 pounds and whose body conforms to that described in the definition of heavy hauler trailer set forth in S4;

(f) Any trailer that has an unloaded vehicle weight which is not less than 95 percent of its GVWR; and

(g) Any load divider dolly.

S4. *Definitions.*

Agricultural commodity trailer means a trailer that is designed to transport bulk agricultural commodities in off-road harvesting sites and to a processing plant or storage location, as evidenced by skeletal construction that accommodates harvest containers, a maximum length of 28 feet, and an arrangement of air control lines and reservoirs that minimizes damage in field operations.

Air brake system means a system that uses air as a medium for transmitting pressure or force from the driver control to the service brake, including an air-over-hydraulic brake subsystem, but does not include a system that uses compressed air or vacuum only to assist the driver in applying muscular force to hydraulic or mechanical components.

Air-over-hydraulic brake subsystem means a subsystem of the air brake system that uses compressed air to transmit a force from the driver control to a hydraulic brake system to actuate the service brakes.

Antilock brake system or *ABS* means a portion of a service brake system that automatically controls the degree of rotational wheel slip during braking by:

(1) Sensing the rate of angular rotation of the wheels;

(2) Transmitting signals regarding the rate of wheel angular rotation to one or more controlling devices which interpret those signals and generate responsive controlling output signals; and

(3) Transmitting those controlling signals to one or more modulators which adjust brake actuating forces in response to those signals.

Auto transporter means a truck and a trailer designed for use in combination to transport motor vehicles, in that the towing vehicle is designed to carry cargo at a location other than the fifth wheel and to load this cargo only by means of the towed vehicle.

Common diaphragm means a single brake chamber diaphragm which is a component of the parking, emergency, and service brake systems.

Container chassis trailer means a semitrailer of skeleton construction limited to a bottom frame, one or more axles, specially built and fitted with locking devices for the transport of intermodal shipping containers, so that when the chassis and container are assembled, the units serve the same function as an over the road trailer.

Directly controlled wheel means a wheel for which the degree of rotational wheel slip is sensed, either at that wheel or on the axle shaft for that wheel and corresponding signals are transmitted to one or more modulators that adjust the brake actuating forces at that wheel. Each modulator may also adjust the brake actuating forces at other wheels that are on the same axle or in the same axle set in response to the same signal or signals.

Effective projected luminous lens area means that area of the projection on a plane perpendicular to the lamp axis of that portion of the light-emitting surface that directs light to the photometric test pattern, and does not include mounting hole bosses, reflex reflector area, beads or rims that may glow or produce small areas of increased intensity as a result of uncontrolled light from small areas (½ degree radius around the test point).

Full-treadle brake application means a brake application in which the treadle valve pressure in any of the valve's output circuits reaches 85 pounds per square inch (psi) within 0.2 seconds after the application is initiated, or in which maximum treadle travel is achieved within 0.2 seconds after the application is initiated.

Heavy hauler trailer means a trailer which has one or more of the following characteristics, but which is not a container chassis trailer:

(1) Its brake lines are designed to adapt to separation or extension of the vehicle frame; or

(2) Its body consists only of a platform whose primary cargo-carrying surface is not more than 40 inches above the ground in an unloaded condition, except that it may include sides that are designed to be easily removable and a permanent ''front end structure'' as that term is used in §393.106 of this title.

Independently controlled wheel means a directly controlled wheel for which the modulator does not adjust the

brake actuating forces at any other wheel on the same axle.

Indirectly controlled wheel means a wheel at which the degree of rotational wheel slip is not sensed, but at which the modulator of an antilock braking system adjusts its brake actuating forces in response to signals from one or more sensed wheel(s).

Initial brake temperature means the average temperature of the service brakes on the hottest axle of the vehicle 0.2 mile before any brake application in the case of road tests, or 18 seconds before any brake application in the case of dynamometer testing.

Intermodal shipping container means a reusable, transportable enclosure that is especially designed with integral locking devices for securing the container to the trailer to facilitate the efficient and bulk shipping and transfer of goods by, or between various modes of transport, such as highway, rail, sea and air.

Load divider dolly means a trailer composed of a trailer chassis and one or more axles, with no solid bed, body, or container attached, and which is designed exclusively to support a portion of the load on a trailer or truck excluded from all the requirements of this standard.

Maximum drive-through speed means the highest possible constant speed at which the vehicle can be driven through 200 feet of a 500-foot radius curve arc without leaving the 12-foot lane.

Maximum treadle travel means the distance that the treadle moves from its position when no force is applied to its position when the treadle reaches a full stop.

Peak friction coefficient or *PFC* means the ratio of the maximum value of braking test wheel longitudinal force to the simultaneous vertical force occurring prior to wheel lockup, as the braking torque is progressively increased.

Pulpwood trailer means a trailer that is designed exclusively for harvesting logs or pulpwood and constructed with a skeletal frame with no means for attachment of a solid bed, body, or container, and with an arrangement of air control lines and reservoirs designed to minimize damage in off-road operations.

Tandem axle means a group or set of two or more axles placed in a close arrangement, one behind the other, with the centerlines of adjacent axles not more than 72 inches apart.

Straddle trailer means a trailer that is designed to transport bulk agricultural commodities from the harvesting location as evidenced by a framework that is driven over the cargo and lifting arms that suspend the cargo for transit.

Wheel lockup means 100 percent wheel slip.

S5. *Requirements.* Each vehicle shall meet the following requirements under the conditions specified in S6. However, at the option of the manufacturer, the following vehicles may meet the stopping distance requirements specified in Table IIa instead of Table II: Three-axle tractors with a front axle that has a GAWR of 14,600 pounds or less, and with two rear drive axles that have a combined GAWR of 45,000 pounds or less, that are manufactured before August 1, 2011; and all other tractors that are manufactured before August 1, 2013.

S5.1 *Required equipment for trucks and buses.* Each truck and bus shall have the following equipment:

S5.1.1 *Air compressor.* An air compressor of sufficient capacity to increase air pressure in the supply and service reservoirs from 85 psi to 100 psi when the engine is operating at the vehicle manufacturer's maximum recommended r.p.m. within a time, in seconds, determined by the quotient (Actual reservoir capacity × 25)/Required reservoir capacity.

S5.1.1.1 *Air compressor cut-in pressure.* The air compressor governor cut-in pressure for each bus shall be 85 p.s.i. or greater. The air compressor governor cut-in pressure for each truck shall be 100 p.s.i. or greater.

S5.1.2 *Reservoirs.* One or more service reservoir systems, from which air is delivered to the brake chambers, and either an automatic condensate drain valve for each service reservoir or a supply reservoir between the service reservoir system and the source of air pressure.

S5.1.2.1 The combined volume of all service reservoirs and supply reservoirs

shall be at least 12 times the combined volume of all service brake chambers. For each brake chamber type having a full stroke at least as great as the first number in Column 1 of Table V, but no more than the second number in Column 1 of Table V, the volume of each brake chamber for purposes of calculating the required combined service and supply reservoir volume shall be either that specified in Column 2 of Table V or the actual volume of the brake chamber at maximum travel of the brake piston or pushrod, whichever is lower. The volume of a brake chamber not listed in Table V is the volume of the brake chamber at maximum travel of the brake piston or pushrod. The reservoirs of the truck portion of an auto transporter need not meet this requirement for reservoir volume.

S5.1.2.2 Each reservoir shall be capable of withstanding an internal hydrostatic pressure of five times the compressor cutout pressure or 500 psi, whichever is greater, for 10 minutes.

S5.1.2.3 Each service reservoir system shall be protected against loss of air pressure due to failure or leakage in the system between the service reservoir and the source of air pressure, by check valves or equivalent devices whose proper functioning can be checked without disconnecting any air line or fitting.

S5.1.2.4 Each reservoir shall have a condensate drain valve that can be manually operated.

S5.1.3 *Towing vehicle protection system.* If the vehicle is intended to tow another vehicle equipped with air brakes, a system to protect the air pressure in the towing vehicle from the effects of a loss of air pressure in the towed vehicle.

S5.1.4 *Pressure gauge.* A pressure gauge in each service brake system, readily visible to a person seated in the normal driving position, that indicates the service reservoir system air pressure. The accuracy of the gauge shall be within plus or minus 7 percent of the compressor cut-out pressure.

S5.1.5 *Warning signal.* A signal, other than a pressure gauge, that gives a continuous warning to a person in the normal driving position when the ignition is in the ''on'' (''run'') position and the air pressure in the service reservoir system is below 60 psi. The signal shall be either visible within the driver's forward field of view, or both audible and visible.

S5.1.6 *Antilock brake system.*

S5.1.6.1(a) Each single-unit vehicle manufactured on or after March 1, 1998, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

(b) Each truck tractor manufactured on or after March 1, 1997, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle, with the wheels of at least one axle being independently controlled. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system. A truck tractor shall have no more than three wheels controlled by one modulator.

S5.1.6.2 *Antilock malfunction signal and circuit.*

(a) Each truck tractor manufactured on or after March 1, 1997, and each single unit vehicle manufactured on or after March 1, 1998, shall be equipped with an indicator lamp, mounted in front of and in clear view of the driver, which is activated whenever there is a malfunction that affects the generation or transmission of response or control signals in the vehicle's antilock brake system. The indicator lamp shall remain activated as long as such a malfunction exists, whenever the ignition (start) switch is in the ''on'' (''run'') position, whether or not the engine is running. Each message about the existence of such a malfunction shall be stored in the antilock brake system after the ignition switch is turned to the ''off'' position and automatically reactivated when the ignition switch is again turned to the ''on'' (''run'') position. The indicator lamp shall also be activated as a check of lamp function whenever the ignition is turned to the ''on'' (''run'') position. The indicator lamp shall be deactivated at the end of the check of lamp function unless there is a malfunction or a message about a malfunction that

existed when the key switch was last turned to the ''off'' position.

(b) Each truck tractor manufactured on or after March 1, 2001, and each single unit vehicle manufactured on or after March 1, 2001, that is equipped to tow another air-braked vehicle, shall be equipped with an electrical circuit that is capable of transmitting a malfunction signal from the antilock brake system(s) on one or more towed vehicle(s) (e.g., trailer(s) and dolly(ies)) to the trailer ABS malfunction lamp in the cab of the towing vehicle, and shall have the means for connection of this electrical circuit to the towed vehicle. Each such truck tractor and single unit vehicle shall also be equipped with an indicator lamp, separate from the lamp required in S5.1.6.2(a), mounted in front of and in clear view of the driver, which is activated whenever the malfunction signal circuit described above receives a signal indicating an ABS malfunction on one or more towed vehicle(s). The indicator lamp shall remain activated as long as an ABS malfunction signal from one or more towed vehicle(s) is present, whenever the ignition (start) switch is in the ''on'' (''run'') position, whether or not the engine is running. The indicator lamp shall also be activated as a check of lamp function whenever the ignition is turned to the ''on'' (''run'') position. The indicator lamp shall be deactivated at the end of the check of lamp function unless a trailer ABS malfunction signal is present.

(c) [Reserved]

S5.1.6.3 *Antilock power circuit for towed vehicles.* Each truck tractor manufactured on or after March 1, 1997, and each single unit vehicle manufactured on or after March 1, 1998, that is equipped to tow another air-braked vehicle shall be equipped with one or more electrical circuits that provide continuous power to the antilock system on the towed vehicle or vehicles whenever the ignition (start) switch is in the ''on'' (''run'') position. Such a circuit shall be adequate to enable the antilock system on each towed vehicle to be fully operable.

S5.1.7 *Service brake stop lamp switch.* A switch that lights the stop lamps when the service brake control is statically depressed to a point that produces a pressure of 6 psi or less in the service brake chambers.

S5.1.8 *Brake distribution and automatic adjustment.* Each vehicle shall be equipped with a service brake system acting on all wheels.

(a) *Brake adjuster.* Wear of the service brakes shall be compensated for by means of a system of automatic adjustment. When inspected pursuant to S5.9, the adjustment of the service brakes shall be within the limits recommended by the vehicle manufacturer.

(b) *Brake indicator.* For each brake equipped with an external automatic adjustment mechanism and having an exposed pushrod, the condition of service brake under-adjustment shall be displayed by a brake adjustment indicator that is discernible when viewed with 20/40 vision from a location adjacent to or underneath the vehicle, when inspected pursuant to S5.9.

S5.2 *Required equipment for trailers.* Each trailer shall have the following equipment:

S5.2.1 *Reservoirs.* One or more reservoirs to which the air is delivered from the towing vehicle.

S5.2.1.1 The total volume of each service reservoir shall be at least eight times the combined volume of all service brake chambers serviced by that reservoir. For each brake chamber type having a full stroke at least as great as the first number in Column 1 of Table V, but no more than the second number in column 1, the volume of each brake chamber for purposes of calculating the required total service reservoir volume shall be either the number specified in Column 2 of Table V or the actual volume of the brake chamber at maximum travel of the brake piston or pushrod, whichever is lower. The volume of a brake chamber not listed in Table V is the volume of the brake chamber at maximum travel of the brake piston or pushrod. The reservoirs on a heavy hauler trailer and the trailer portion of an auto transporter need not meet this requirement for reservoir volume.

S5.2.1.2 Each reservoir shall be capable of withstanding an internal hydrostatic pressure of 500 psi for 10 minutes.

S5.2.1.3 Each reservoir shall have a condensate drain valve that can be manually operated.

S5.2.1.4 Each service reservoir shall be protected against loss of air pressure due to failure or leakage in the system between the service reservoir and its source of air pressure by check valves or equivalent devices.

S5.2.2 *Brake distribution and automatic adjustment.* Each vehicle shall be equipped with a service brake system acting on all wheels.

(a) *Brake adjuster.* Wear of the service brakes shall be compensated for by means of a system of automatic adjustment. When inspected pursuant to S5.9, the adjustment of the service brakes shall be within the limits recommended by the vehicle manufacturer.

(b) *Brake indicator.* For each brake equipped with an external automatic adjustment mechanism and having an exposed pushrod, the condition of service brake under-adjustment shall be displayed by a brake adjustment indicator in a manner that is discernible when viewed with 20/40 vision from a location adjacent to or underneath the vehicle, when inspected pursuant to S5.9.

S5.2.3 *Antilock brake system.*

S5.2.3.1(a) Each semitrailer (including a trailer converter dolly) manufactured on or after March 1, 1998, shall be equipped with an antilock brake system that directly controls the wheels of at least one axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

(b) Each full trailer manufactured on or after March 1, 1998, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle of the vehicle and at least one rear axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

S5.2.3.2 *Antilock malfunction signal.* Each trailer (including a trailer converter dolly) manufactured on or after March 1, 2001, that is equipped with an antilock brake system shall be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this antilock brake system malfunction signal circuit to the towing vehicle. The electrical circuit need not be separate or dedicated exclusively to this malfunction signaling function. The signal shall be present whenever there is a malfunction that affects the generation or transmission of response or control signals in the trailer's antilock brake system. The signal shall remain present as long as the malfunction exists, whenever power is supplied to the antilock brake system. Each message about the existence of such a malfunction shall be stored in the antilock brake system whenever power is no longer supplied to the system, and the malfunction signal shall be automatically reactivated whenever power is again supplied to the trailer's antilock brake system. In addition, each trailer manufactured on or after March 1, 2001, that is designed to tow other air-brake equipped trailers shall be capable of transmitting a malfunction signal from the antilock brake systems of additional trailers it tows to the vehicle towing it.

S5.2.3.3 *Antilock malfunction indicator.*

(a) In addition to the requirements of S5.2.3.2, each trailer and trailer converter dolly shall be equipped with an external antilock malfunction indicator lamp that meets the requirements of S5.2.3.3 (b) through (d).

(b)(1) The lamp shall be designed to conform to the performance requirements of SAE Recommended Practice J592 JUN92 (incorporated by reference, see §571.5), or SAE Recommended Practice J592e (1972) (incorporated by reference, see §571.5), for combination, clearance, and side marker lamps, which are marked with a ''PC'' or ''P2'' on the lens or housing, in accordance with SAE Recommended Practice J759 JAN95 (incorporated by reference, see §571.5).

(2) The color of the lamp shall be yellow.

(3) The letters ''ABS'' shall be permanently molded, stamped, or otherwise marked or labeled in letters not less than 10 mm (0.4 inches) high on the lamp lens or its housing to identify the function of the lamp. Alternatively, the letters ''ABS'' may be painted on the trailer body or dolly or a plaque with the letters ''ABS'' may be affixed to the trailer body or converter dolly;

the letters ''ABS'' shall be not less than 25 mm (1 inch) high. A portion of one of the letters in the alternative identification shall be not more than 150 mm (5.9 inches) from the edge of the lamp lens.

(c) *Location requirements.* (1) Each trailer that is not a trailer converter dolly shall be equipped with a lamp mounted on a permanent structure on the left side of the trailer as viewed from the rear, no closer than 150 mm (5.9 inches), and no farther than 600 mm (23.6 inches) from the red rear side marker lamp, when measured between the closest edge of the effective projected luminous lens area of each lamp.

(2) Each trailer converter dolly shall be equipped with a lamp mounted on a permanent structure of the dolly so that the lamp is not less than 375 mm (14.8 inches) above the road surface when measured from the center of the lamp with the dolly at curb weight. When a person, standing 3 meters (9.8 feet) from the lamp, views the lamp from a perspective perpendicular to the vehicle's centerline, no portion of the lamp shall be obscured by any structure on the dolly.

(3) Each trailer that is not a trailer converter dolly and on which the malfunction indicator lamp cannot be placed within the location specified in S5.2.3.3(c)(1) shall be equipped with a lamp mounted on a permanent structure on the left side of the trailer as viewed from the rear, near the red rear side marker lamp or on the front face of the left rear fender of a trailer equipped with fenders.

(d) The lamp shall be illuminated whenever power is supplied to the antilock brake system and there is a malfunction that affects the generation or transmission of response or control signals in the trailer's antilock brake system. The lamp shall remain illuminated as long as such a malfunction exists and power is supplied to the antilock brake system. Each message about the existence of such a malfunction shall be stored in the antilock brake system whenever power is no longer supplied to the system. The lamp shall be automatically reactivated when power is again supplied to the trailer's antilock brake system. The lamp shall also be activated as a check of lamp function whenever power is first supplied to the antilock brake system and the vehicle is stationary. The lamp shall be deactivated at the end of the check of lamp function, unless there is a malfunction or a message about a malfunction that existed when power was last supplied to the antilock brake system.

S5.3 Service brakes—road tests. The service brake system on each truck tractor shall, under the conditions of S6, meet the requirements of S5.3.1, S5.3.3, S5.3.4, and S5.3.6, when tested without adjustments other than those specified in this standard. The service brake system on each bus and truck (other than a truck tractor shall) manufactured before July 1, 2005 and each bus and truck (other than a truck tractor) manufactured in two or more stages shall, under the conditions of S6, meet the requirements of S5.3.1, S5.3.3, and S5.3.4 when tested without adjustments other than those specified in this standard. The service brake system on each bus and truck (other than a truck tractor) manufactured on or after July 1, 2005 and each bus and truck (other than a truck tractor) manufactured in two or more stages on or after July 1, 2006 shall, under the conditions of S6, meet the requirements of S5.3.1, S5.3.3, S5.3.4, and S5.3.6, when tested without adjustments other than those specified in this standard. The service brake system on each trailer shall, under the conditions of S6, meet the requirements of S5.3.3, S5.3.4, and S5.3.5 when tested without adjustments other than those specified in this standard. However, a heavy hauler trailer and the truck and trailer portions of an auto transporter need not met the requirements of S5.3.

S5.3.1 *Stopping distance—trucks and buses.* When stopped six times for each combination of vehicle type, weight, and speed specified in S5.3.1.1, in the sequence specified in Table I, each truck tractor manufactured on or after March 1, 1997, and each single unit vehicle manufactured on or after March 1, 1998, shall stop at least once in not more than the distance specified in Table II, measured from the point at which movement of the service brake control begins, without any part of the

vehicle leaving the roadway, and with wheel lockup permitted only as follows:

(a) At vehicle speeds above 20 mph, any wheel on a nonsteerable axle other than the two rearmost nonliftable, nonsteerable axles may lock up, for any duration. The wheels on the two rearmost nonliftable, nonsteerable axles may lock up according to S5.3.1(b).

(b) At vehicle speeds above 20 mph, one wheel on any axle or two wheels on any tandem may lock up for any duration.

(c) At vehicle speeds above 20 mph, any wheel not permitted to lock in S5.3.1 (a) or (b) may lock up repeatedly, with each lockup occurring for a duration of one second or less.

(d) At vehicle speeds of 20 mph or less, any wheel may lock up for any duration.

S5.3.1.1 Stop the vehicle from 60 mph on a surface with a peak friction coefficient of 1.02 with the vehicle loaded as follows:

(a) Loaded to its GVWR so that the load on each axle, measured at the tire-ground interface, is most nearly proportional to the axles' respective GAWRs, without exceeding the GAWR of any axle.

(b) In the truck tractor only configuration plus up to 500 lbs. or, at the manufacturer's option, at its unloaded weight plus up to 500 lbs. (including driver and instrumentation) and plus not more than an additional 1,000 lbs. for a roll bar structure on the vehicle, and

(c) At its unloaded vehicle weight (except for truck tractors) plus up to 500 lbs. (including driver and instrumentation) or, at the manufacturer's option, at its unloaded weight plus up to 500 lbs. (including driver and instrumentation) plus not more than an additional 1,000 lbs. for a roll bar structure on the vehicle. If the speed attainable in two miles is less than 60 mph, the vehicle shall stop from a speed in Table II that is four to eight mph less than the speed attainable in two miles.

S5.3.2 [Reserved]

S5.3.3 *Brake actuation time.* Each service brake system shall meet the requirements of S5.3.3.1 (a) and (b).

S5.3.3.1(a) With an initial service reservoir system air pressure of 100 psi, the air pressure in each brake chamber shall, when measured from the first movement of the service brake control, reach 60 psi in not more than 0.45 second in the case of trucks and buses, 0.50 second in the case of trailers, other than trailer converter dollies, designed to tow another vehicle equipped with air brakes, 0.55 second in the case of trailer converter dollies, and 0.60 second in the case of trailers other than trailers designed to tow another vehicle equipped with air brakes. A vehicle designed to tow another vehicle equipped with air brakes shall meet the above actuation time requirement with a 50-cubic-inch test reservoir connected to the control line output coupling. A trailer, including a trailer converter dolly, shall meet the above actuation time requirement with its control line input coupling connected to the test rig shown in Figure 1.

(b) For a vehicle that is designed to tow another vehicle equipped with air brakes, the pressure in the 50-cubic-inch test reservoir referred to in S5.3.3.1(a) shall, when measured from the first movement of the service brake control, reach 60 psi not later than the time the fastest brake chamber on the vehicle reaches 60 psi or, at the option of the manufacturer, in not more than 0.35 second in the case of trucks and buses, 0.55 second in the case of trailer converter dollies, and 0.50 second in the case of trailers other than trailer converter dollies.

S5.3.4 *Brake release time.* Each service brake system shall meet the requirements of S5.3.4.1 (a) and (b).

S5.3.4.1(a) With an initial service brake chamber air pressure of 95 psi, the air pressure in each brake chamber shall, when measured from the first movement of the service brake control, fall to 5 psi in not more than 0.55 second in the case of trucks and buses; 1.00 second in the case of trailers, other than trailer converter dollies, designed to tow another vehicle equipped with air brakes; 1.10 seconds in the case of trailer converter dollies; and 1.20 seconds in the case of trailers other than trailers designed to tow another vehicle equipped with air brakes. A vehicle designated to tow another vehicle

equipped with air brakes shall meet the above release time requirement with a 50-cubic-inch test reservoir connected to the control line output coupling. A trailer, including a trailer converter dolly, shall meet the above release time requirement with its control line input coupling connected to the test rig shown in Figure 1.

(b) For vehicles designed to tow another vehicle equipped with air brakes, the pressure in the 50-cubic-inch test reservoir referred to in S5.3.4.1(a) shall, when measured from the first movement of the service brake control, fall to 5 psi in not more than 0.75 seconds in the case of trucks and buses, 1.10 seconds in the case of trailer converter dollies, and 1.00 seconds in the case of trailers other than trailer converter dollies.

S5.3.5 *Control signal pressure differential—converter dollies and trailers designed to tow another vehicle equipped with air brakes.*

(a) For a trailer designed to tow another vehicle equipped with air brakes, the pressure differential between the control line input coupling and a 50-cubic-inch test reservoir attached to the control line output coupling shall not exceed the values specified in S5.3.5(a) (1), (2), and (3) under the conditions specified in S5.3.5(b) (1) through (4):

(1) 1 psi at all input pressures equal to or greater than 5 psi, but not greater than 20 psi;

(2) 2 psi at all input pressures equal to or greater than 20 psi but not greater than 40 psi; and

(3) Not more than a 5-percent differential at any input pressure equal to or greater than 40 psi.

(b) The requirements in S5.3.5(a) shall be met—

(1) When the pressure at the input coupling is steady, increasing or decreasing;

(2) When air is applied to or released from the control line input coupling using the trailer test rig shown in Figure 1;

(3) With a fixed orifice consisting of a 0.0180 inch diameter hole (no. 77 drill bit) in a 0.032 inch thick disc installed in the control line between the trailer test rig coupling and the vehicle's control line input coupling; and

(4) Operating the trailer test rig in the same manner and under the same conditions as it is operated during testing to measure brake actuation and release times, as specified in S5.3.3 and S5.3.4, except for the installation of the orifice in the control line to restrict airflow rate.

S5.3.6 Stability and control during braking—trucks and buses. When stopped four consecutive times for each combination of weight, speed, and road conditions specified in S5.3.6.1 and S5.3.6.2, each truck tractor shall stop at least three times within the 12-foot lane, without any part of the vehicle leaving the roadway. When stopped four consecutive times for each combination of weight, speed, and road conditions specified in S5.3.6.1 and S5.3.6.2, each bus and truck (other than a truck tractor) manufactured on or after July 1, 2005, and each bus and truck (other than a truck tractor) manufactured in two or more stages on or after July 1, 2006, shall stop at least three times within the 12-foot lane, without any part of the vehicle leaving the roadway.

S5.3.6.1 Using a full-treadle brake application for the duration of the stop, stop the vehicle from 30 mph or 75 percent of the maximum drive-through speed, whichever is less, on a 500-foot radius curved roadway with a wet level surface having a peak friction coefficient of 0.55 when measured on a straight or curved section of the curved roadway using an ASTM F2493 standard reference tire, in accordance with ASTM E1337–19 (incorporated by reference, see § 571.5), at a speed of 40 mph, with water delivery.

S5.3.6.2 Stop the vehicle, with the vehicle:

(a) Loaded to its GVWR, for a truck tractor, and

(b) At its unloaded weight plus up to 500 pounds (including driver and instrumentation), or at the manufacturer's option, at its unloaded weight plus up to 500 pounds (including driver and instrumentation) and plus not more than an additional 1000 pounds for a roll bar structure on the vehicle, for a truck, bus, or truck tractor.

S5.4 *Service brake system—dynamometer tests.* When tested without prior road testing, under the conditions of

S6.2, each brake assembly shall meet the requirements of S5.4.1, S5.4.2, and S5.4.3 when tested in sequence and without adjustments other than those specified in the standard. For purposes of the requirements of S5.4.2 and S5.4.3, an average deceleration rate is the change in velocity divided by the deceleration time measured from the onset of deceleration.

S5.4.1 *Brake retardation force.* The sum of the retardation forces exerted by the brakes on each vehicle designed to be towed by another vehicle equipped with air brakes shall be such that the quotient sum of the brake retardation forces / sum of GAWR's relative to brake chamber air pressure, and shall have values not less than those shown in Column 1 of Table III. Retardation force shall be determined as follows:

S5.4.1.1 After burnishing the brake pursuant to S6.2.6, retain the brake assembly on the inertia dynamometer. With an initial brake temperature between 125 °F. and 200 °F., conduct a stop from 50 m.p.h., maintaining brake chamber air pressure at a constant 20 psi. Measure the average torque exerted by the brake from the time the specified air pressure is reached until the brake stops and divide by the static loaded tire radius specified by the tire manufacturer to determine the retardation force. Repeat the procedure six times, increasing the brake chamber air pressure by 10 psi each time. After each stop, rotate the brake drum or disc until the temperature of the brake falls to between 125 °F. and 200 °F.

S5.4.2 *Brake power.* When mounted on an inertia dynamometer, each brake shall be capable of making 10 consecutive decelerations at an average rate of 9 f.p.s.p.s. from 50 m.p.h. to 15 m.p.h., at equal intervals of 72 seconds, and shall be capable of decelerating to a stop from 20 m.p.h. at an average deceleration rate of 14 f.p.s.p.s. 1 minute after the 10th deceleration. The series of decelerations shall be conducted as follows:

S5.4.2.1 With an initial brake temperature between 150 °F. and 200 °F. for the first brake application, and the drum or disc rotating at a speed equivalent to 50 m.p.h., apply the brake and decelerate at an average deceleration rate of 9 f.p.s.p.s. to 15 m.p.h. Upon reaching 15 m.p.h., accelerate to 50 m.p.h. and apply the brake for a second time 72 seconds after the start of the first application. Repeat the cycle until 10 decelerations have been made. The service line air pressure shall not exceed 100 psi during any deceleration.

S5.4.2.2 One minute after the end of the last deceleration required by S5.4.2.1 and with the drum or disc rotating at a speed of 20 m.p.h., decelerate to a stop at an average deceleration rate of 14 f.p.s.p.s.

S5.4.3 *Brake recovery.* Except as provided in S5.4.3(a) and (b), starting two minutes after completing the tests required by S5.4.2, a vehicle's brake shall be capable of making 20 consecutive stops from 30 mph at an average deceleration rate of 12 f.p.s.p.s., at equal intervals of one minute measured from the start of each brake application. The service line air pressure needed to attain a rate of 12 f.p.s.p.s. shall be not more than 85 lb/in^2, and not less than 20lb/in^2 for a brake not subject to the control of an antilock system, or 12 lb/in^2 for a brake subject to the control of an antilock system.

(a) Notwithstanding S5.4.3, neither front axle brake of a truck-tractor is subject to the requirements set forth in S5.4.3.

(b) Notwithstanding S5.4.3, neither front axle brake of a bus or a truck other than a truck-tractor is subject to the requirement set forth in S5.4.3 prohibiting the service line air pressure from being less than 20 lb/in^2 for a brake not subject to the control of an antilock system or 12 lb/in^2 for a brake subject to the control of an antilock system.

S5.5 *Antilock system.*

S5.5.1 *Antilock system malfunction.* On a truck tractor manufactured on or after March 1, 1997, that is equipped with an antilock brake system and a single unit vehicle manufactured on or after March 1, 1998, that is equipped with an antilock brake system, a malfunction that affects the generation or transmission of response or control signals of any part of the antilock system shall not increase the actuation and release times of the service brakes.

S5.5.2 *Antilock system power—trailers.* On a trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, that is equipped with an antilock system that requires electrical power for operation, the power shall be obtained from the towing vehicle through one or more electrical circuits which provide continuous power whenever the powered vehicle's ignition (start) switch is in the ''on'' (''run'') position. The antilock system shall automatically receive power from the stoplamp circuit, if the primary circuit or circuits are not functioning. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, that is equipped to tow another air-braked vehicle shall be equipped with one or more circuits which provide continuous power to the antilock system on the vehicle(s) it tows. Such circuits shall be adequate to enable the antilock system on each towed vehicle to be fully operable.

S5.6 *Parking brakes.*

(a) Except as provided in S5.6(b) and S5.6(c), each vehicle other than a trailer converter dolly shall have a parking brake system that under the conditions of S6.1 meets the requirements of:

(1) S5.6.1 or S5.6.2, at the manufacturer's option, and

(2) S5.6.3, S5.6.4, S5.6.5, and S5.6.6.

(b) At the option of the manufacturer, for vehicles equipped with brake systems which incorporate a common diaphragm, the performance requirements specified in S5.6(a) which must be met with any single leakage-type failure in a common diaphragm may instead be met with the level of leakage-type failure determined in S5.6.7. The election of this option does not affect the performance requirements specified in S5.6(a) which apply with single leakage-type failures other than failures in a common diaphragm.

(c) At the option of the manufacturer, the trailer portion of any agricultural commodity trailer, heavy hauler trailer, or pulpwood trailer may meet the requirements of § 393.43 of this title instead of the requirements of S5.6(a).

S5.6.1 *Static retardation force.* With all other brakes made inoperative, during a static drawbar pull in a forward or rearward direction, the static retardation force produced by the application of the parking brakes shall be:

(a) In the case of a vehicle other than a truck-tractor that is equipped with more than two axles, such that the quotient static retardation force/GAWR is not less than 0.28 for any axle other than a steerable front axle; and

(b) In the case of a truck-tractor that is equipped with more than two axles, such that the quotient static retardation force/GVWR is not less than 0.14.

S5.6.2 *Grade holding.* With all parking brakes applied, the vehicle shall remain stationary facing uphill and facing downhill on a smooth, dry portland cement concrete roadway with a 20-percent grade, both

(a) When loaded to its GVWR, and

(b) At its unloaded vehicle weight plus 1500 pounds (including driver and instrumentation and roll bar).

S5.6.3 *Application and holding.* Each parking brake system shall meet the requirements of S5.6.3.1 through S5.6.3.4.

S5.6.3.1 The parking brake system shall be capable of achieving the minimum performance specified either in S5.6.1 or S5.6.2 with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (excluding failure of a component of a brake chamber housing but including failure of any brake chamber diaphragm that is part of any other brake system including a diaphragm which is common to the parking brake system and any other brake system), when the pressures in the vehicle's parking brake chambers are at the levels determined in S5.6.3.4.

S5.6.3.2 A mechanical means shall be provided that, after a parking brake application is made with the pressures in the vehicle's parking brake chambers at the levels determined in S5.6.3.4, and all air and fluid pressures in the vehicle's braking systems are then bled down to zero, and without using electrical power, holds the parking brake application with sufficient parking retardation force to meet the minimum performance specified in S5.6.3.1 and in either S5.6.1 or S5.6.2.

S5.6.3.3 For trucks and buses, with an initial reservoir system pressure of 100 psi and, if designed to tow a vehicle

equipped with air brakes, with a 50 cubic inch test reservoir connected to the supply line coupling, no later than three seconds from the time of actuation of the parking brake control, the mechanical means referred to in S5.6.3.2 shall be actuated. For trailers, with the supply line initially pressurized to 100 psi using the supply line portion of the trailer test rig (Figure 1) and, if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the rear supply line coupling, no later than three seconds from the time venting to the atmosphere of the front supply line coupling is initiated, the mechanical means referred to in S5.6.3.2 shall be actuated. This requirement shall be met for trucks, buses and trailers both with and without any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.3.4 The parking brake chamber pressures for S5.6.3.1 and S5.6.3.2 are determined as follows. For trucks and buses, with an initial reservoir system pressure of 100 psi and, if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the supply line coupling, any single leakage type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The parking brake control is actuated and the pressures in the vehicle's parking brake chambers are measured three seconds after that actuation is initiated. For trailers, with the supply line initially pressurized to 100 psi using the supply line portion of the trailer test rig (Figure 1) and, if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the rear supply line coupling, any single leakage type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The front supply line coupling is vented to the atmosphere and the pressures in the vehicle's parking brake chambers are measured three seconds after that venting is initiated.

S5.6.4 *Parking brake control—trucks and buses.* The parking brake control shall be separate from the service brake control. It shall be operable by a person seated in the normal driving position. The control shall be identified in a manner that specifies the method of control operation. The parking brake control shall control the parking brakes of the vehicle and of any air braked vehicle that it is designed to tow.

S5.6.5 *Release Performance.* Each parking brake system shall meet the requirements specified in S5.6.5.1 through S5.6.5.4.

S5.6.5.1 For trucks and buses, with initial conditions as specified in S5.6.5.2, at all times after an application actuation of the parking brake control, and with any subsequent level of pressure, or combination of levels of pressure, in the reservoirs of any of the vehicle's brake systems, no reduction in parking brake retardation force shall result from a release actuation of the parking brake control unless the parking brakes are capable, after such release, of being reapplied at a level meeting the minimum performance specified either in S5.6.1 or S5.6.2. This requirement shall be met both with and without the engine on, and with and without single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.5.2 The initial conditions for S5.6.5.1 are as follows: The reservoir system pressure is 100 psi. If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir is connected to the supply line coupling.

S5.6.5.3 For trailers, with initial conditions as specified in S5.6.5.4, at all times after actuation of the parking brakes by venting the front supply line coupling to the atmosphere, and with any subsequent level of pressure, or combination of levels of pressure, in the reservoirs of any of the vehicle's brake systems, the parking brakes

shall not be releasable by repressurizing the supply line using the supply line portion of the trailer test rig (Figure 1) to any pressure above 70 psi, unless the parking brakes are capable, after such release, of reapplication by subsequent venting of the front supply line coupling to the atmosphere, at a level meeting the minimum performance specified either in S5.6.1 or S5.6.2. This requirement shall be met both with and without any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.5.4 The initial conditions for S5.6.5.3 are as follows: The reservoir system and supply line are pressurized to 100 psi, using the supply line portion of the trailer test rig (Figure 1). If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir is connected to the rear supply line coupling.

S5.6.6 *Accumulation of actuation energy*. Each parking brake system shall meet the requirements specified in S5.6.6.1 through S5.6.6.6.

S5.6.6.1 For trucks and buses, with initial conditions as specified in S5.6.6.2, the parking brake system shall be capable of meeting the minimum performance specified either in S5.6.1 or S5.6.2, with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1) at the conclusion of the test sequence specified in S5.6.6.3.

S5.6.6.2 The initial conditions for S5.6.6.1 are as follows: The engine is on. The reservoir system pressure is 100 psi. If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir is connected to the supply line coupling.

S5.6.6.3 The test sequence for S5.6.6.1 is as follows: The engine is turned off. Any single leakage type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is then introduced in the brake system. An application actuation of the parking brake control is then made. Thirty seconds after such actuation, a release actuation of the parking brake control is made. Thirty seconds after the release actuation, a final application actuation of the parking brake control is made.

S5.6.6.4 For trailers, with initial conditions as specified in S5.6.6.5, the parking brake system shall be capable of meeting the minimum performance specified either in S5.6.1 or S5.6.2, with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), at the conclusion of the test sequence specified in S5.6.6.6.

S5.6.6.5 The initial conditions for S5.6.6.4 are as follows: The reservoir system and supply line are pressurized to 100 psi, using the supply line portion of the trailer test rig (Figure 1). If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir is connected to the rear supply line coupling.

S5.6.6.6 The test sequence for S5.6.6.4 is as follows. Any single leakage type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The front supply line coupling is vented to the atmosphere. Thirty seconds after the initiation of such venting, the supply line is repressurized with the trailer test rig (Figure 1). Thirty seconds after the initiation of such repressurizing of the supply line, the front supply line is vented to the atmosphere. This procedure is conducted either by connection and disconnection of the supply line coupling or by use of a valve installed in the supply line portion of the trailer test rig near the supply line coupling.

S5.6.7 *Maximum level of common diaphragm leakage-type failure/ Equivalent level of leakage from the air chamber containing that diaphragm*. In the case of vehicles for which the option in S5.6(b) has been elected, determine the maximum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) according

to the procedures set forth in S5.6.7.1 through S5.6.7.2.3.

S5.6.7.1 *Trucks and buses.*

S5.6.7.1.1 According to the following procedure, determine the threshold level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which the vehicle's parking brakes become unreleasable. With an initial reservoir system pressure of 100 psi, the engine turned off, no application of any of the vehicle's brakes, and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, introduce a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm). Apply the parking brakes by making an application actuation of the parking brake control. Reduce the pressures in all of the vehicle's reservoirs to zero, turn on the engine and allow it to idle, and allow the pressures in the vehicle's reservoirs to rise until they stabilize or until the compressor shut-off point is reached. At that time, make a release actuation of the parking brake control, and determine whether all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation force to meet the minimum performance specified in either S5.6.1 or S5.6.2. Repeat this procedure with progressively decreasing or increasing levels (whichever is applicable) of leakage-type diaphragm failures or equivalent leakages, to determine the minimum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2.

S5.6.7.1.2 At the level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) determined in S5.6.7.1.1, and using the following procedure, determine the threshold maximum reservoir rate (in psi per minute). With an initial reservoir system pressure of 100 psi, the engine turned off, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, make an application actuation of the parking brake control. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application.

S5.6.7.1.3 Using the following procedure, introduce a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm) that results in a maximum reservoir leakage rate that is three times the threshold maximum reservoir leakage rate determined in S5.6.7.1.2. With an initial reservoir system pressure of 100 psi, the engine turned off, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, make an application actuation of the parking brake control. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application. The level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) associated with this reservoir leakage rate is the level that is to be used under the option set forth in S5.6(b).

S5.6.7.2 *Trailers.*

S5.6.7.2.1 According to the following procedure, determine the threshold level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which the vehicle's parking brakes become unreleasable. With an initial reservoir system and supply line pressure of 100 psi, no application of any of the vehicle's brakes, and, if the vehicle is designed to tow a vehicle equipped with

air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, introduce a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm). Make a parking brake application by venting the front supply line coupling to the atmosphere, and reduce the pressures in all of the vehicle's reservoirs to zero. Pressurize the supply line by connecting the trailer's front supply line coupling to the supply line portion of the trailer test rig (Figure 1) with the regulator of the trailer test rig set at 100 psi, and determine whether all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2. Repeat this procedure with progressively decreasing or increasing levels (whichever is applicable) of leakage-type diaphragm failures or equivalent leakages, to determine the minimum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2.

S5.6.7.2.2 At the level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) determined in S5.6.7.2.1, and using the following procedure, determine the threshold maximum reservoir leakage rate (in psi per minute). With an initial reservoir system and supply line pressure of 100 psi, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the rear supply line coupling, make a parking brake application by venting the front supply line coupling to the atmosphere. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application.

S5.6.7.2.3 Using the following procedure, a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm) that results in a maximum reservoir leakage rate that is three times the threshold maximum reservoir leakage rate determined in S5.6.7.2.2. With an initial reservoir system and supply line pressure of 100 psi, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the rear supply line coupling, make a parking brake application by venting the front supply line coupling to the atmosphere. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application. The level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) associated with this reservoir leakage rate is the level that is to be used under the option set forth in S5.6(b).

S5.7 *Emergency brake system for trucks and buses.* Each vehicle shall be equipped with an emergency brake system which, under the conditions of S6.1, conforms to the requirements of S5.7.1 through S5.7.3. However, the truck portion of an auto transporter need not meet the road test requirements of S5.7.1 and S5.7.3.

S5.7.1 *Emergency brake system performance.* When stopped six times for each combination of weight and speed specified in S5.3.1.1, except for a loaded truck tractor with an unbraked control trailer, on a road surface having a PFC of 1.02, with a single failure in the service brake system of a part designed to contain compressed air or brake fluid (except failure of a common valve, manifold, brake fluid housing, or brake chamber housing), the vehicle shall stop at least once in not more than the distance specified in Column 5 of Table II, measured from the point at which movement of the service brake control begins, except that a truck-tractor tested at its unloaded vehicle weight

plus up to 1,500 pounds shall stop at least once in not more than the distance specified in Column 6 of Table II. The stop shall be made without any part of the vehicle leaving the roadway, and with unlimited wheel lockup permitted at any speed.

S5.7.2 *Emergency brake system operation.* The emergency brake system shall be applied and released, and be capable of modulation, by means of the service brake control.

S5.7.3 *Towing vehicle emergency brake requirements.* In addition to meeting the other requirements of S5.7, a vehicle designed to tow another vehicle equipped with air brakes shall—

(a) In the case of a truck-tractor in the unloaded condition and a single unit truck which is capable of towing an airbrake equipped vehicle and is loaded to GVWR, be capable of meeting the requirements of S5.7.1 by operation of the service brake control only, with the trailer air supply line and air control line from the towing vehicle vented to the atmosphere in accordance with S6.1.14;

(b) Be capable of modulating the air in the supply or control line to the trailer by means of the service brake control with a single failure in the towing vehicle service brake system as specified in S5.7.1.

(c) [Reserved]

S5.8 *Emergency brakes for trailers.* Each trailer shall meet the requirements of S5.8.1 through S5.8.3.

S5.8.1 *Emergency braking capability.* Each trailer other than a trailer converter dolly shall have a parking brake system that conforms to S5.6 and that applies with the force specified in S5.6.1 or S5.6.2 when the air pressure in the supply line is at atmospheric pressure. A trailer converter dolly shall have, at the manufacturer's option—

(a) A parking brake system that conforms to S5.6 and that applies with the force specified in S5.6.1 or S5.6.2 when the air pressure in the supply line is at atmospheric pressure, or

(b) An emergency system that automatically applies the service brakes when the service reservoir is at any pressure above 20 lb/in^2 and the supply line is at atmospheric pressure. However, any agricultural commodity trailer, heavy hauler trailer, or pulpwood trailer shall meet the requirements of S5.8.1 or, at the option of the manufacturer, the requirements of §393.43 of this title.

S5.8.2 *Supply line pressure retention.* Any single leakage type failure in the service brake system (except for a failure of the supply line, a valve directly connected to the supply line or a component of a brake chamber housing) shall not result in the pressure in the supply line falling below 70 psi, measured at the forward trailer supply coupling. A trailer shall meet the above supply line pressure retention requirement with its brake system connected to the trailer test rig shown in Figure 1, with the reservoirs of the trailer and test rig initially pressurized to 100 psi and the regulator of the trailer test rig set at 100 psi; except that a trailer equipped with an air-applied, mechanically-held parking brake system and not designed to tow a vehicle equipped with air brakes, at the manufacturer's option, may meet the requirements of S5.8.4 rather than those of S5.8.2 and S5.8.3.

S5.8.3 *Automatic application of parking brakes.* With an initial reservoir system pressure of 100 psi and initial supply line pressure of 100 psi, and if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the rear supply line coupling, and with any subsequent single leakage type failure in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), whenever the air pressure in the supply line is 70 psi or higher, the parking brakes shall not provide any brake retardation as a result of complete or partial automatic application of the parking brakes.

S5.8.4 *Automatic application of air-applied, mechanically held parking brakes.* With its brake system connected to the supply line portion of the trailer test rig (Figure 1) and the regulator of the trailer test rig set at 100 psi, and with any single leakage type failure in the service brake system (except for a failure of the supply line, a valve directly connected to the supply line or a component of a brake chamber, but including failure of any common diaphragm), the parking brakes shall not provide

any brake retardation as a result of complete or partial automatic application of the parking brakes.

S5.9 *Final inspection.* Inspect the service brake system for the condition of adjustment and for the brake indicator display in accordance with S5.1.8 and S5.2.2.

S6. *Conditions.* The requirements of S5 shall be met by a vehicle when it is tested according to the conditions set in this S6, without replacing any brake system part or making any adjustments to the brake system except as specified. Unless otherwise specified, where a range of conditions is specified, the vehicle must be capable of meeting the requirements at all points within the range. On vehicles equipped with automatic brake adjusters, the automatic brake adjusters must remain activated at all times. Compliance of vehicles manufactured in two or more stages may, at the option of the final-stage manufacturer, be demonstrated to comply with this standard by adherence to the instructions of the incomplete vehicle manufacturer provided with the vehicle in accordance with § 568.4(a)(7)(ii) and § 568.5 of title 49 of the Code of Federal Regulations.

S6.1 *Road test conditions.*

S6.1.1 Except as otherwise specified, the vehicle is loaded to its GVWR, distributed proportionally to its GAWRs. During the burnish procedure specified in S6.1.8, truck tractors shall be loaded to their GVWR, by coupling them to an unbraked flatbed semitrailer, which semitrailer shall be loaded so that the weight of the tractor-trailer combination equals the GVWR of the truck tractor. The load on the unbraked flatbed semitrailer shall be located so that the truck tractor's wheels do not lock during burnish.

S6.1.2 The inflation pressure is as specified by the vehicle manufacturer for the GVWR.

S6.1.3 Unless otherwise specified, the transmission selector control is in neutral or the clutch is disengaged during all decelerations and during static parking brake tests.

S6.1.4 All vehicle openings (doors, windows, hood, trunk, cargo doors, etc.) are in a closed position except as required for instrumentation purposes.

S6.1.5 The ambient temperature is between 32 °F. and 100 °F.

S6.1.6 The wind velocity is zero.

S6.1.7 Unless otherwise specified, stopping tests are conducted on a 12-foot wide level, straight roadway having a peak friction coefficient of 1.02. For road tests in S5.3, the vehicle is aligned in the center of the roadway at the beginning of a stop. Peak friction coefficient is measured using an ASTM F2493 standard reference test tire in accordance with ASTM E1337–19 (incorporated by reference, see § 571.5), at a speed of 40 mph, without water delivery for the surface with PFC of 1.02, and with water delivery for the surface with PFC of 0.55.

S6.1.8 For vehicles with parking brake systems not utilizing the service brake friction elements, burnish the friction elements of such systems prior to the parking brake test according to the manufacturer's recommendations. For vehicles with parking brake systems utilizing the service brake friction elements, burnish the brakes as follows: With the transmission in the highest gear appropriate for a speed of 40 mph, make 500 snubs between 40 mph and 20 mph at a deceleration rate of 10 f.p.s.p.s., or at the vehicle's maximum deceleration rate if less than 10 f.p.s.p.s. Except where an adjustment is specified, after each brake application accelerate to 40 mph and maintain that speed until making the next brake application at a point 1 mile from the initial point of the previous brake application. If the vehicle cannot attain a speed of 40 mph in 1 mile, continue to accelerate until the vehicle reaches 40 mph or until the vehicle has traveled 1.5 miles from the initial point of the previous brake application, whichever occurs first. Any automatic pressure limiting valve is in use to limit pressure as designed. The brakes may be adjusted up to three times during the burnish procedure, at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing, in accordance with the vehicle manufacturer's recommendation.

S6.1.9 Static parking brake tests for a semitrailer are conducted with the front-end supported by an unbraked

dolly. The weight of the dolly is included as part of the trailer load.

S6.1.10 In a test other than a static parking test, a truck tractor is tested at its GVWR by coupling it to an unbraked flatbed semi-trailer (hereafter, control trailer) as specified in S6.1.10.2 to S6.1.10.4.

S6.1.10.1 [Reserved]

S6.1.10.2 The center of gravity height of the ballast on the loaded control trailer shall be less than 24 inches above the top of the tractor's fifth wheel.

S6.1.10.3 The control trailer has a single axle with a GAWR of 18,000 pounds and a length, measured from the transverse centerline of the axle to the centerline of the kingpin, of 258 ±6 inches.

S6.1.10.4 The control trailer is loaded so that its axle is loaded at 4,500 pounds and the tractor is loaded to its GVWR, loaded above the kingpin only, with the tractor's fifth wheel adjusted so that the load on each axle measured at the tire-ground interface is most nearly proportional to the axles' respective GAWRs, without exceeding the GAWR of the tractor's axle or axles or control trailer's axle.

S6.1.11 *Special drive conditions.* A vehicle equipped with an interlocking axle system or a front wheel drive system that is engaged and disengaged by the driver is tested with the system disengaged.

S6.1.12 *Liftable axles.* A vehicle with a liftable axle is tested at GVWR with the liftable axle down and at unloaded vehicle weight with the liftable axle up.

S6.1.13 *Trailer test rig.*

The trailer test rig shown in Figure 1 is calibrated in accordance with the calibration curves shown in Figure 3. For the requirements of S5.3.3.1 and S5.3.4.1, the pressure in the trailer test rig reservoir is initially set at 100 psi for actuation tests and 95 psi for release tests.

S6.1.14 In testing the emergency braking system of towing vehicles under S5.7.3(a), the hose(s) is vented to the atmosphere at any time not less than 1 second and not more than 1 minute before the emergency stop begins, while the vehicle is moving at the speed from which the stop is to be made and any manual control for the towing vehicle protection system is in the position to supply air and brake control signals to the vehicle being towed. No brake application is made from the time the line(s) is vented until the emergency stop begins and no manual operation of the parking brake system or towing vehicle protection system occurs from the time the line(s) is vented until the stop is completed.

S6.1.15 *Initial brake temperature.* Unless otherwise specified, the initial brake temperature is not less than 150 °F and not more than 200 °F.

S6.1.16 *Thermocouples.*

The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in Figure 2. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the rubbing surface of a drum or rotor. The second thermocouple shall be installed at a depth of .080 inch and located within 1 inch circumferentially of the thermocouple installed at .040 inch depth. For centergrooved shoes or pads, thermocouples are installed within one-eighth of an inch to one-quarter of an inch of the groove and as close to the center as possible.

S6.1.17 Selection of compliance options. Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S6.2 *Dynamometer test conditions.*

S6.2.1 The dynamometer inertia for each wheel is equivalent to the load on the wheel with the axle loaded to its GAWR. For a vehicle having additional GAWRs specified for operation at reduced speeds, the GAWR used is that specified for a speed of 50 mph, or, at the option of the manufacturer, any speed greater than 50 mph.

S6.2.2 The ambient temperature is between 75 °F. and 100 °F.

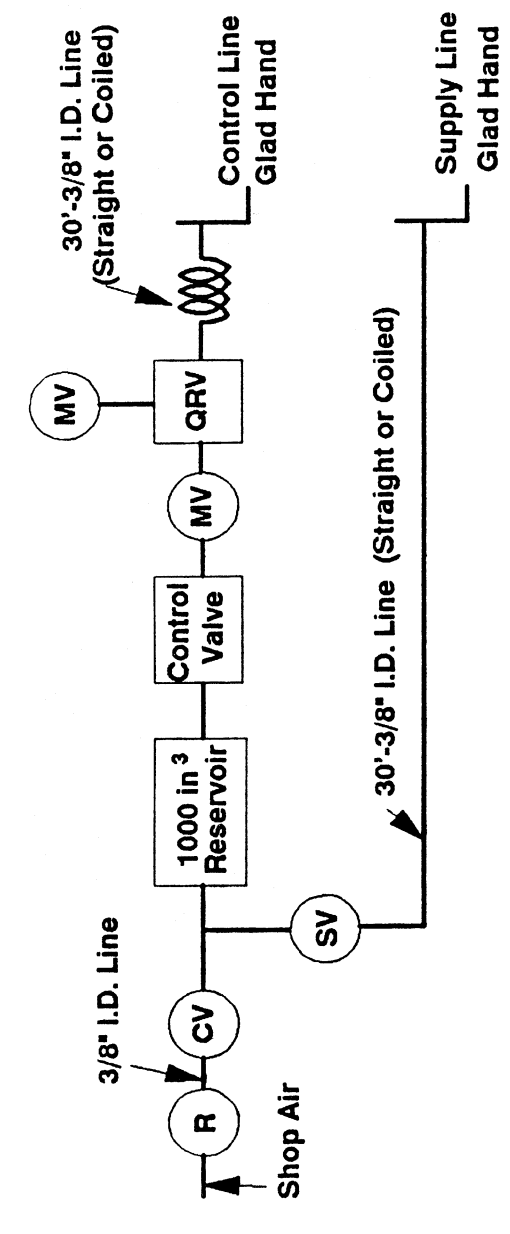
S6.2.3 Air at ambient temperature is directed uniformly and continuously over the brake drum or disc at a velocity of 2,200 feet per minute.

S6.2.4 The temperature of each brake is measured by a single plug-type thermocouple installed in the center of the lining surface of the most heavily loaded shoe or pad as shown in Figure 2. The thermocouple is outside any center groove.

S6.2.5 The rate of brake drum or disc rotation on a dynamometer corresponding to the rate of rotation on a vehicle at a given speed is calculated by assuming a tire radius equal to the static loaded radius specified by the tire manufacturer.

S6.2.6 Brakes are burnished before testing as follows: place the brake assembly on an inertia dynamometer and adjust the brake as recommended by the vehicle manufacturer. Make 200 stops from 40 mph at a deceleration of 10 f.p.s.p.s., with an initial brake temperature on each stop of not less than 315 °F and not more than 385 °F. Make 200 additional stops from 40 mph at a deceleration of 10 f.p.s.p.s. with an initial brake temperature on each stop of not less than 450 °F and not more than 550 °F. The brakes may be adjusted up to three times during the burnish procedure, at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing, in accordance with the vehicle manufacturer's recommendation.

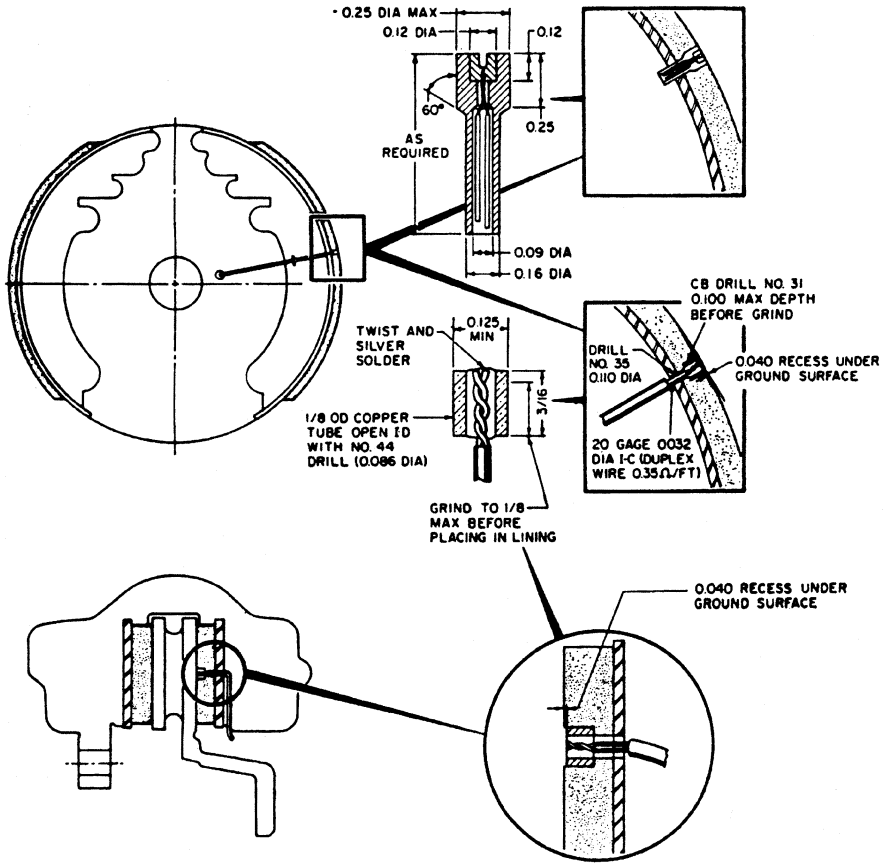
S6.2.7 The brake temperature is increased to a specified level by conducting one or more stops from 40 m.p.h. at a deceleration of 10 f.p.s.p.s. The brake temperature is decreased to a specified level by rotating the drum or disc at a constant 30 m.p.h.



SV - Shut-off Valve
R - Regulator (set at 100 psi for service brake actuation tests;
95 psi for service brake release tests;
100 psi for parking brake tests in S5.6.3.3, S5.6.3.4, S5.6.5.4, and S5.6.6.5,
and for the supply line pressure retention test in S5.8.2; and any
pressure above 70 psi for parking brake test in S5.6.5.3.)
CV - Check Valve
MV - Metering Valve (Variable or Fixed)
QRV - Quick Release Valve

Figure 1. Trailer Test Rig.

FIGURE 2
THERMOCOUPLE INSTALLATION



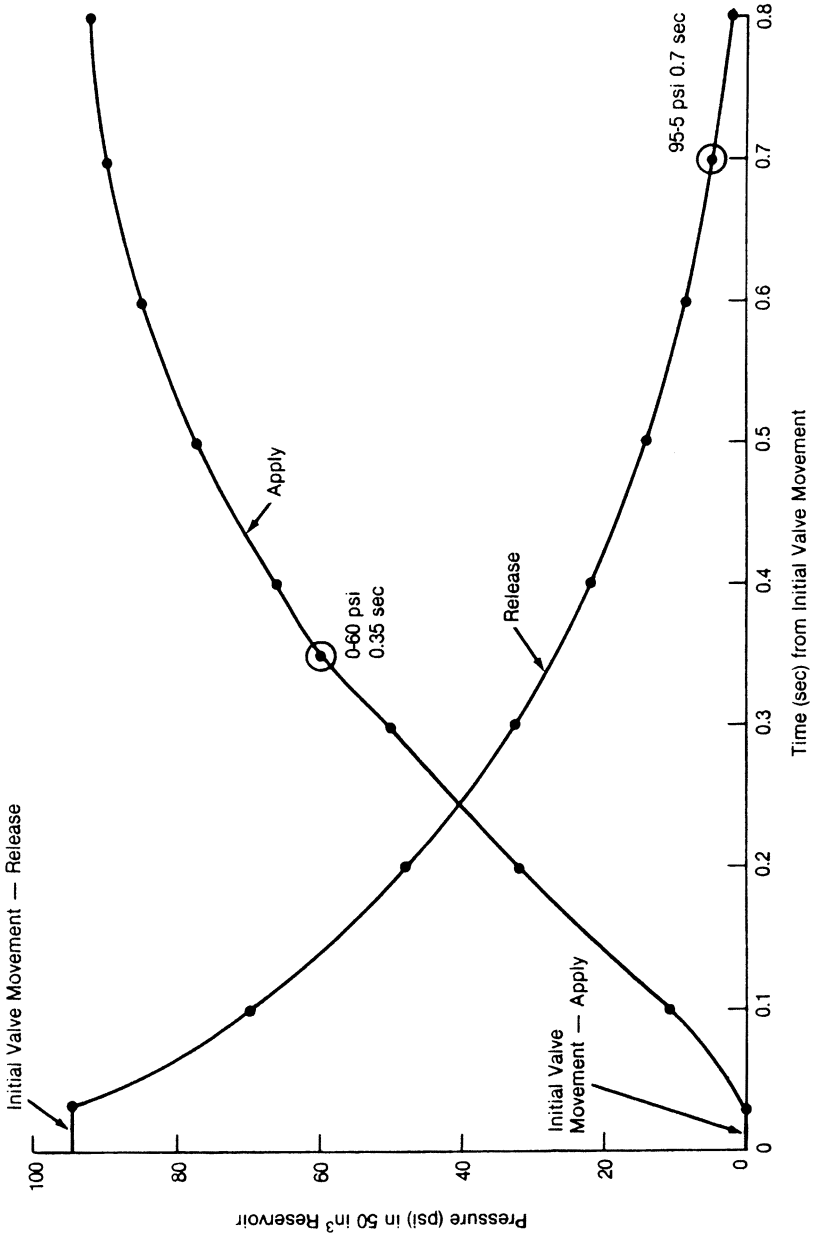


Figure 3. Pressure vs. Time for 50 in³ Test Reservoir.

TABLE I—STOPPING SEQUENCE

	Truck tractors	Single unit trucks and buses
Burnish (S6.1.8)	1	1

TABLE I—STOPPING SEQUENCE—Continued

	Truck tractors	Single unit trucks and buses
Stability and Control at GVWR (S5.3.6)	2	N/A
Stability and Control at LLVW (S5.3.6)	3	5
Manual Adjustment of Brakes	4	N/A
60 mph Service Brake Stops at GVWR (S5.3.1)	5	2
60 mph Emergency Service Brake Stops at GVWR (S5.7.1)	N/A	3
Parking Brake Test at GVWR (S5.6)	6	4
Manual Adjustment of Brakes	7	6
60 mph Service Brake Stops at LLVW (S5.3.1)	8	7
60 mph Emergency Service Brake Stops at LLVW (S5.7.1)	9	8
Parking Brake Test at LLVW (S5.6)	10	9
Final Inspection	11	10

TABLE II—STOPPING DISTANCE IN FEET

Vehicle speed in miles per hour	Service brake						Emergency brake	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
30	70	78	65	78	84	61	170	186
35	96	106	89	106	114	84	225	250
40	125	138	114	138	149	108	288	325
45	158	175	144	175	189	136	358	409
50	195	216	176	216	233	166	435	504
55	236	261	212	261	281	199	520	608
60	280	310	250	310	335	235	613	720

Note:
(1) Loaded and Unloaded Buses.
(2) Loaded Single-Unit Trucks.
(3) Loaded Tractors with Two Axles; or with Three Axles and a GVWR of 70,000 lbs. or less; or with Four or More Axles and a GVWR of 85,000 lbs. or less. Tested with an Unbraked Control Trailer.
(4) Loaded Tractors with Three Axles and a GVWR greater than 70,000 lbs.; or with Four or More Axles and a GVWR greater than 85,000 lbs. Tested with an Unbraked Control Trailer.
(5) Unloaded Single-Unit Trucks.
(6) Unloaded Tractors (Bobtail).
(7) All Vehicles except Tractors, Loaded and Unloaded.
(8) Unloaded Tractors (Bobtail).

TABLE IIA—STOPPING DISTANCE IN FEET: OPTIONAL REQUIREMENTS FOR: (1) THREE-AXLE TRACTORS WITH A FRONT AXLE THAT HAS A GAWR OF 14,600 POUNDS OR LESS, AND WITH TWO REAR DRIVE AXLES THAT HAVE A COMBINED GAWR OF 45,000 POUNDS OR LESS, MANUFACTURED BEFORE AUGUST 1, 2011; AND (2) ALL OTHER TRACTORS MANUFACTURED BEFORE AUGUST 1, 2013

Vehicle speed in miles per hour	Service brake				Emergency brake	
	(1)	(2)	(3)	(4)	(5)	(6)
30	70	78	84	89	170	186
35	96	106	114	121	225	250
40	125	138	149	158	288	325
45	158	175	189	200	358	409
50	195	216	233	247	435	504
55	236	261	281	299	520	608
60	280	310	335	355	613	720

Note: (1) Loaded and unloaded buses; (2) Loaded single unit trucks; (3) Unloaded truck tractors and single unit trucks; (4) Loaded truck tractors tested with an unbraked control trailer; (5) All vehicles except truck tractors; (6) Unloaded truck tractors.

TABLE III—BRAKE RETARDATION FORCE

Column 1 brake retardation force/GAWR	Column 2 brake chamber pressure, PSI
0.05	20
0.12	30
0.18	40

TABLE III—BRAKE RETARDATION FORCE—Continued

Column 1 brake retardation force/GAWR	Column 2 brake chamber pressure, PSI
0.25	50
0.31	60

TABLE III—BRAKE RETARDATION FORCE—Continued

Column 1 brake retardation force/GAWR	Column 2 brake chamber pressure, PSI
0.37	70

TABLE III—BRAKE RETARDATION FORCE—Continued

Column 1 brake retardation force/GAWR	Column 2 brake chamber pressure, PSI
0.41	80

TABLE IV [RESERVED]

TABLE V—BRAKE CHAMBER RATED VOLUMES

Brake Chamber type (nominal area of piston or diaphragm in square inches)	Column 1 full stroke (inches)	Column 2 rated volume (cubic inches)
Type 9	1.75/2.10	25
Type 12	1.75/2.10	30
Type 14	2.25/2.70	40
Type 16	2.25/2.70	46
Type 18	2.25/2.70	50
Type 20	2.25/2.70	54
Type 24	2.50/3.20	67
Type 30	2.50/3.20	89
Type 36	3.00/3.60	135

[61 FR 27290, May 31, 1996, as amended at 61 FR 49695, Sept. 23, 1996; 61 FR 60636, Nov. 29, 1996; 63 FR 7727, Feb. 17, 1998; 66 FR 64158, Dec. 12, 2001; 67 FR 36820, May 28, 2002; 68 FR 47497, Aug. 11, 2003; 74 FR 9176, Mar. 3, 2009; 74 FR 42785, Aug. 25, 2009; 75 FR 15620, Mar. 30, 2010; 76 FR 44833, July 27, 2011; 77 FR 759, Jan. 6, 2012; 78 FR 9628, Feb. 11, 2013; 78 FR 21853, Apr. 12, 2013; 87 FR 34808, June 8, 2022]

§571.122 Standard No. 122; Motorcycle brake systems.

S1. *Scope*. This standard specifies requirements for motorcycle service brake systems and, where applicable, associated parking brake systems.

S2. *Purpose*. The purpose of the standard is to ensure safe motorcycle braking performance under normal and emergency riding conditions.

S3. *Application*. This standard applies to category 3–1 motorcycles, category 3–2 motorcycles, category 3–3 motorcycles, and category 3–4 motorcycles manufactured on and after September 1, 2014. This standard applies to category 3–5 motorcycles manufactured on and after September 1, 2015. At the manufacturer's option, any motorcycle manufactured on or after October 23, 2012 may comply with this standard.

S4. *Definitions*.

Antilock brake system or *ABS* means a system which senses wheel slip and automatically modulates the pressure producing the braking forces at the wheel(s) to limit the degree of wheel slip.

Baseline test means a stop or a series of stops carried out in order to confirm the performance of the brake prior to subjecting it to a further test such as the heating procedure or wet brake stop.

Brake means those parts of the brake system where the forces opposing the movement of the motorcycle are developed.

Brake system means the combination of parts consisting of the control, the brake, and the components that provide the functional link between the control and the brake, but excluding the engine, whose function it is to progressively reduce the speed of a moving motorcycle, bring it to a halt, and keep it stationary when halted.

Category 3–1 motorcycle means a two-wheeled motorcycle with an engine cylinder capacity in the case of a thermic engine not exceeding 50 cubic centimeters (cm^3) and whatever the means of propulsion a maximum design speed not exceeding 50 kilometers per hour (km/h).

Category 3–2 motorcycle means a three-wheeled motorcycle of any wheel arrangement with an engine cylinder capacity in the case of a thermic engine not exceeding 50 cm^3 and whatever the means of propulsion a maximum design speed not exceeding 50 km/h.

Category 3–3 motorcycle means a two-wheeled motorcycle with an engine cylinder capacity in the case of a thermic engine exceeding 50 cm^3 or whatever the means of propulsion a maximum design speed exceeding 50 km/h.

Category 3–4 motorcycle means a motorcycle manufactured with three

wheels asymmetrically arranged in relation to the longitudinal median plane with an engine cylinder capacity in the case of a thermic engine exceeding 50 cm^3 or whatever the means of propulsion a maximum design speed exceeding 50 km/h. (This category definition is intended to include motorcycles with sidecars.)

Category 3–5 motorcycle means a motorcycle manufactured with three wheels symmetrically arranged in relation to the longitudinal median plane with an engine cylinder capacity in the case of a thermic engine exceeding 50 cm^3 or whatever the means of propulsion a maximum design speed exceeding 50 km/h.

Combined brake system or *CBS* means:

(a) For motorcycle categories 3–1 and 3–3: a service brake system where at least two brakes on different wheels are actuated by the operation of a single control.

(b) For motorcycle categories 3–2 and 3–5: a service brake system where the brakes on all wheels are actuated by the operation of a single control.

(c) For motorcycle category 3–4: a service brake system where the brakes on at least the front and rear wheels are actuated by the operation of a single control. (If the rear wheel and the asymmetrical wheel are braked by the same brake system, this is regarded as the rear brake.)

Control means the part actuated directly by the rider in order to supply and regulate the energy required for braking the motorcycle.

Driver mass means the nominal mass of a driver that equals 75 kg (68 kg occupant mass plus 7kg of luggage mass).

Engine disconnected means when the engine is no longer internally connected to the driving wheel(s), i.e., the clutch is disengaged and/or the transmission is in neutral.

Gross vehicle mass means the maximum mass of the fully laden solo vehicle, based on its construction and design performances, as declared by the manufacturer.

Initial brake temperature means the temperature of the hottest brake before any brake application.

Laden means the gross vehicle mass.

Lightly loaded means mass in running order plus 15 kg for test equipment, or the laden condition, whichever is less. In the case of ABS tests on a low friction surface (paragraphs S6.9.4 to S6.9.7), the mass for test equipment is increased to 30 kg to account for outriggers.

Mass in running order means the sum of unladen vehicle mass and driver mass.

Peak braking coefficient or *PBC* means the measure of tire-to-road surface friction based on the maximum deceleration of a rolling tire.

Power-assisted braking system means a brake system in which the energy necessary to produce the braking force is supplied by the physical effort of the rider assisted by one or more energy supplying devices, for example vacuum assisted (with vacuum booster).

Secondary brake system means the second service brake system on a motorcycle equipped with a combined brake system.

Service brake system means a brake system which is used for slowing the motorcycle when in motion.

Sidecar means a one-wheeled vehicle that is attached to the side of a motorcycle.

Single brake system means a brake system which acts on only one axle.

Split service brake system or *SSBS* means a brake system that operates the brakes on all wheels, consisting of two or more subsystems actuated by a single control designed so that a single failure in any subsystem (such as a leakage type failure of a hydraulic subsystem) does not impair the operation of any other subsystem.

Stopping distance means the distance traveled by the motorcycle from the point the rider begins to actuate the brake control to the point at which the motorcycle reaches full stop. For tests where simultaneous actuation of two controls is specified, the distance traveled is taken from the point the first control is actuated.

Test speed means the motorcycle speed measured the moment the rider begins to actuate the brake control. For tests where simultaneous actuation of two controls is specified, the motorcycle speed is taken from the moment the first control is actuated.

Unladen vehicle mass means the nominal mass of a complete vehicle as determined by the following criteria:

(a) Mass of the vehicle with bodywork and all factory fitted equipment, electrical and auxiliary equipment for normal operation of vehicle, including liquids, tools, fire extinguisher, standard spare parts, chocks and spare wheel, if fitted.

(b) The fuel tanks filled to at least 90 percent of rated capacity and the other liquid containing systems (except those for used water) to 100 percent of the capacity specified by the manufacturer.

Vmax means either the speed attainable by accelerating at a maximum rate from a standing start for a distance of 1.6 km on a level surface, with the vehicle lightly loaded, or the speed measured in accordance with International Organization for Standardization (ISO) 7117:1995(E) (incorporated by reference; see §571.5).

Wheel lock means the condition that occurs when there is 100 percent wheel slip.

S5. *General requirements.*

S5.1 *Brake system requirements.* Each motorcycle shall meet each of the test requirements specified for a motorcycle of its category and for those brake features on the motorcycle.

S5.1.1 *Service brake system control operation.* Each motorcycle shall have a configuration that enables a rider to actuate the service brake system control while seated in the normal driving position and with both hands on the steering control.

S5.1.2 *Secondary brake system control operation.* Each motorcycle shall have a configuration that enables a rider to actuate the secondary brake system control while seated in the normal driving position and with at least one hand on the steering control.

S5.1.3 *Parking brake system.*

(a) If a parking brake system is fitted, it shall hold the motorcycle stationary on the slope prescribed in S6.8.2. The parking brake system shall:

(1) have a control which is separate from the service brake system controls; and

(2) be held in the locked position by solely mechanical means.

(b) Each motorcycle equipped with a parking brake shall have a configuration that enables a rider to be able to actuate the parking brake system while seated in the normal driving position.

S5.1.4 *Two-wheeled motorcycles of categories 3–1 and 3–3.* Each category 3–1 and 3–3 two-wheeled motorcycle shall be equipped with either two separate service brake systems, or a split service brake system, with at least one brake operating on the front wheel and at least one brake operating on the rear wheel.

S5.1.5 *Three-wheeled motorcycles of category 3–4.* Each category 3–4 motorcycle shall comply with the brake system requirements in S5.1.4. A brake on the asymmetric wheel (with respect to the longitudinal axis) is not required.

S5.1.6 *Three-wheeled motorcycles of category 3–2.* Each category 3–2 motorcycle shall be equipped with a parking brake system plus one of the following service brake systems:

(a) Two separate service brake systems, except CBS, which, when applied together, operate the brakes on all wheels; or

(b) A split service brake system; or

(c) A CBS that operates the brake on all wheels and a secondary brake system which may be the parking brake system.

S5.1.7 *Three-wheeled motorcycles of categories 3–5.* Each category 3–5 motorcycle shall be equipped with:

(a) A parking brake system; and

(b) A foot actuated service brake system which operates the brakes on all wheels by way of either:

(1) A split service brake system; or

(2) A CBS and a secondary brake system, which may be the parking brake system.

S5.1.8 *Two separate service brake systems.* For motorcycles where two separate service brake systems are installed, the systems may share a common brake, if a failure in one system does not affect the performance of the other.

S5.1.9 *Hydraulic service brake system.* For motorcycles that use hydraulic fluid for brake force transmission, the master cylinder shall:

(a) Have a sealed, covered, separate reservoir for each brake system; and

(b) Have a minimum reservoir capacity equivalent to 1.5 times the total fluid displacement required to satisfy the new to fully worn lining condition with the worst case brake adjustment conditions; and

(c) Have a reservoir where the fluid level is visible for checking without removal of the cover.

(d) Have a brake fluid warning statement that reads as follows, in letters at least 3/32 of an inch high: *Warning: Clean filler cap before removing. Use only _____ fluid from a sealed container* (inserting the recommended type of brake fluid as specified in accordance with 49 CFR 571.116, e.g., ''DOT 3''). The lettering shall be:

(1) Permanently affixed, engraved, or embossed;

(2) Located so as to be visible by direct view, either on or within 4 inches of the brake-fluid reservoir filler plug or cap; and

(3) Of a color that contrasts with its background, if it is not engraved or embossed.

S5.1.10 *Warning lamps.* All warning lamps shall be mounted in the rider's view.

S5.1.10.1 *Split service brake system warning lamps.*

(a) Each motorcycle that is equipped with a split service brake system shall be fitted with a red warning lamp, which shall be activated:

(1) When there is a hydraulic failure on the application of a force of ≤90 N on the control; or

(2) Without actuation of the brake control, when the brake fluid level in the master cylinder reservoir falls below the greater of:

(i) That which is specified by the manufacturer; or

(ii) That which is less than or equal to half of the fluid reservoir capacity.

(b) To permit function checking, the warning lamp shall be illuminated by the activation of the ignition switch and shall be extinguished when the check has been completed. The warning lamp shall remain on while a failure condition exists whenever the ignition switch is in the ''on'' position.

(c) Each indicator lamp shall have the legend ''Brake Failure'' on or adjacent to it in letters not less than 3/32 of an inch high that shall be legible to the driver in daylight when lighted.

S5.1.10.2 *Antilock brake system warning lamps.*

(a) Each motorcycle equipped with an ABS system shall be fitted with a yellow warning lamp. The lamp shall be activated whenever there is a malfunction that affects the generation or transmission of signals in the motorcycle's ABS system.

(b) To permit function checking, the warning lamp shall be illuminated by the activation of the ignition switch and extinguished when the check has been completed. The warning lamp shall remain on while a failure condition exists whenever the ignition switch is in the ''on'' position.

(c) The warning lamp shall be labeled in accordance with the specifications in Table 3 of Standard No. 123 (49 CFR 571.123) for ''ABS Malfunction'' (Item No. 13).

S5.2 *Durability.*

S5.2.1 *Compensation for wear.* Wear of the brakes shall be compensated for by means of a system of automatic or manual adjustment.

S5.2.2 *Notice of wear.* The friction material thickness shall either be visible without disassembly, or where the friction material is not visible, wear shall be assessed by means of a device designed for that purpose.

S5.2.3 *Testing.* During all the tests in this standard and on their completion, there shall be no friction material detachment and no leakage of brake fluid.

S5.3 *Measurement of dynamic performance.* There are two ways in which brake system performance is measured. The particular method to be used is specified in the respective tests in S6.

S5.3.1 *Stopping distance.*

(a) Based on the basic equations of motion:

$$S = 0.1 \cdot V + (X) \cdot V^2,$$

Where:

S = stopping distance in meters
V = initial vehicle speed in km/h
X = a variable based on the requirement for each test

(b) To calculate the corrected stopping distance using the actual vehicle test speed, the following formula is used:

$Ss = 0.1 \cdot Vs + (Sa - 0.1 \cdot Va) \cdot Vs^2/Va^2$,

Where:

Ss = corrected stopping distance in meters
Vs = specified vehicle test speed in km/h
Sa = actual stopping distance in meters
Va = actual vehicle test speed in km/h

NOTE TO S5.3.1(b): This equation is only valid when the actual test speed (Va) is within ±5 km/h of the specified test speed (Vs).

S5.3.2 *Continuous deceleration recording.* The other method used to measure performance is the continuous recording of the vehicle instantaneous deceleration from the moment a force is applied to the brake control until the end of the stop.

S6. *Test conditions, procedures and performance requirements.*

S6.1 *General.*

S6.1.1 *Test surfaces.*

S6.1.1.1 *High friction surface.* A high friction surface is used for all dynamic brake tests excluding the ABS tests where a low-friction surface is specified. The high-friction surface test area is a clean, dry and level surface, with a gradient of ≤1 percent. The high-friction surface has a peak braking coefficient (PBC) of 1.02.

S6.1.1.2 *Low-friction surface.* A low-friction surface is used for ABS tests where a low-friction surface is specified. The low-friction surface test area is a clean and level surface, which may be wet or dry, with a gradient of ≤1 percent. The low-friction surface has a PBC of ≤0.50.

S6.1.1.3 *Measurement of PBC.* The PBC is measured using the ASTM F2493 standard reference test tire, in accordance with ASTM E1337–19, at a speed of 64 km/h (incorporated by reference; see §571.5).

S6.1.1.4 *Parking brake system tests.* The specified test slope has a clean and dry surface that does not deform under the weight of the motorcycle.

S6.1.1.5 *Test lane width.* For two-wheeled motorcycles (motorcycle categories 3–1 and 3–3) the test lane width is 2.5 meters. For three-wheeled motorcycles (motorcycle categories 3–2, 3–4 and 3–5) the test lane width is 2.5 meters plus the vehicle width.

S6.1.2 *Ambient temperature.* The ambient temperature is between 4 °C and 45 °C.

S6.1.3 *Wind speed.* The wind speed is not more than 5 meters per second (m/s).

S6.1.4 *Test speed tolerance.* The test speed tolerance is ±5 km/h. In the event of the actual test speed deviating from the specified test speed (but within the ±5 km/h tolerance), the actual stopping distance is corrected using the formula in S5.3.1(b).

S6.1.5 *Automatic transmission.* Motorcycles with automatic transmission shall meet all test requirements—whether they are for ''engine connected'' or ''engine disconnected.'' If an automatic transmission has a neutral position, the neutral position is selected for tests where ''engine disconnected'' is specified.

S6.1.6 *Vehicle position and wheel lock.* The vehicle is positioned in the center of the test lane for the beginning of each stop. Stops are made without the vehicle wheels passing outside the applicable test lane and without wheel lock.

S6.1.7 *Test sequence.* Test sequence is as specified in Table 1.

S6.2 *Preparation.*

S6.2.1 *Engine idle speed.* The engine idle speed is set to the manufacturer's specification.

S6.2.2 *Tire pressures.* The tires are inflated to the manufacturer's specification for the vehicle loading condition for the test.

S6.2.3 *Control application points and direction.* For a hand control lever, the input force (F) is applied on the control lever's forward surface perpendicular to the axis of the lever fulcrum and its outermost point on the plane along which the control lever rotates (see Figure 1). The input force is applied to a point located 50 millimeters (mm) from the outermost point of the control lever, measured along the axis between the central axis of the fulcrum of the lever and its outermost point. For a foot control pedal, the input force is applied to the center of, and at right angles to, the control pedal.

S6.2.4 *Brake temperature measurement.* The brake temperature is measured on the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, using a plug-type thermocouple

that is embedded in the friction material, as shown in Figure 2.

S6.2.5 *Burnishing procedure.* The vehicle brakes are burnished prior to evaluating performance.

S6.2.5.1 *Vehicle condition.*

(a) Vehicle lightly loaded.

(b) Engine disconnected.

S6.2.5.2 *Conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature before each brake application is ≤100 °C.

(b) *Test speed.*

(1) Initial speed: 50 km/h or 0.8 Vmax, whichever is lower.

(2) Final speed = 5 to 10 km/h.

(c) *Brake application.* Each service brake system control actuated separately.

(d) *Vehicle deceleration.*

(1) Single front brake system only:

(i) 3.0–3.5 meters per second squared (m/s^2) for motorcycle categories 3–3 and 3–4

(ii) 1.5–2.0 m/s^2 for motorcycle categories 3–1 and 3–2

(2) Single rear brake system only: 1.5–2.0 m/s^2

(3) CBS or split service brake system, and category 3–5: 3.5–4.0 m/s^2

(e) *Number of decelerations.* There shall be 100 decelerations per brake system.

(f) For the first stop, accelerate the vehicle to the initial speed and then actuate the brake control under the conditions specified until the final speed is reached. Then reaccelerate to the initial speed and maintain that speed until the brake temperature falls to the specified initial value. When these conditions are met, reapply the brake as specified. Repeat this procedure for the number of specified decelerations. After burnishing, adjust the brakes in accordance with the manufacturer's recommendations.

S6.3 *Dry stop test—single brake control actuated.*

S6.3.1 *Vehicle condition.*

(a) The test is applicable to all motorcycle categories.

(b) Laden. For vehicles fitted with CBS and split service brake system, the vehicle is tested in the lightly loaded condition in addition to the laden condition.

(c) Engine disconnected.

S6.3.2 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(b) *Test speed.*

(1) Motorcycle categories 3–1 and 3–2: 40 km/h or 0.9 Vmax, whichever is lower.

(2) Motorcycle categories 3–3, 3–4 and 3–5: 60 km/h or 0.9 Vmax, whichever is lower.

(c) *Brake application.* Each service brake system control actuated separately.

(d) *Brake actuation force.*

(1) Hand control: ≤200 N.

(2) Foot control:

(i) ≤350 N for motorcycle categories 3–1, 3–2, 3–3, and 3–4.

(ii) ≤500 N for motorcycle category 3–5.

(e) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

(f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

S6.3.3 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in paragraph S6.3.2., the stopping distance shall be as specified in column 2 of Table 2.

S6.4 *Dry stop test—all service brake controls actuated.*

S6.4.1 *Vehicle condition.*

(a) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(b) Lightly loaded.

(c) Engine disconnected.

S6.4.2 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(b) *Test speed.* Test speed is 100 km/h or 0.9 Vmax, whichever is lower.

(c) *Brake application.* Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels.

(d) *Brake actuation force.*

(1) Hand control: ≤250 N.

(2) Foot control:

(i) ≤400 N for motorcycle categories 3–3 and 3–4.

(ii) ≤500 N for motorcycle category 3–5.

(e) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

(f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

S6.4.3 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in paragraph S6.4.2., the stopping distance (S) shall be $S \leq 0.0060\ V^2$ (where V is the specified test speed in km/h and S is the required stopping distance in meters).

S6.5 *High speed test.*

S6.5.1 *Vehicle condition.*

(a) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(b) Test is not required for vehicles with Vmax ≤125 km/h.

(c) Lightly loaded.

(d) Engine connected (clutch engaged) with the transmission in the highest gear.

S6.5.2 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(b) *Test speed.*

(1) Test speed is 0.8 Vmax for motorcycles with Vmax >125 km/h and <200 km/h.

(2) Test speed is 160 km/h for motorcycles with Vmax ≥200 km/h.

(c) *Brake application.* Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake system control in the case of a service brake system that operates on all wheels.

(d) *Brake actuation force.*

(1) Hand control: ≤200 N.

(2) Foot control:

(i) ≤350 N for motorcycle categories 3–3 and 3–4.

(ii) ≤500 N for motorcycle category 3–5.

(e) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

(f) For each stop, accelerate the vehicle to the test speed and then actuate the brake control(s) under the conditions specified in this paragraph.

S6.5.3 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in paragraph S6.5.2, the stopping distance (S) shall be $S \leq 0.1\ V + 0.0067\ V^2$ (where V is the specified test speed in km/h and S is the required stopping distance in meters).

S6.6 *Wet brake test.*

S6.6.1 *General information.*

(a) The test is comprised of two parts that are carried out consecutively for each brake system:

(1) A baseline test based on the dry stop test—single brake control actuated (S6.3).

(2) A single wet brake stop using the same test parameters as in (1), but with the brake(s) being continuously sprayed with water while the test is conducted in order to measure the brakes' performance in wet conditions.

(b) The test is not applicable to parking brake systems unless it is the secondary brake.

(c) Drum brakes or fully enclosed disc brakes are excluded from this test unless ventilation or open inspection ports are present.

(d) This test requires the vehicle to be fitted with instrumentation that gives a continuous recording of brake control force and vehicle deceleration.

S6.6.2 *Vehicle condition.*

(a) The test is applicable to all motorcycle categories.

(b) Laden. For vehicles fitted with CBS and split service brake system, the vehicle is tested in the lightly loaded condition in addition to the laden condition.

(c) Engine disconnected.

(d) Each brake is fitted with water spray equipment as shown in Figure 3.

(1) *Disc brakes—sketch of water spray equipment.* The disc brake water spray equipment is installed as follows:

(i) Water is sprayed onto each brake with a flow rate of 15 liters/hr. The water is equally distributed on each side of the rotor.

(ii) If the surface of the rotor has any shielding, the spray is applied 45° prior to the shield.

(iii) If it is not possible to locate the spray in the position shown on the sketch, or if the spray coincides with a brake ventilation hole or similar, the spray nozzle may be advanced by an additional 90° maximum from the edge of the pad, using the same radius.

(2) *Drum brakes with ventilation and open inspection ports.* The water spray equipment is installed as follows:

(i) Water is sprayed equally onto both sides of the drum brake assembly (on the stationary back plate and on the rotating drum) with a flow rate of 15 liters/hr.

(ii) The spray nozzles are positioned two thirds of the distance from the outer circumference of the rotating drum to the wheel hub center.

(iii) The nozzle position is >15° from the edge of any opening in the drum back plate.

S6.6.3 *Baseline test—test conditions and procedure.*

(a) The test in paragraph S6.3 (dry stop test—single brake control actuated) is carried out for each brake system but with the brake control force that results in a vehicle deceleration of 2.5–3.0 m/s^2, and the following is determined:

(1) The average brake control force measured when the vehicle is traveling between 80 percent and 10 percent of the specified test speed.

(2) The average vehicle deceleration in the period 0.5 to 1.0 seconds after the point of actuation of the brake control.

(3) The maximum vehicle deceleration during the complete stop but excluding the final 0.5 seconds.

(b) Conduct 3 baseline stops and average the values obtained in (1), (2), and (3).

S6.6.4 *Wet brake test—test conditions and procedure.*

(a) The vehicle is ridden at the test speed used in the baseline test set out in S6.6.3 with the water spray equipment operating on the brake(s) to be tested and with no application of the brake system.

(b) After a distance of ≥500 m, apply the average brake control force determined in the baseline test for the brake system being tested.

(c) Measure the average vehicle deceleration in the period 0.5 to 1.0 seconds after the point of actuation of the brake control.

(d) Measure the maximum vehicle deceleration during the complete stop but excluding the final 0.5 seconds.

S6.6.5 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in paragraph S6.6.4, the wet brake deceleration performance shall be:

(a) The value measured in paragraph S6.6.4(c) shall be ≥60 percent of the average deceleration values recorded in the baseline test in paragraph S6.6.3(a)(2), i.e., in the period 0.5 to 1.0 seconds after the point of actuation of the brake control; and

(b) The value measured in S6.6.4(d) shall be ≤120 percent of the average deceleration values recorded in the baseline test S6.6.3(a)(3), i.e., during the complete stop but excluding the final 0.5 seconds.

S6.7 *Heat fade test.*

S6.7.1 *General information.*

(a) The test comprises three parts that are carried out consecutively for each brake system:

(1) A baseline test using the dry stop test—single brake control actuated (S6.3).

(2) A heating procedure which consists of a series of repeated stops in order to heat the brake(s).

(3) A hot brake stop using the dry stop test—single brake control actuated (S6.3), to measure the brake's performance after the heating procedure.

(b) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(c) The test is not applicable to parking brake systems and secondary service brake systems.

(d) All stops are carried out with the motorcycle laden.

(e) The heating procedure requires the motorcycle to be fitted with instrumentation that gives a continuous recording of brake control force and vehicle deceleration.

S6.7.2 *Baseline test.*

S6.7.2.1 *Vehicle condition—baseline test.* Engine disconnected.

S6.7.2.2 *Test conditions and procedure—baseline test.*

(a) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(b) *Test speed.* Test speed is 60 km/h or 0.9 Vmax, whichever is the lower.

(c) *Brake application.* Each service brake system control is actuated separately.

(d) *Brake actuation force.*

(1) Hand control: ≤200 N.

(2) Foot control:

(i) ≤350 N for motorcycle categories 3–3 and 3–4.

(ii) ≤500 N for motorcycle category 3–5.

(e) Accelerate the vehicle to the test speed, actuate the brake control under the conditions specified and record the control force required to achieve the vehicle braking performance specified in the table to S6.3.3 (Table 2).

S6.7.3 *Heating procedure.*

S6.7.3.1 *Vehicle condition—heating procedure.* Engine transmission:

(a) From the specified test speed to 50 per cent specified test speed: connected, with the highest appropriate gear selected such that the engine speed remains above the manufacturer's specified idle speed.

(b) From 50 per cent specified test speed to standstill: disconnected.

S6.7.3.2 *Test conditions and procedure—heating procedure.*

(a) *Initial brake temperature.* Initial brake temperature is (prior to first stop only) ≥55 °C and ≤100 °C.

(b) *Test speed.*

(1) Single brake system, front wheel braking only: 100 km/h or 0.7 Vmax, whichever is the lower.

(2) Single brake system, rear wheel braking only: 80 km/h or 0.7 Vmax, whichever is the lower.

(3) CBS or split service brake system: 100 km/h or 0.7 Vmax, whichever is the lower.

(c) *Brake application.* Each service brake system control actuated separately.

(d) *Brake actuation force.*

(1) For the first stop: The constant control force that achieves a vehicle deceleration rate of 3.0—3.5 m/s^2 while the vehicle is decelerating between 80 percent and 10 percent of the specified speed.

(2) For the remaining stops:

(i) The same constant brake control force as used for the first stop.

(ii) Number of stops: 10.

(iii) Interval between stops: 1000 m.

(e) Carry out a stop to the conditions specified in this paragraph and then immediately use maximum acceleration to reach the specified speed and maintain that speed until the next stop is made.

S6.7.4 *Hot brake stop—test conditions and procedure.* Perform a single stop under the conditions used in the baseline test (S6.7.2) for the brake system that has been heated during the procedure in accordance with S6.7.3. This stop is carried out within one minute of the completion of the procedure set out in S6.7.3 with a brake control application force less than or equal to the force used during the test set out in S6.7.2.

S6.7.5 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in S6.7.4, the stopping distance S_2 shall be $\leq 1.67\ S_1 - 0.67 \times 0.1V$,

Where:

S_1 = corrected stopping distance in meters achieved in the baseline test set out in S6.7.2.

S_2 = corrected stopping distance in meters achieved in the hot brake stop set out in S6.7.4.

V = specified test speed in km/h.

S6.8 *Parking brake system test—for motorcycles with parking brakes.*

S6.8.1 *Vehicle condition.*

(a) The test is applicable to motorcycle categories 3–2, 3–4 and 3–5.

(b) Laden.

(c) Engine disconnected.

S6.8.2 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is ≤100 °C.

(b) *Test surface gradient.* Test surface gradient is equal to 18 percent.

(c) *Brake actuation force.*

(1) Hand control: ≤400 N.

(2) Foot control: ≤500 N.

(d) For the first part of the test, park the vehicle on the test surface gradient facing up the slope by applying the parking brake system under the conditions specified in this paragraph. If the vehicle remains stationary, start the measurement of the test period.

(e) The vehicle must remain stationary to the limits of traction of the braked wheels.

(f) On completion of the test with vehicle facing up the gradient, repeat the same test procedure with the vehicle facing down the gradient.

S6.8.3 *Performance requirements.* When tested in accordance with the test procedure set out in S6.8.2, the parking brake system shall hold the vehicle stationary for 5 minutes when the vehicle is both facing up and facing down the gradient.

S6.9 *ABS tests.*

S6.9.1 *General.*

(a) The tests are only applicable to the ABS fitted on motorcycle categories 3–1 and 3–3.

(b) The tests are to confirm the performance of brake systems equipped with ABS and their performance in the event of ABS electrical failure.

(c) *Fully cycling* means that the antilock system is repeatedly modulating the brake force to prevent the directly controlled wheels from locking.

(d) Wheel-lock is allowed as long as the stability of the vehicle is not affected to the extent that it requires the operator to release the control or causes a vehicle wheel to pass outside the test lane.

(e) The test series comprises the individual tests in Table 3, which may be carried out in any order.

S6.9.2 *Vehicle condition.*

(a) Lightly loaded.

(b) Engine disconnected.

S6.9.3 *Stops on a high friction surface.*

S6.9.3.1 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(b) *Test speed.* Test speed is 60 km/h or 0.9 Vmax, whichever is lower.

(c) *Brake application.* Simultaneous actuation of both service brake system controls, if so equipped, or of the single service brake control in the case of a service brake system that operates on all wheels.

(d) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(e) If one wheel is not equipped with ABS, the control for the service brake on that wheel is actuated with a force that is lower than the force that will cause the wheel to lock.

(f) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops.

(g) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

S6.9.3.2 *Performance requirements.* When the brakes are tested in accordance with the test procedures referred to in S6.9.3.1:

(a) The stopping distance (S) shall be $\leq 0.0063\ V^2$ (where V is the specified test speed in km/h and S is the required stopping distance in meters); and

(b) there shall be no wheel lock beyond that allowed for in paragraph S6.9.1(d), and the vehicle wheels shall stay within the test lane.

S6.9.4 *Stops on a low friction surface.*

S6.9.4.1 *Test conditions and procedure.* As set out in S6.9.3.1, but using the low friction surface instead of the high friction one.

S6.9.4.2 *Performance requirements.* When the brakes are tested in accordance with the test procedures set out in S6.9.4.1:

(a) the stopping distance (S) shall be $\leq 0.0056\ V^2/P$ (where V is the specified test speed in km/h, P is the peak braking coefficient and S is the required stopping distance in meters); and

(b) there shall be no wheel lock beyond that allowed for in paragraph S6.9.1(d), and the vehicle wheels shall stay within the test lane.

S6.9.5 *Wheel lock checks on high and low friction surfaces.*

S6.9.5.1 *Test conditions and procedure.*

(a) *Test surfaces.* High friction or low friction surface, as applicable.

(b) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(c) *Test speed.*

(1) On the high friction surface: 80 km/h or 0.8 Vmax, whichever is lower.

(2) On the low friction surface: 60 km/h or 0.8 Vmax, whichever is lower.

(d) *Brake application.*

(1) Each service brake system control actuated separately.

(2) Where ABS is fitted to both brake systems, simultaneous actuation of both brake controls in addition to (1).

(e) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(f) *Brake application rate.* The brake control actuation force is applied in 0.2–0.5 seconds.

(g) Number of stops: until the vehicle meets the performance requirements, with a maximum of 3 stops.

(h) For each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

S6.9.5.2 *Performance requirements.* When the brakes are tested in accordance with the test procedures set out in S6.9.5.1, there shall be no wheel lock beyond that allowed for in paragraph

S6.9.1(d), and the vehicle wheels shall stay within the test lane.

S6.9.6 *Wheel lock check—high to low friction surface transition.*

S6.9.6.1 *Test conditions and procedure.*

(a) *Test surfaces.* A high friction surface immediately followed by a low friction surface.

(b) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(c) *Test speed.* The speed that will result in 50 km/h or 0.5 Vmax, whichever is the lower, at the point where the vehicle passes from the high friction to the low friction surface.

(d) *Brake application.*

(1) Each service brake system control actuated separately.

(2) Where ABS is fitted to both brake systems, simultaneous actuation of both brake controls in addition to (1).

(e) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(f) Number of stops: until the vehicle meets the performance requirements, with a maximum of 3 stops.

(g) For each stop, accelerate the vehicle to the test speed and then actuate the brake control before the vehicle reaches the transition from one friction surface to the other.

S6.9.6.2 *Performance requirements.* When the brakes are tested in accordance with the test procedures set out in S6.9.6.1, there shall be no wheel lock beyond that allowed for in paragraph S6.9.1(d), and the vehicle wheels shall stay within the test lane.

S6.9.7 *Wheel lock check—low to high friction surface transition.*

S6.9.7.1 *Test conditions and procedure.*

(a) *Test surfaces.* A low friction surface immediately followed by a high friction surface with a PBC ≥0.90.

(b) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(c) *Test speed.* The speed that will result in 50 km/h or 0.5 Vmax, whichever is the lower, at the point where the vehicle passes from the low friction to the high friction surface.

(d) *Brake application.*

(1) Each service brake system control applied separately.

(2) Where ABS is fitted to both brake systems, simultaneous application of both brake controls in addition to (1).

(e) *Brake actuation force.* The force applied is that which is necessary to ensure that the ABS will cycle fully throughout each stop, down to 10 km/h.

(f) Number of stops: until the vehicle meets the performance requirements, with a maximum of 3 stops.

(g) For each stop, accelerate the vehicle to the test speed and then actuate the brake control before the vehicle reaches the transition from one friction surface to the other.

(h) Record the vehicle's continuous deceleration.

S6.9.7.2 *Performance requirements.* When the brakes are tested in accordance with the test procedures set out in S6.9.7.1:

(a) There shall be no wheel lock beyond that allowed for in paragraph S6.9.1(d), and the vehicle wheels shall stay within the test lane, and

(b) within 1 second of the rear wheel passing the transition point between the low and high friction surfaces, the vehicle deceleration shall increase.

S6.9.8 *Stops with an ABS electrical failure.*

S6.9.8.1 *Test conditions and procedure.* With the ABS electrical system disabled, carry out the test set out in S6.3 (dry stop test—single brake control actuated) applying the conditions relevant to the brake system and vehicle being tested.

S6.9.8.2 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in S6.9.8.1:

(a) The system shall comply with the failure warning requirements of S5.1.10.2; and

(b) the minimum requirements for stopping distance shall be as specified in column 2 under the heading ''Single brake system, rear wheel(s) braking only'' in Table 2.

S6.10 *Partial failure test—for split service brake systems.*

S6.10.1 *General information.*

(a) The test is only applicable to vehicles that are equipped with split service brake systems.

(b) The test is to confirm the performance of the remaining subsystem in the event of a hydraulic system leakage failure.

S6.10.2 *Vehicle condition.*

(a) The test is applicable to motorcycle categories 3–3, 3–4 and 3–5.

(b) Lightly loaded.

(c) Engine disconnected.

S6.10.3 *Test conditions and procedure.*

(a) *Initial brake temperature.* Initial brake temperature is ≥55 °C and ≤100 °C.

(b) *Test speed.* Test speed is 50 km/h and 100 km/h or 0.8 Vmax, whichever is lower.

(c) Brake actuation force.

(1) Hand control: ≤250 N.

(2) Foot control: ≤400 N.

(d) Number of stops: until the vehicle meets the performance requirements, with a maximum of 6 stops for each test speed.

(e) Alter the service brake system to induce a complete loss of braking in any one subsystem. Then, for each stop, accelerate the vehicle to the test speed and then actuate the brake control under the conditions specified in this paragraph.

(f) Repeat the test for each subsystem.

S6.10.4 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in S6.10.3:

(a) the system shall comply with the failure warning requirements set out in paragraph S5.1.10.1; and

(b) the stopping distance (S) shall be $\leq 0.1\ V + 0.0117\ V^2$ (where V is the specified test speed in km/h and S is the required stopping distance in meters).

S6.11 *Power-assisted braking system failure test.*

S6.11.1 *General information.*

(a) The test is not conducted when the vehicle is equipped with another separate service brake system.

(b) The test is to confirm the performance of the service brake system in the event of failure of the power assistance.

S6.11.2 *Test conditions and procedure.* Carry out the test set out in S6.3.3 (dry stop test—single brake control actuated) for each service brake system with the power assistance disabled.

S6.11.3 *Performance requirements.* When the brakes are tested in accordance with the test procedure set out in S6.11.2, the stopping distance shall be as specified in column 2 of Table 4. Note that if the power assistance may be activated by more than one control, the above performance shall be achieved when each control is actuated separately.

TABLES AND FIGURES TO § 571.122

TABLE 1—TEST SEQUENCE

Test order	Paragraph
1. Dry stop—single brake control actuated	S6.3
2. Dry stop—all service brake controls actuated	S6.4
3. High speed	S6.5
4. Wet brake	S6.6
5. If fitted:	
6.1. Parking brake system	S6.8
6.2. ABS	S6.9
6.3. Partial failure, for split service brake systems	S6.10
6.4. Power-assisted braking system failure	S6.11
6. Heat fade	S6.7

TABLE 2—PERFORMANCE REQUIREMENTS, DRY STOP TEST—SINGLE BRAKE CONTROL ACTUATED

Column 1	Column 2
Motorcycle category	Stopping Distance(s) (where V is the specified test speed in km/h and S is the required stopping distance in meters)
Single brake system, front wheel(s) braking only	
3–1	$S \leq 0.1\ V + 0.0111\ V^2$.
3–2	$S \leq 0.1\ V + 0.0143\ V^2$.
3–3	$S \leq 0.1\ V + 0.0087\ V^2$.
3–4	$S \leq 0.1\ V + 0.0105\ V^2$.
3–5	Not applicable.
Single brake system, rear wheel(s) braking only	
3–1	$S \leq 0.1\ V + 0.0143\ V^2$.
3–2	$S \leq 0.1\ V + 0.0143\ V^2$.
3–3	$S \leq 0.1\ V + 0.0133\ V^2$.
3–4	$S \leq 0.1\ V + 0.0105\ V^2$.
3–5	Not applicable.
Vehicles with CBS or split service brake systems: For laden and lightly loaded conditions	
3–1 and 3–2	$S \leq 0.1\ V + 0.0087\ V^2$.
3–3	$S \leq 0.1\ V + 0.0076\ V^2$.
3–4	$S \leq 0.1\ V + 0.0071\ V^2$.
3–5	$S \leq 0.1\ V + 0.0077\ V^2$.
Vehicles with CBS—secondary service brake system	
ALL	$S \leq 0.1\ V + 0.0154\ V.^2$

TABLE 3—ABS TESTS

ABS Tests	Paragraph
a. Stops on a high friction surface—as specified in S6.1.1.1	S6.9.3
b. Stops on a low friction surface—as specified in S6.1.1.2	S6.9.4
c. Wheel lock checks on high and low friction surfaces	S6.9.5

TABLE 3—ABS TESTS—Continued

ABS Tests	Paragraph
d. Wheel lock check—high to low friction surface transition	S6.9.6
e. Wheel lock check—low to high friction surface transition	S6.9.7
f. Stops with an ABS electrical failure	S6.9.8

TABLE 4—PERFORMANCE REQUIREMENTS, POWER-ASSISTED BRAKING SYSTEM FAILURE TEST

Column 1	Column 2
Vehicle category	Stopping Distance(s) (where V is the specified test speed in km/h and S is the required stopping distance in meters)
Single brake system	
3–1	$S \leq 0.1\ V + 0.0143\ V^2$.
3–2	$S \leq 0.1\ V + 0.0143\ V^2$.
3–3	$S \leq 0.1\ V + 0.0133\ V^2$.
3–4	$S \leq 0.1\ V + 0.0105\ V^2$.
Vehicles with CBS or split service brake systems	
All	$S \leq 0.1\ V + 0.0154\ V.^2$

Figure 1. Hand control lever force application points and direction.

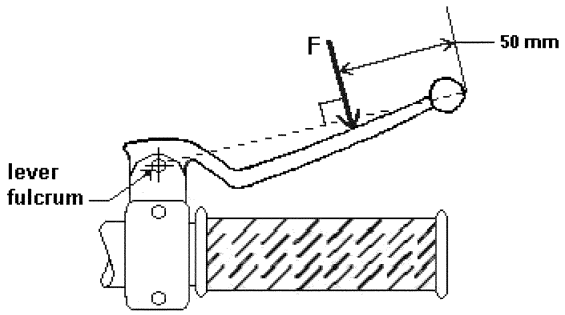


Figure 2. Typical Plug Type Thermocouple Installations

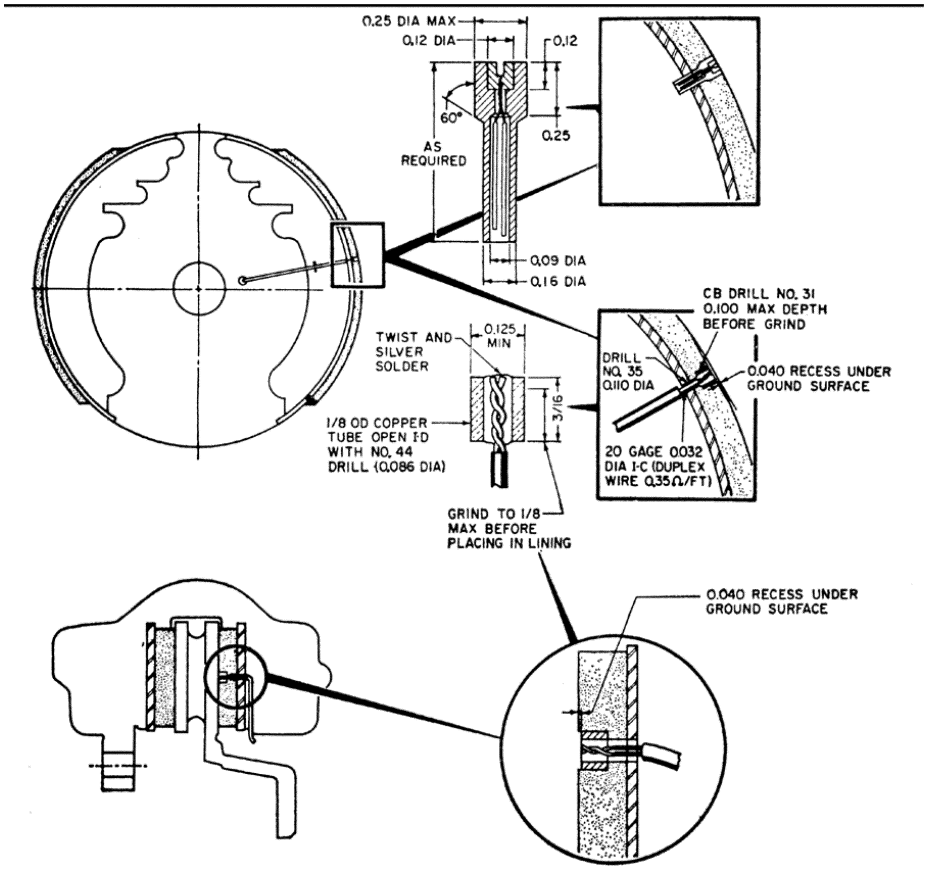
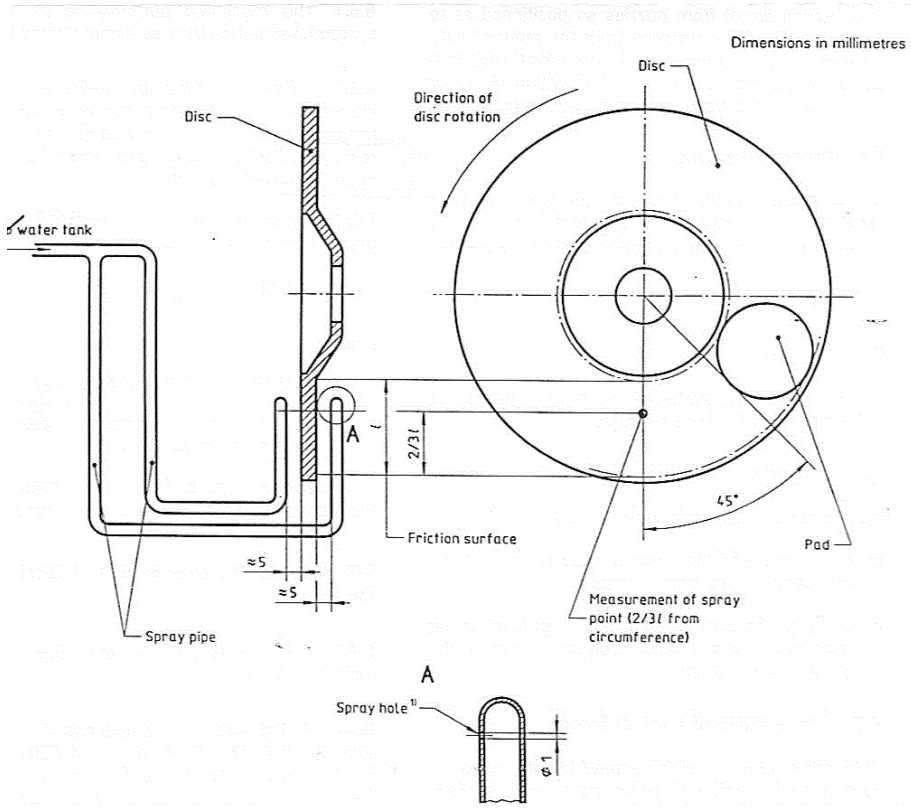


Figure 3. Wet brake test.



[77 FR 51671, Aug. 24, 2012, as amended at 86 FR 1298, Jan. 8, 2021; 87 FR 34810, June 8, 2022]

§571.122a Standard No. 122; Motorcycle brake systems.

S1. *Scope.* This standard specifies performance requirements for motorcycle brake systems.

S2. *Purpose.* The purpose of the standard is to insure safe motorcycle braking performance under normal and emergency conditions.

S3. *Application.* This standard applies to motorcycles. However, this standard does not apply to motorcycles certified to comply with §571.122.

S4. *Definitions.*

Braking interval means the distance measured from the start of one brake application to the start of the next brake application.

Initial brake temperature means the temperature of the hottest service brake of the vehicle 0.2 mile before any brake application.

Skid number means the frictional resistance of a pavement measured in accordance with ASTM E274–70 (incorporated by reference, see §571.5) at 40 mph, omitting water delivery as specified in paragraphs 7.1 and 7.2 of that method.

Stopping distance means the distance traveled by a vehicle from the start of the brake application to the point where the vehicle stops.

Split service brake system means a brake system consisting of two or more subsystems actuated by a single control designed so that a leakage-type

failure of a pressure component in a single subsystem (except structural failure of a housing that is common to all subsystems) shall not impair the operation of the other subsystem(s).

S5. *Requirements.* Each motorcycle shall meet the following requirements under the conditions specified in S6, when tested according to the procedures and in the sequence specified in S7. Corresponding test procedures of S7 are indicated in parentheses. If a motorcycle is incapable of attaining a specified speed, its service brakes shall be capable of stopping the vehicle from the multiple of 5 m.p.h. that is 4 m.p.h. to 8 m.p.h. less than the speed attainable in 1 mile, within stopping distances that do not exceed the stopping distances specified in Table 1.

S5.1 *Required equipment—split service brake system.* Each motorcycle shall have either a split service brake system or two independently actuated service brake systems.

S5.1.1 *Mechanical service brake system.* Failure of any component in a mechanical service brake system shall not result in a loss of braking ability in the other service brake system on the vehicle.

S5.1.2 *Hydraulic service brake system.* A leakage failure in a hydraulic service brake system shall not result in a loss of braking ability in the other service brake system on the vehicle. Each motorcycle equipped with a hydraulic brake system shall have the equipment specified in S5.1.2.1 and S5.1.2.2.

S5.1.2.1 *Master cylinder reservoirs.* Each master cylinder shall have a separate reservoir for each brake circuit, with each reservoir filler opening having its own cover, seal, and cover retention device. Each reservoir shall have a minimum capacity equivalent to one and one-half times the total fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir move from a new lining, fully retracted position to a fully worn, fully applied position. Where adjustment is a factor, the worst condition of adjustment shall be used for this measurement.

S5.1.2.2 *Reservoir labeling.* Each motorcycle shall have a brake fluid warning statement that reads as follows, in letters at least three thirty-seconds of an inch high:

Warning: Clean filler cap before removing. Use only _____ fluid from a sealed container. (Inserting the recommended type of brake fluid as specified in 49 CFR 571.116, e.g., DOT 3.)

The lettering shall be:

(a) Permanently affixed, engraved, or embossed;

(b) Located so as to be visible by direct view, either on or within 4 inches of the brake-fluid reservoir filler plug or cap; and

(c) Of a color that contrasts with its background, if it is not engraved or embossed.

S5.1.3 *Split service brake system.* In addition to the equipment required by S5.1.2 each motorcycle equipped with a split service brake system shall have a failure indicator lamp as specified in S5.1.3.1.

S5.1.3.1 *Failure indicator lamp.*

(a) One or more electrically operated service brake system failure indicator lamps that is mounted in front of and in clear view of the driver, and that is activated—

(1) In the event of pressure failure in any part of the service brake system, other than a structural failure of either a brake master cylinder body in a split integral body type master cylinder system or a service brake system failure indicator body, before or upon application of not more than 20 pounds of pedal force upon the service brake.

(2) Without the application of pedal force, when the level of brake fluid in a master cylinder reservoir drops to less than the recommended safe level specified by the manufacturer or to less than one-half the fluid reservoir capacity, whichever is the greater.

(b) All failure indicator lamps shall be activated when the ignition switch is turned from the ''off'' to the ''on'' or to the ''start'' position.

(c) Except for the momentary activation required by S5.1.3.1(b), each indicator lamp, once activated, shall remain activated as long as the condition exists, whenever the ignition switch is in the ''on'' position. An indicator lamp activated when the ignition is turned to the ''start'' position shall be deactivated upon return of the switch

to the ''on'' position unless a failure exists in the service brake system.

(d) Each indicator lamp shall have a red lens with the legend ''Brake Failure'' on or adjacent to it in letters not less than three thirty-seconds of an inch high that shall be legible to the driver in daylight when lighted.

S5.1.4 *Parking brake.* Each three-wheeled motorcycle shall be equipped with a parking brake of a friction type with a solely mechanical means to retain engagement.

S5.1.5 *Other requirements.* The brake system shall be installed so that the lining thickness of drum brake shoes may be visually inspected, either directly or by use of a mirror without removing the drums, and so that disc brake friction lining thickness may be visually inspected without removing the pads.

S5.2 *Service brake system—first (preburnish) effectiveness.*

S5.2.1 *Service brake system.* The service brakes shall be capable of stopping the motorcycle from 30 m.p.h. and 60 m.p.h. within stopping distances which do not exceed the stopping distances specified in Column I of Table I (S7.3.1).

S5.2.2 *Partial service brake system.* Each independently actuated service brake system on each motorcycle shall be capable of stopping the motorcycle from 30 m.p.h. and 60 m.p.h. within stopping distances which do not exceed the stopping distances specified in Column II of Table I (S7.3.2).

S5.3 *Service brake system—second effectiveness.* The service brakes shall be capable of stopping the motorcycle from 30 m.p.h., 60 m.p.h., 80 m.p.h., and the multiple of 5 m.p.h. that is 4 m.p.h. to 8 m.p.h. less than the speed attainable in 1 mile if this speed is 95 m.p.h. or greater, within stopping distances that do not exceed the stopping distances specified in Column III of Table I (S7.5).

S5.4 *Service brake system—fade and recovery.* These requirements do not apply to a motor-driven cycle whose speed attainable in 1 mile is 30 m.p.h. or less.

S5.4.1 *Baseline check—minimum and maximum pedal forces.* The pedal and lever forces used in establishing the fade baseline check average shall be within the limits specified in S6.10 (S7.6.1).

S5.4.2 *Fade.* Each motorcycle shall be capable of making 10 fade stops from 60 m.p.h. at not less than 15 f.p.s.p.s. for each stop (S7.6.2).

S5.4.3 *Fade recovery.* Each motorcycle shall be capable of making five recovery stops with a pedal force that does not exceed 400 Newtons (90 pounds), and a hand lever force that does not exceed 245 Newtons (55 pounds) for any of the first four recovery stops and that for the fifth recovery stop, is within, plus 89 Newtons (20 pounds) and minus 44 Newtons (10 pounds) of the fade test baseline check average force (S7.6.3), but not less than 0 Newtons (0 pounds).

S5.5 *Service brake system—final effectiveness.* These requirements do not apply to a motor-driven cycle whose speed attainable in 1 mile is 30 mph or less.

S5.5.1 *Service brake system.* The service brakes shall be capable of stopping the motorcycle in a manner that complies with S5.3 (S7.8.1).

S5.5.2 *Hydraulic service brake system—partial failure.* In the event of a pressure component leakage failure, other than a structural failure of either a brake master cylinder body in a split integral body type master cylinder system or a service brake system failure indicator body, the remaining portion of the service brake system shall continue to operate and shall be capable of stopping the motorcycle from 30 m.p.h. and 60 m.p.h. within stopping distances that do not exceed the stopping distances specified in Column IV of Table I (S7.8.2).

S5.6 *Parking brake system.* The parking brake system shall be capable of holding the motorcycle stationary (to the limits of traction of the braked wheels), for 5 minutes, in both forward and reverse directions, on a 30 percent grade, with an applied force of not more than 90 pounds for a foot-operated system and 55 pounds for a hand-operated system (S7.9).

S5.7 *Service brake system—water recovery.*

S5.7.1 *Baseline check.* The pedal and lever forces used in establishing the water recovery baseline check average

shall be within the limits specified in S6.10 (S7.10.1).

S5.7.2 *Water recovery test.* Each motorcycle shall be capable of making five recovery stops with a pedal force that does not exceed 400 Newtons (90 pounds), and hand lever force that does not exceed 245 Newtons (55 pounds), for any of the first four recovery stops, and that for the fifth recovery stop, is within, plus 89 Newtons (20 pounds) and minus 44 Newtons (10 pounds) of the water recovery baseline check average force (S7.10.2), but not less than 0 Newtons (0 pounds).

S5.8 *Service brake system design durability.* Each motorcycle shall be capable of completing all braking requirements of S5 without detachment of brake linings from the shoes or pad, detachment or fracture of any brake system components, or leakage of fluid or lubricant at the wheel cylinder, and master cylinder reservoir cover, seal, or retention device (S7.11).

S6 *Test conditions.* The requirements of S5 shall be met under the following conditions. Where a range of conditions is specified, the motorcycle shall be capable of meeting the requirements at all points within the range.

S6.1 *Vehicle weight.* Motorcycle weight is unloaded vehicle weight plus 200 pounds (including driver and instrumentation), with the added weight distributed in the saddle or carrier if so equipped.

S6.2 *Tire inflation pressure.* Tire inflation pressure is the pressure recommended by the manufacturer for the vehicle weight specified in paragraph S6.1.

S6.3 *Transmission.* Unless otherwise specified, all stops are made with the clutch disengaged.

S6.4 *Engine.* Engine idle speed and ignition timing settings are according to the manufacturer's recommendations. If the vehicle is equipped with an adjustable engine speed governor, it is adjusted according to the manufacturer's recommendation.

S6.5 *Ambient temperature.* The ambient temperature is between 32 °F. and 100 °F.

S6.6 *Wind velocity.* The wind velocity is zero.

S6.7 *Road surface.* Road tests are conducted on level roadway having a skid number of 81. The roadway is 8 feet wide for two-wheeled motorcycles, and overall vehicle width plus 5 feet for three-wheeled motorcycles. The parking brake test surface is clean, dry, smooth portland cement concrete.

S6.8 *Vehicle position.* The motorcycle is aligned in the center of the roadway at the start of each brake application. Stops are made without any part of the motorcycle leaving the roadway and without lockup of any wheel.

S6.9 *Thermocouples.* The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in Figure 1.

S6.10 *Brake actuation forces.* Except for the requirements of the fifth recovery stop in S5.4.3 and S5.7.2 (S7.6.3 and S7.10.2), the hand lever force is not less than 10 Newtons (2.3 pounds) and not more than 245 Newtons (55 pounds) and the foot pedal force is not less than 25 Newtons (5.6 pounds) and not more than 400 Newtons (90 pounds). The point of initial application of the lever forces is 1.2 inches from the end of the brake lever grip. The direction of the force is perpendicular to the handle grip on the plane along which the brake lever rotates, and the point of application of the pedal force is the center of the foot contact pad of the brake pedal. The direction of the force is perpendicular to the foot contact pad on the plane along which the brake pedal rotates, as shown in Figure 2.

S7. *Test procedures and sequence.* Each motorcycle shall be capable of meeting all the requirements of this standard when tested according to the procedures and in the sequence set forth below without replacing any brake system part, or making any adjustments to the brake system other than as permitted in S7.4. A motorcycle shall be deemed to comply with S5.2, S5.3 and S5.5 if at least one of the stops specified in S7.3, S7.5 and S7.8 is made within the stopping distances specified in Table I.

S7.1 *Braking warming.* If the initial brake temperature for the first stop in a test procedure (other than S7.10) has not been reached, heat the brakes to

the initial brake temperature by making up to 10 stops from 30 m.p.h. at a deceleration of not more than 10 f.p.s.p.s. On independently operated brake systems, the coldest brake shall be within 10 °F. of the hottest brake.

S7.2 *Pretest instrumentation check.* Conduct a general check of test instrumentation by making not more than 10 stops from a speed of not more than 30 m.p.h. at a deceleration of not more than 10 f.p.s.p.s. If test instrument repair, replacement, or adjustment is necessary, make not more than 10 additional stops after such repair, replacement or adjustment.

S7.3 *Service brake system—first (preburnished) effectiveness test.*

S7.3.1 *Service brake system.* Make six stops from 30 m.p.h. and then six stops from 60 m.p.h. with an initial brake temperature between 130 °F. and 150 °F.

S7.3.2 *Partial service brake system.* For a motorcycle with two independently actuated service brake systems, repeat S7.3.1 using each service brake system individually.

S7.4 *Service brake system—burnish procedure.* Burnish the brakes by making 200 stops from 30 m.p.h. at 12 f.p.s.p.s. The braking interval shall be either the distance necessary to reduce the initial brake temperature to between 130 °F. and 150 °F. or 1 mile, whichever occurs first. Accelerate at maximum rate to 30 m.p.h. immediately after each stop and maintain that speed until making the next stop. After burnishing adjust the brakes in accordance with the manufacturer's recommendation.

S7.5 *Service brake system—second effectiveness test.* Repeat S7.3.1. Then, make four stops from 80 m.p.h. and four stops from the multiple of 5 m.p.h. that is 4 m.p.h. to 8 m.p.h. less than the speed attainable in 1 mile if that speed is 95 m.p.h. or greater.

S7.6 *Service brake system—fade and recovery test.* These requirements do not apply to a motor-driven cycle whose speed attainable in 1 mile is 30 m.p.h. or less.

S7.6.1 *Baseline check stops.* Make three stops from 30 m.p.h. at 10 to 11 f.p.s.p.s. for each stop. Compute the average of the maximum brake pedal forces and the maximum brake lever forces required for the three stops.

S7.6.2 *Fade stops.* Make 10 stops from 60 m.p.h. at not less than 15 f.p.s.p.s. for each stop. The initial brake temperature before the first brake application shall be between 130 °F. and 150 °F. Initial brake temperatures before brake applications for subsequent stops shall be those occurring at the distance intervals. Attain the required deceleration as quickly as possible and maintain at least this rate for not less than three-fourths of the total stopping distance for each stop. The interval between the starts of service brake applications shall be 0.4 mile. Drive 1 mile at 30 m.p.h. after the last fade stop and immediately conduct the recovery test specified in S7.6.3.

S7.6.3 *Recovery test.* Make five stops from 30 m.p.h. at 10 to 11 f.p.s.p.s. for each stop. The braking interval shall not be more than 1 mile. Immediately after each stop accelerate at maximum rate to 30 m.p.h. and maintain that speed until making the next stop.

S7.7 *Service brake system—reburnish.* Repeat S7.4 except make 35 burnish stops instead of 200 stops. Brakes may be adjusted after reburnish if no tools are used. These requirements do not apply to a motor-driven cycle whose speed attainable in 1 mile is 30 m.p.h. or less.

S7.8 *Service brake system—final effectiveness test.* These requirements do not apply to a motor-driven cycle whose speed attainable in 1 mile is 30 m.p.h. or less.

S7.8.1 *Service brake system.* Repeat S7.5 including S7.3.1.

S7.8.2 *Partial service brake system test.* Alter the service brake system on three-wheeled motorcycles to induce a complete loss of braking in any one subsystem. Determine the line pressure or pedal force necessary to cause the brake system failure indicator to operate. Make six stops from 30 m.p.h. and then six stops from 60 m.p.h. with an initial brake temperature between 130 °F. and 150 °F. Repeat for each subsystem. Determine that the brake failure indicator is operating when the master cylinder fluid level is less than the level specified in S5.1.3.1(a)(2), and that it complies with S5.1.3.1(c). Check for proper operation with each reservoir in turn at a low level. Restore

the service brake system to normal at completion of this test.

S7.9 *Parking brake test.* Starting with an initial brake temperature of not more than 150 °F., drive the motorcycle downhill on the 30 percent grade with the longitudinal axis of the motorcycle in the direction of the grade. Apply the service brakes with a force not exceeding 90 pounds to stop the motorcycle and place the transmission in neutral. Apply the parking brake by exerting a force not exceeding those specified in S5.6. Release the service brake and allow the motorcycle to remain at rest (to the limit of traction of the braked wheels) for 5 minutes. Repeat the test with the motorcycle parked in the reversed (uphill) position on the grade.

S7.10 *Service brake system—water recovery test.*

S7.10.1 *Baseline check stops.* Make three stops from 30 m.p.h. at 10 to 11 f.p.s.p.s. for each stop. Compute the average of the maximum brake pedal forces and of the maximum brake lever forces required for the three stops.

S7.10.2 *Wet brake recovery stops.* Completely immerse the rear brake assembly of the motorcycle in water for 2 minutes with the brake fully released. Next completely immerse the front brake assembly of the motorcycle in water for 2 minutes with the brake fully released. Perform the entire wetting procedure in not more than 7 minutes. Immediately after removal of the front brake from water, accelerate at a maximum rate to 30 mi/h without a brake application. Immediately upon reaching that speed make five stops, each from 30 mi/h at 10 to 11 ft/s^2 for each stop. After each stop (except the last) accelerate the motorcycle immediately at a maximum rate to 30 mi/h and begin the next stop.

S7.11 *Final inspection.* Upon completion of all the tests inspect the brake system in an assembled condition, for compliance with the brake lining inspection requirements. Disassemble all brakes and inspect:

(a) The entire brake system for detachment or fracture of any component.

(b) Brake linings for detachment from the shoe or pad.

(c) Wheel cylinder, master cylinder, and axle seals for fluid or lubricant leakage.

(d) Master cylinder for reservoir capacity and retention device.

(e) Master cylinder label for compliance with S5.1.2.2.

TABLE I—STOPPING DISTANCES FOR EFFECTIVENESS, FADE AND PARTIAL SYSTEM TESTS

Vehicle test speed, m.p.h.	Stopping distance, feet—Effectiveness tests			
	Preburnish effectiveness total system (S5.2.1)—I	Preburnish effectiveness partial mechanical systems (S5.2.2)—II	Effectiveness total system (S5.4) (SS5.7.1)—III	Effectiveness partial hydraulic systems (S5.7.2)—IV
15	13	30	11	25
20	24	54	19	44
25	37	84	30	68
30	54	121	43	97
35	74	165	58	132
40	96	216	75	173
45	121	273	95	218
50	150	337	128	264
55	181	407	155	326
60	216	484	185	388
65			217	455
70			264	527
75			303	606
80			345	689
85			389	778
90			484	872
95			540	971
100			598	1076
105			659	1188
110			723	1302
115			791	1423
120			861	1549

TABLE II—BRAKE TEST SEQUENCE AND REQUIREMENTS

Sequence L.C.	Test procedure	Requirements
1. Instrumentation check	S7.2	
2. First (Preburnish) effectiveness test:		
(a) Service brake system	S7.3.1	S5.2.1
(b) Partial service brake system	S7.3.2	S5.2.2
3. Burnish procedure	S7.4	
4. Second effectiveness test	S7.5	S5.3
5. First fade and recovery test	S7.6	S5.4
6. Reburnish	S7.7	
7. Final effectiveness test:		
(a) Service brake system	S7.8.1	S5.5.1
(b) Partial service brake system	S7.8.2	S5.5.2
8. Parking brake test (three-wheeled motorcycles only)	S7.9	S5.6
9. Water recovery test	S7.10	S5.7
10. Design durability	S7.11	S5.8

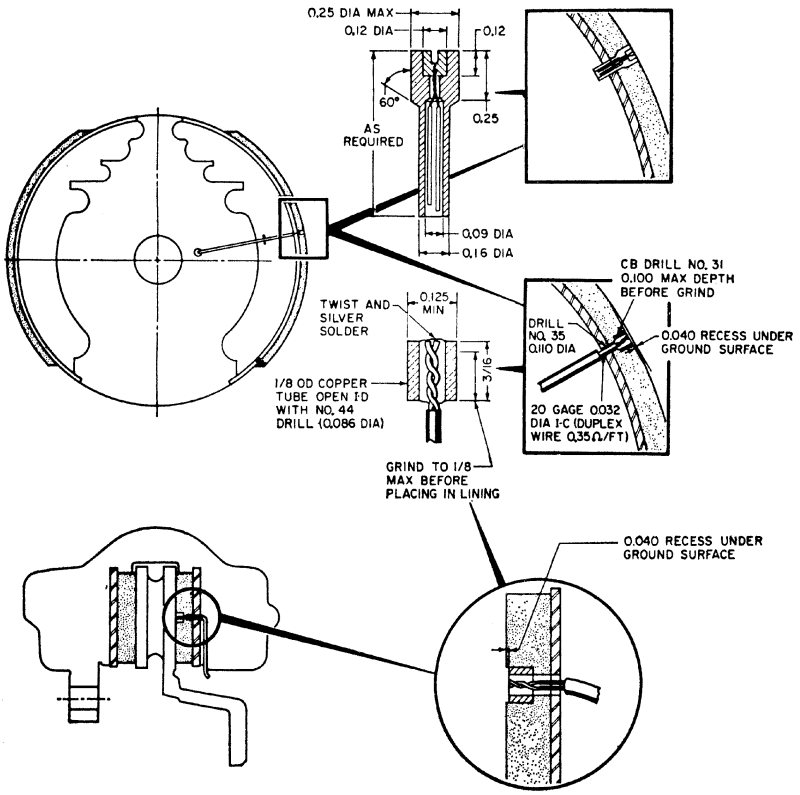
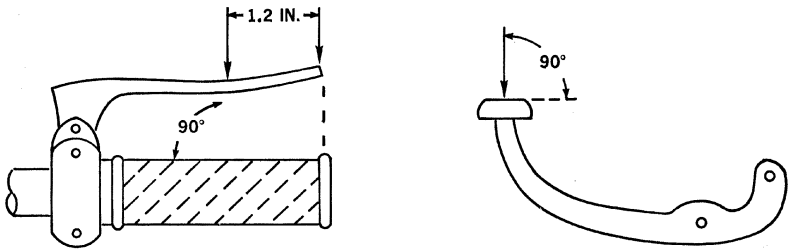


FIGURE 1 - TYPICAL PLUG TYPE THERMOCOUPLE INSTALLATIONS

FIG. 2 DIRECTION OF FORCE



(BRAKE LEVER) (BRAKE PEDAL)

(Authority: Delegation of authority at 38 FR 12147; secs. 102, 103, 119, Pub. L. 89–563, 80 Stat. 718 (15 U.S.C. 1391, 1392, 1407); delegations of authority at 49 CFR 1.50 and 49 CFR 501.8)

[37 FR 5034, Mar. 9, 1972, as amended at 37 FR 11974, June 16, 1972; 38 FR 14753, June 5, 1973; 39 FR 32914, Sept. 12, 1974; 39 FR 43075, Dec. 10, 1974; 41 FR 24593, June 17, 1976; 43 FR 9606, Mar. 9, 1978; 43 FR 46548, Oct. 10, 1978; 66 FR 42617, Aug. 14, 2001; 77 FR 760, Jan. 6, 2012. Redesignated and amended at 77 FR 51671, Aug. 24, 2012]

§571.123 Standard No. 123; Motorcycle controls and displays.

S1. *Scope.* This standard specifies requirements for the location, operation, identification, and illumination of motorcycle controls and displays, and requirements for motorcycle stands and footrests.

S2. *Purpose.* The purpose of this standard is to minimize accidents caused by operator error in responding to the motoring environment, by standardizing certain motorcycle controls and displays.

S3. *Application.* This standard applies to motorcycles equipped with handlebars, except for motorcycles that are designed, and sold exclusively for use by law enforcement agencies.

S4. *Definitions. Clockwise* and *counterclockwise* mean opposing directions of rotation around the following axes, as applicable.

(a) The operational axis of the ignition control, viewed from in front of the ignition lock opening;

(b) The axis of the right handlebar on which the twist-grip throttle is located, viewed from the end of that handlebar;

(c) The axis perpendicular to the center of the speedometer, viewed from the operator's normal eye position.

Scooter means a motorcycle that:

(1) Has a platform for the operator's feet or has integrated footrests, and

(2) Has a step-through architecture, meaning that the part of the vehicle forward of the operator's seat and between the legs of an operator seated in the riding position, is lower in height than the operator's seat.

S5. *Requirements.*

S5.1. Each motorcycle shall be equipped with a supplemental engine stop control, located and operable as specified in Table 1.

S5.2 Each motorcycle to which this standard applies shall meet the following requirements:

S5.2.1 *Control location and operation.* If any item of equipment listed in Table 1, Column 1, is provided, the control for such item shall be located as specified in Column 2, and operable as specified in Column 3. Each control located on a right handlebar shall be operable by the operator's right hand throughout its full range without removal of the operator's right hand from the throttle. Each control located on a left handlebar shall be operable by the operator's left hand throughout its full range without removal of the operator's left hand from the handgrip. If a motorcycle with an automatic clutch other than a scooter is equipped with a supplemental rear brake control, the control shall be located on the left handlebar. If a scooter with an automatic clutch is equipped with a supplemental rear brake control, the control shall be on the right side and operable by the operator's right foot. A supplemental control shall provide brake actuation identical to that provided by the required control of Table 1, Item 11, of this Standard. If a motorcycle is equipped with self-proportioning or antilock braking devices utilizing a single control for front and rear brakes, the control shall be located and operable in the same manner as a rear brake control, as specified in Table 1, Item 11, and in this paragraph.

S5.2.2 *Display illumination and operation.* If an item of equipment listed in Table 2, Column 1, is provided, the display for such item shall be visible to a seated operator under daylight conditions, shall illuminate as specified in Column 2, and shall operate as specified in Column 3.

S5.2.3 *Control and display identification.* If an item of equipment in Table 3, Column 1, is provided, the item and its operational function shall be identified by:

(a) A symbol substantially in the form shown in Column 3; or

(b) Wording shown in both Column 2 and Column 4; or

(c) A symbol substantially in the form shown in Column 3 and wording shown in both Column 2 and Column 4.

(d) The abbreviations ''M.P.H.'', ''km/h'', ''r/min'', ''Hi'', ''Lo'', ''L'', ''R'', and ''Res'' appearing in Column 2 and Column 4 may be spelled in full. Symbols and words may be provided for equipment items where none are shown in Column 2, Column 3, and Column 4. Any identification provided shall be placed on or adjacent to the control or display position, and shall appear upright to the operator.

S5.2.4 *Stands.* A stand shall fold rearward and upward if it contacts the

ground when the motorcycle is moving forward.

S5.2.5 *Footrests.* Footrests shall be provided for each designated seating position. Each footrests for a passenger other than an operator shall fold rearward and upward when not in use.

Table 1 - Motorcycle Control Location and Operation Requirements

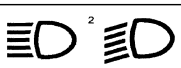
	Equipment Control - Column 1	**Location -- Column 2**	**Operation -- Column 3**
1	Manual clutch or integrated clutch and gear change	Left handlebar	Squeeze to disengage clutch.
2	Foot-operated gear change	Left foot control	An upward motion of the operator's toe shifts transmission toward lower numerical gear ratios (commonly referred to as "higher gears"), and a downward motion toward higher numerical gear ratios (commonly referred to as lower gears"). If three or more gears are provided, it shall not be possible to shift from the highest gear directly to the lowest, or vice versa.
3	Headlamp upper-lower beam control	Left handlebar	Up for upper beam, down for lower beam. If combined with the headlight on-off switch, means shall be provided to prevent inadvertent actuation of the "off" function.
4	Horn	Left handlebar	Push to activate.
5	Turn signal lamps	Handlebars.	

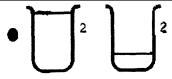
6	Ignition		"Off" - counterclockwise from other positions.
7	Manual fuel shutoff control		Rotate to operate. "On" and "Off" are separated by 90 degrees of rotation. "Off" and "Reserve" (if provided) are separated by 90 degrees of rotation. Sequence order: "On" - "Off" - "Reserve".
8	Twist-grip throttle	Right handlebar	Self-closing to idle in a clockwise direction after release of hand.
9	Supplemental engine stop	Right handlebar	
10	Front wheel brake	Right handlebar	Squeeze to engage.
11	Rear wheel brakes	Right foot control Left handlebar for a motor-driven cycle and for a scooter with an automatic clutch	Depress to engage. Squeeze to engage.
[1]See S5.2.1 for requirements for vehicles with a single control for front and rear brakes, and with a supplemental rear brake control.			

TABLE 2—MOTORCYCLE DISPLAY ILLUMINATION AND OPERATION REQUIREMENTS

Display—Column 1	Illumination—Column 2	Operation—Column 3
1. Speedometer	Yes	The display is illuminated whenever the headlamp is activated.
2. Neutral indication	Green display lamp	The display lamp illuminates when the gear selector is in neutral position.

Table 3 to § 571.123--Motorcycle Control and Display Identification Requirements

No.	Column 1	Column 2	Column 3	Column 4
	Equipment	*Control and Display Identification Word*	*Control and Display Identification Symbol*	*Identification at Appropriate Position of Control and Display*
1	Ignition	Ignition	_____	Off
2	Supplemental Engine Stop (Off, Run)	Engine Stop		Off, Run
3	Manual Choke or Mixture Enrichment	Choke or Enrichener		_____
4	Electric Starter	_____		Start [1]
5	Headlamp Upper-Lower Beam Control	Lights	 [2]	Hi, Lo
6	Horn	Horn		_____
7	Turn Signal	Turn	 [2] [3]	L, R
8	Speedometer	MPH OR MPH and km/h [5]	_____	MPH [4] MPH, km/h [5]
9	Neutral Indicator	Neutral	N	_____
10	Upper Beam Indicator	High Beam	 [2]	_____

11	Tachometer	R.P.M. or r/min.		
12	Fuel Tank Shutoff Valve (Off, On, Res.)	Fuel		Off, On, Res.
13	ABS Malfunction	ABS or Anti-lock or Antilock [6]		

[1] Required only if electric starter is separate from ignition switch.

[2] Framed areas may be filled.

[3] The pair of arrows is a single symbol. When the indicators for left and right turn operate independently, however, the two arrows will be considered separate symbols and may be spaced accordingly.

[4] MPH increase in a clockwise direction. Major graduations and numerals appear at 10 mph intervals, minor graduations at 5 mph intervals. (37 F.R. 17474 – August 19, 1972. Effective: 9/1/74)

[5] If the speedometer is graduated in miles per hour (MPH) and in kilometers per hour (km/h), the identifying words or abbreviation shall be "MPH" and "km/h" in any combination of upper or lower case letters.

[6] Letters shall be at least 2.4 mm (3/32 in.) high.

[37 FR 7207, Apr. 12, 1972, as amended at 37 FR 17475, Aug. 29, 1972; 39 FR 32915, Sept. 12, 1974; 48 FR 42819, Sept. 20, 1983; 49 FR 35381, Sept. 7, 1984; 49 FR 35504, Sept. 10, 1984; 56 FR 61387, Dec. 3, 1991; 63 FR 28933, May 27, 1998; 63 FR 51001, Sept. 24, 1998; 70 FR 51295, Aug. 30, 2005; 86 FR 1298, Jan. 8, 2020]

§571.124 Standard No. 124; Accelerator control systems.

S1. *Scope*. This standard establishes requirements for the return of a vehicle's throttle to the idle position when the driver removes the actuating force from the accelerator control, or in the event of a severance or disconnection in the accelerator control system.

S2. *Purpose*. The purpose of this standard is to reduce deaths and injuries resulting from engine overspeed caused by malfunctions in the accelerator control system.

S3. *Application*. This standard applies to passenger cars, multi-purpose passenger vehicles, trucks, and buses.

S4. *Definitions*.

S4.1 *Driver-operated accelerator control system* means all vehicle components, except the fuel metering device, that regulate engine speed in direct response to movement of the driver-operated control and that return the throttle to the idle position upon release of the actuating force.

Fuel metering device means the carburetor, or in the case of certain engines the fuel injector, fuel distributor or fuel injection pump.

Throttle means the component of the fuel metering device that connects to the driver-operated accelerator control system and that by input from the driver-operated accelerator control system controls the engine speed.

Idle position means the position of the throttle at which it first comes in contact with an engine idle speed control appropriate for existing conditions according to the manufacturers' recommendations. These conditions include, but are not limited to, engine speed adjustments for cold engine, air

conditioning, and emission control, and the use of throttle setting devices.

Ambient temperature means the surrounding air temperature, at a distance such that it is not significantly affected by heat from the vehicle under test.

S4.2 In the case of vehicles powered by electric motors, the words *throttle* and *idle* refer to the motor speed controller and motor shutdown, respectively.

S5. *Requirements.* The vehicle shall meet the following requirements when the engine is running under any load condition, and at any ambient temperature between −40 degrees Celsius and + 52 degrees Celsius after 12 hours of conditioning at any temperature within that range.

S5.1 There shall be at least two sources of energy capable of returning the throttle to the idle position within the time limit specified by S5.3 from any accelerator position or speed whenever the driver removes the opposing actuating force. In the event of failure of one source of energy by a single severance or disconnection, the throttle shall return to the idle position within the time limits specified by S5.3, from any accelerator position or speed whenever the driver removes the opposing actuating force.

S5.2 The throttle shall return to the idle position from any accelerator position or any speed of which the engine is capable whenever any one component of the accelerator control system is disconnected or severed at a single point. The return to idle shall occur within the time limit specified by S5.3, measured either from the time of severance or disconnection or from the first removal of the opposing actuating force by the driver.

S5.3 Except as provided below, maximum time to return to idle position shall be 1 second for vehicles of 4536 kilograms or less GVWR, and 2 seconds for vehicles of more than 4536 kilograms GVWR. Maximum time to return to idle position shall be 3 seconds for any vehicle that is exposed to ambient air at −18 degrees Celsius to −40 degrees Celsius during the test or for any portion of the 12-hour conditioning period.

[38 FR 2980, Jan. 31, 1973, as amended at 60 FR 13645, Mar. 14, 1995]

§ 571.125 Standard No. 125; Warning devices.

S1. *Scope.* This standard establishes requirements for devices, without self-contained energy sources, that are designed to be carried in motor vehicles and used to warn approaching traffic of the presence of a stopped vehicle, except for devices designed to be permanently affixed to the vehicle.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries due to rear end collisions between moving traffic and disabled vehicles.

S3. *Application.* This standard applies to devices, without self-contained energy sources, that are designed to be carried in buses and trucks that have a gross vehicle weight rating (GVWR) greater than 10,000 pounds. These devices are used to warn approaching traffic of the presence of a stopped vehicle, except for devices designed to be permanently affixed to the vehicle.

S4. *Definitions. Entrance angle* means the angle having as its sides the line through the center, and normal to the face, of the object to be tested, and the line from the center of the object to the center of the source of illumination (Figure 2).

Fluorescent means the property of emitting visible light due to the absorption of radiation of a shorter wavelength which may be outside the visible spectrum.

Observation angle means the angle having as its sides the line from the observation point to the center of the object to be tested and the line from the center of that object to the center of the source of illumination (Figure 2).

Reflex reflective means reflective of light in directions close to the direction of incident light, over a wide range of variations in the direction of incident light.

S5. *Requirements.*

S5.1 *Equipment.*

S5.1.1 Reflex reflective material and fluorescent material that meet the requirements of this standard shall be affixed to both faces of the warning device. Alternatively, a dual purpose orange fluorescent and red reflective material that meets the requirements of this standard (hereafter referred to as ''dual purpose material'') may be affixed to both faces in places of the reflective and fluorescent materials.

S5.1.2 Each warning device shall be protected from damage and deterioration—

(a) By enclosure in an opaque protective reusable container, except that two or three warning devices intended to be sold for use as a set with a single vehicle may be enclosed in a single container; or

(b) By secure attachment to any light-tight, enclosed, and easily accessible compartment of a new motor vehicle with which it is supplied by the vehicle manufacturer.

S5.1.3 The warning device shall be designed to be erected, and replaced in its container, without the use of tools.

S5.1.4 The warning device shall be permanently and legibly marked with:

(a) Name of manufacturer;

(b) Month and year of manufacture, which may be expressed numerically, as ''6/72''; and

(c) The symbol DOT, or the statement that the warning device complies with all applicable Federal motor vehicle safety standards.

S5.1.5 Each warning device shall have instructions for its erection and display.

(a) The instructions shall be either indelibly printed on the warning device or attached in such a manner that they cannot be easily removed.

(b) Instructions for each warning device shall include a recommendation that the driver activate the vehicular hazard warning signal lamps before leaving the vehicle to erect the warning device.

(c) Instructions shall include the illustration depicted in Figure 3 indicating recommended positioning.

S5.2 *Configuration.*

S5.2.1 When the warning device is erected on level ground:

(a) Part of the warning device shall form an equilateral triangle that stands in a plane not more than 10° from the vertical, with the lower edge of the base of the triangle horizontal and not less than 1 inch above the ground.

(b) None of the required portion of the reflective material and fluorescent material shall be obscured by any other part of the warning device except for any portion of the material over which it is necessary to provide fasteners, pivoting beads or other means to allow collapsibility or support of the device. In any event, sufficient reflective and fluorescent material shall be used on the triangle to meet the requirements of S5.4 and S5.5.

S5.2.2 Each of the three sides of the triangular portion of the warning device shall not be less than 17 and not more than 22 inches long, and not less than 2 and not more than 3 inches wide (Figure 1).

S5.2.3 Each face of the triangular portion of the warning device shall have an outer border of red reflex reflective material of uniform width and not less than 0.75 and not more than 1.75 inches wide, and an inner border of orange fluorescent material of uniform width and not less than 1.25 and not more than 1.30 inches wide (Figure 1). However, this requirement shall not apply if the dual purpose material is used.

S5.2.4 Each vertex of the triangular portion of the warning device shall have a radius of not less than 0.25 inch and not more than 0.50 inch.

S5.2.5 All edges shall be rounded or chamfered, as necessary, to reduce the possibility of cutting or harm to the user.

S5.2.6 The device shall consist entirely of the triangular portion and attachments necessary for its support and enclosure, without additional visible shapes or attachments.

S5.3 *Color.*

S5.3.1 The color of the red reflex reflective material on the warning device shall have the following characteristics, both before and after the warning device has been conditioned in accordance with S6.1, when the source of illumination is a lamp with a tungsten filament operating at 2856° Kelvin color temperature. Expressed in terms of the

International Commission on Illumination (CIE) 1931 standard colorimetric observer system (CIE chromaticity diagram, Figure 4), the chromaticity coordinates of the red reflex reflective material shall lie within the region bounded by the spectrum locus and the lines on the diagram defined by the following equations:

Boundary	Equations
Yellow	y = 0.33
White	x + y = 0.98

S5.3.2 The color of the orange fluorescent material on the warning device shall have the following characteristics, both before and after the warning device has been conditioned in accordance with S6.1, when the source of illumination is a 150-watt high pressure xenon compact arc lamp. Expressed in terms of the International Commission on Illumination (CIE) 1931 standard colorimetric observer system, the chromaticity coordinates of the orange fluorescent material shall lie within the region bounded by the spectrum locus and the lines on the diagram defined by the following equations:

Boundary	Equations
Yellow	y = 0.49x + 0.17
White	x + y = 0.93
Red	y = 0.35

The 150-watt high pressure xenon compact arc lamp shall illuminate the sample using the unmodified spectrum at an angle of incidence of 45° and an angle of observation of 90°. If dual purpose material is being tested, it shall be illuminated by a 150-watt high pressure xenon compact arc lamp, whose light is diffused by an integrating sphere.

S5.4 *Reflectivity*. When the red reflex reflective material on the warning device is tested in accordance with S6.2, both before and after the warning device has been conditioned in accordance with S6.1, its total candlepower per incident foot candle shall be not less than the values specified in Table I for each of the listed entrance angles.

S5.5 *Luminance*. When the orange fluorescent material on the warning device is tested in accordance with S6.3, both before and after the warning device has been conditioned in accordance with S6.1, it shall have a minimum relative luminance of 25 percent of a flat magnesium oxide surface and a minimum product of that relative luminance and width in inches of 44.

S5.6 *Stability*. When the warning device is erected on a horizontal brushed concrete surface both with and against the brush marks and subjected to a horizontal wind of 40 miles per hour in any direction for 3 minutes—

(a) No part of it shall slide more than 3 inches from its initial position;

(b) Its triangular portion shall not tilt to a position that is more than 10° from the vertical; and

(c) Its triangular position shall not turn through a horizontal angle of more than 10° in either direction from the initial position.

S5.7 *Durability*. When the warning device is conditioned in accordance with S6.1, no part of the warning device shall become warped or separated from the rest of the warning device.

S6. *Test Procedures*.

S6.1 *Conditions*.

S6.1.1 Submit the warning device to the following conditioning sequence, returning the device after each step in the sequence to ambient air at 68 °F. for at least 2 hours.

(a) Minus 40 °F. for 16 hours in a circulating air chamber using ambient air which would have not less than 30 percent and not more than 70 percent relative humidity at 70 °F.;

(b) 150 °F. for 16 hours in a circulating air oven using ambient air which would have not less than 30 percent and not more than 70 percent relative humidity at 70 °F.;

(c) 100 °F. and 90 percent relative humidity for 16 hours;

(d) Salt spray (fog) test in accordance with ASTM B117–64 (incorporated by reference, see § 571.5), except that the test shall be for 4 hours rather than 40 hours; and

(e) Immersion for 2 hours in water at a temperature of 100 °F.

S6.2 *Reflectivity Test*. Test the red reflex reflective materials as follows:

(a) Unless dual purpose material is used, prevent the orange fluorescent material from affecting the photometric measurement of the reflectivity of the red reflex reflective material, either by separation or masking.

(b) Use a lamp with a tungsten filament operating at 2856° Kelvin color temperature as the source of illumination.

(c) Place the source of illumination 100 feet from the red reflex reflective material (Figure 2).

(d) Place the observation point directly above the source of illumination (Figure 2).

(e) Calculate the total candlepower per incident foot candle of the red reflex reflective material at each of the entrance and observation angles specified in Table 1.

S6.3 *Luminance Test.* Test the orange fluorescent material as follows:

(a) Unless dual purpose material is used, prevent the red reflex reflective material from affecting the photometric measurement of the luminance of the orange fluorescent material.

(b) Using a 150-watt high pressure xenon compact arc lamp as the light source, illuminate the test sample at an angle of incidence of 45° and an angle of observation of 90°. If dual purpose material is being tested, illuminate the sample diffusely through an integrating sphere.

(c) Measure the luminance of the material at a perpendicular viewing angle, with no ray of the viewing beam more than 5° from the perpendicular to the specimen.

(d) Repeat the procedure for a flat magnesium oxide surface, and compute the quotient (percentage) of the luminance of the material relative to that of the magnesium oxide surface.

WARNING DEVICE

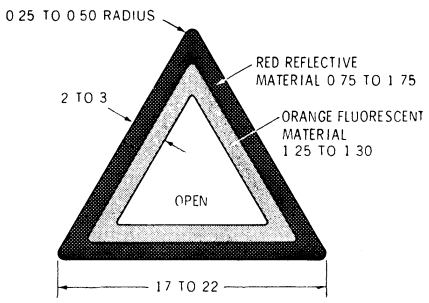
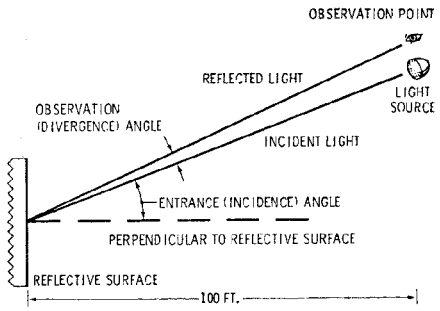
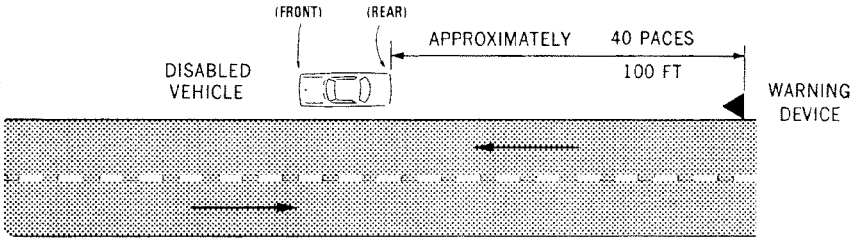


FIG. 1—DIMENSIONS OF WARNING DEVICE (INCHES)



REFLECTIVITY TEST DIAGRAM

Figure 2



RECOMMENDED WARNING DEVICE POSITIONING

Figure 3

TOTAL MINIMUM CANDLEPOWER PER INCIDENT FOOT CANDLE

Observation Angles - Degrees	Entrance Angles - Degrees						
	0	10 up	10 down	20 left	20 right	30 left	30 right
0.2	80	80	80	40	40	8.0	8.0
1.5	0.8	0.8	0.8	0.4	0.4	0.08	0.08

TABLE 1

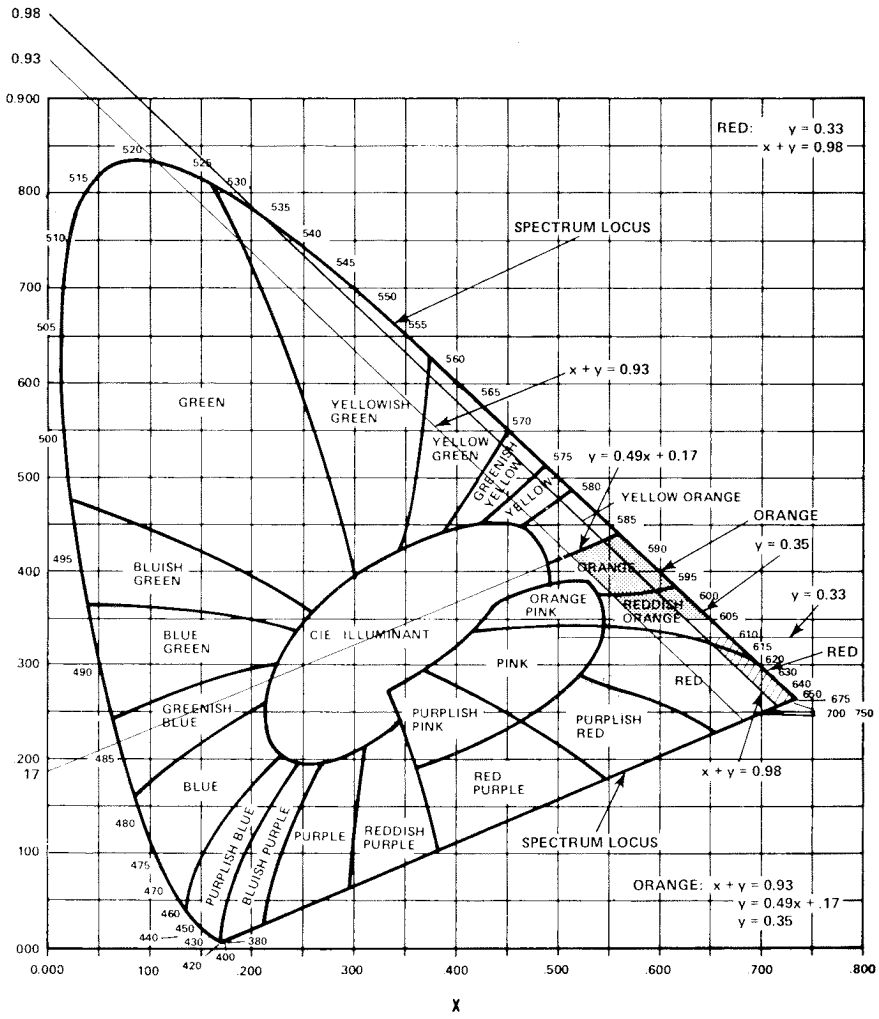


Figure 4. CIE Chromaticity Diagram.

[39 FR 28636, Aug. 9, 1974, as amended at 40 FR 4, Jan. 2, 1975; 59 FR 49591, Sept. 29, 1994; 77 FR 760, Jan. 6, 2012]

§571.126 Standard No. 126; Electronic stability control systems for light vehicles.

S1. *Scope.* This standard establishes performance and equipment requirements for electronic stability control (ESC) systems.

S2. *Purpose.* The purpose of this standard is to reduce the number of deaths and injuries that result from crashes in which the driver loses directional control of the vehicle, including those resulting in vehicle rollover.

S3 *Application*. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating of 4,536 kilograms (10,000 pounds) or less, according to the phase-in schedule specified in S8 of this standard.

S4. *Definitions*.

Ackerman Steer Angle means the angle whose tangent is the wheelbase divided by the radius of the turn at a very low speed.

Drive configuration means the driver-selected, or default, condition for distributing power from the engine to the drive wheels (examples include, but are not limited to, 2-wheel drive, front-wheel drive, rear-wheel drive, all-wheel drive, 4-wheel drive high gear with locked differential, and 4-wheel drive low gear).

Electronic stability control system or *ESC system* means a system that has all of the following attributes:

(1) That augments vehicle directional stability by applying and adjusting the vehicle brake torques individually to induce a correcting yaw moment to a vehicle;

(2) That is computer-controlled with the computer using a closed-loop algorithm to limit vehicle oversteer and to limit vehicle understeer;

(3) That has a means to determine the vehicle's yaw rate and to estimate its side slip or side slip derivative with respect to time;

(4) That has a means to monitor driver steering inputs;

(5) That has an algorithm to determine the need, and a means to modify engine torque, as necessary, to assist the driver in maintaining control of the vehicle; and

(6) That is operational over the full speed range of the vehicle (except at vehicle speeds less than 20 km/h (12.4 mph), when being driven in reverse, or during system initialization).

Lateral acceleration means the component of the vector acceleration of a point in the vehicle perpendicular to the vehicle's x-axis (longitudinal) and parallel to the road plane.

Low-range four-wheel drive configuration means a drive configuration that has the effect of locking the drive gears at the front and rear axles together and providing an additional gear reduction between the engine speed and vehicle speed of at least 2.0.

Mode means an ESC performance algorithm, whether driver-selected or not (examples include, but are not limited to, standard (default) mode, performance mode, snow or slippery road mode, or Off mode).

Oversteer means a condition in which the vehicle's yaw rate is greater than the yaw rate that would occur at the vehicle's speed as a result of the Ackerman Steer Angle.

Side slip or *side slip angle* means the arctangent of the lateral velocity of the center of gravity of the vehicle divided by the longitudinal velocity of the center of gravity.

Understeer means a condition in which the vehicle's yaw rate is less than the yaw rate that would occur at the vehicle's speed as a result of the Ackerman Steer Angle.

Yaw rate means the rate of change of the vehicle's heading angle measured in degrees/second of rotation about a vertical axis through the vehicle's center of gravity.

S5. *Requirements*. Subject to the phase-in set forth in S8, each vehicle must be equipped with an ESC system that meets the requirements specified in S5 under the test conditions specified in S6 and the test procedures specified in S7 of this standard.

S5.1 *Required Equipment*. Vehicles to which this standard applies must be equipped with an electronic stability control system that:

S5.1.1 Is capable of applying brake torques individually to all four wheels and has a control algorithm that utilizes this capability.

S5.1.2 Is operational during all phases of driving including acceleration, coasting, and deceleration (including braking), except when the driver has disabled ESC, the vehicle speed is below 20 km/h (12.4 mph), the vehicle is being driven in reverse, or during system initialization

S5.1.3 Remains capable of activation even if the antilock brake system or traction control system is also activated.

S5.2 *Performance Requirements*. During each test performed under the test conditions of S6 and the test procedure of S7.9, the vehicle with the ESC system

engaged must satisfy the stability criteria of S5.2.1 and S5.2.2, and it must satisfy the responsiveness criterion of S5.2.3 during each of those tests conducted with a commanded steering wheel angle of 5A or greater, where A is the steering wheel angle computed in S7.6.1.

S5.2.1 The yaw rate measured one second after completion of the sine with dwell steering input (time T_0 + 1 in Figure 1) must not exceed 35 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks) ($å_{Peak}$ in Figure 1) during the same test run, and

S5.2.2 The yaw rate measured 1.75 seconds after completion of the sine with dwell steering input must not exceed 20 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks) during the same test run.

S5.2.3 The lateral displacement of the vehicle center of gravity with respect to its initial straight path must be at least 1.83 m (6 feet) for vehicles with a GVWR of 3,500kg (7,716 lb) or less, and 1.52 m (5 feet) for vehicles with a GVWR greater than 3,500 kg (7,716 lb) when computed 1.07 seconds after the Beginning of Steer (BOS). BOS is defined in S7.11.6.

S5.2.3.1 The computation of lateral displacement is performed using double integration with respect to time of the measurement of lateral acceleration at the vehicle center of gravity, as expressed by the formula:

$$\text{Lateral Displacement} = \iint Ay_{C.G.}\,dt$$

S5.2.3.2 Time t = 0 for the integration operation is the instant of steering initiation, known as the Beginning of Steer (BOS). BOS is defined in S7.11.6.

S5.3 *ESC Malfunction.* The vehicle must be equipped with a telltale that provides a warning to the driver of the occurrence of one or more malfunctions that affect the generation or transmission of control or response signals in the vehicle's electronic stability control system. When tested according to S7.10, the ESC malfunction telltale:

S5.3.1 As of September 1, 2011, must be mounted inside the occupant compartment in front of and in clear view of the driver;

S5.3.2 As of September 1, 2011, must be identified by the symbol shown for ''ESC Malfunction Telltale'' or the specified words or abbreviations listed in Table 1 of Standard No. 101 (49 CFR 571.101);

S5.3.3 As of September 1, 2011, except as provided in paragraphs S5.3.4, S5.3.5, S5.3.8, and S5.3.10, the ESC malfunction telltale must illuminate only when a malfunction(s) of the ESC system exists and must remain continuously illuminated under the conditions specified in S5.3 for as long as the malfunction(s) exists (unless the ''ESC malfunction'' and ''ESC Off'' telltales are combined in a two-part telltale and the ''ESC Off'' telltale is illuminated), whenever the ignition locking system is in the ''On'' (''Run'') position; and

S5.3.4 As of September 1, 2011, except as provided in paragraph S5.3.5, each ESC malfunction telltale must be activated as a check of lamp function either when the ignition locking system is turned to the ''On'' (''Run'') position when the engine is not running, or when the ignition locking system is in a position between ''On'' (''Run'') and ''Start'' that is designated by the manufacturer as a check position.

S5.3.5 The ESC malfunction telltale need not be activated when a starter interlock is in operation.

S5.3.6 The requirement S5.3.4 does not apply to telltales shown in a common space.

S5.3.7 The ESC malfunction telltale must extinguish at the next ignition cycle after the malfunction has been corrected.

S5.3.8 The manufacturer may use the ESC malfunction telltale in a flashing mode to indicate ESC operation.

S5.3.9 Prior to September 1, 2011, a disconnection of the power to the ESC electronic control unit may be indicated by the ABS malfunction telltale instead of the ESC malfunction telltale.

S5.3.10 Manufacturers may use the ESC malfunction telltale in a steady-burning mode to indicate malfunctions of ESC-related systems and functions

including traction control, trailer stability assist, corner brake control, and other similar functions that use throttle and/or individual wheel torque control to operate and share common components with the ESC system, and may use the ESC malfunction telltale in a flashing mode to indicate operation of these ESC-related systems.

S5.4 *ESC Off and Other System Controls.* The manufacturer may include an ''ESC Off'' control whose only purpose is to place the ESC system in a mode or modes in which it will no longer satisfy the performance requirements of S5.2.1, S5.2.2, and S5.2.3. An ''ESC Off'' control may be combined with other controls in a multi-function control. Manufacturers may also provide controls for other systems that have an ancillary effect upon ESC operation. Controls of either kind that place the ESC system in a mode in which it will no longer satisfy the performance requirements of S5.2.1, S5.2.2, and S5.2.3 are permitted, provided that:

S5.4.1 The vehicle's ESC system must always return to the manufacturer's original default ESC mode that satisfies the requirements of S5.1 and S5.2 at the initiation of each new ignition cycle, regardless of what ESC mode the driver had previously selected, unless (a) the vehicle is in a low-range four-wheel drive configuration selected by the driver on the previous ignition cycle that is designed for low-speed, off-road driving, or (b) the vehicle is in a four-wheel drive configuration selected by the driver on the previous ignition cycle that is designed for operation at higher speeds on snow-, sand-, or dirt-packed roads and that has the effect of locking the drive gears at the front and rear axles together, provided that the vehicle meets the stability performance requirements of S5.2.1 and S5.2.2 in this mode.

S5.4.2 In addition to the requirements of S5.4.1, if the vehicle's ESC system has more than one ESC mode that satisfies the requirements of S5.1 and S5.2 within the drive configuration selected for the previous ignition cycle, the system must return to the manufacturer's original default ESC mode.

S5.4.3 As of September 1, 2011, a control whose only purpose is to place the ESC system in a mode or modes in which it will no longer satisfy the performance requirements of S5.2.1, S5.2.2, and S5.2.3 must be identified by the symbol shown for ''ESC Off'' in Table 1 of Standard No. 101 (49 CFR 571.101), or the text, ''ESC Off'' as listed under ''Word(s) or Abbreviations'' in Table 1 of Standard No. 101 (49 CFR 571.101).

S5.4.4 A control for another system that has the ancillary effect of placing the ESC system in a mode in which it no longer satisfies the performance requirements of S5.2.1, S5.2.2, and S5.2.3 need not be identified by the ''ESC Off'' identifiers in Table 1 of Standard No. 101 (49 CFR 571.101), but the ESC status must be identified by the ''ESC Off'' telltale in accordance with S5.5, as of September 1, 2011, except if the vehicle is in a 4-wheel drive high gear configuration that has the effect of locking the drive gears at the front and rear axles together provided the vehicle meets the stability performance criteria of S5.2.1 and S5.2.2.

S5.5 *ESC Off Telltale*

S5.5.1 Except as provided in S5.5.10, the vehicle manufacturer must provide a telltale indicating that the vehicle has been put into a mode that renders it unable to satisfy the requirements of S5.2.1, S5.2.2 and S5.2.3, if such a mode is provided.

S5.5.2 As of September 1, 2011, the ''ESC Off'' telltale must be identified by the symbol shown for ''ESC Off'' in Table 1 of Standard No. 101 (49 CFR 571.101) or the text, ''ESC Off'' as listed under ''Word(s) or Abbreviations'' in Table 1 of Standard No. 101 (49 CFR 571.101).

S5.5.3 As of September 1, 2011, the ''ESC Off'' telltale must be mounted inside the occupant compartment in front of and in clear view of the driver.

S5.5.4 Except as provided in paragraph S5.4.4, the ''ESC Off'' telltale must remain continuously illuminated for as long as the ESC is in a mode that renders it unable to satisfy the requirements of S5.2.1, S5.2.2, and S5.2.3, and

S5.5.5 Notwithstanding S5.3.1(e) of 49 CFR 571.101, the vehicle manufacturer may use the ''ESC Off'' telltale to indicate an ESC level of function other than the fully functional default mode even if the vehicle would meet S5.2.1, S5.2.2 and S5.2.3 at that level of ESC function.

S5.5.6 As of September 1, 2011, except as provided in paragraph S5.5.7 and S5.5.8, each ''ESC Off'' telltale must be activated as a check of lamp function either when the ignition locking system is turned to the ''On'' (''Run'') position when the engine is not running, or when the ignition locking system is in a position between ''On'' (''Run'') and ''Start'' that is designated by the manufacturer as a check position.

S5.5.7 The ''ESC Off'' telltale need not be activated when a starter interlock is in operation.

S5.5.8 The requirement S5.5.6 does not apply to telltales shown in a common space.

S5.5.9 The ''ESC Off'' telltale must extinguish after the ESC system has been returned to its fully functional default mode.

S5.5.10 The ''ESC Off'' telltale need not illuminate when the vehicle is in a 4-wheel drive high gear locked differential configuration that has the effect of locking the drive gears at the front and rear axles together provided the vehicle meets the stability performance requirements of S5.2.1 and S5.2.2.

S5.6 *ESC System Technical Documentation.* To ensure a vehicle is equipped with an ESC system that meets the definition of ''ESC System'' in S4, the vehicle manufacturer must make available to the agency, upon request, the following documentation:

S5.6.1 A system diagram that identifies all ESC system hardware. The diagram must identify what components are used to generate brake torques at each wheel, determine vehicle yaw rate, estimated side slip or the side slip derivative and driver steering inputs.

S5.6.2 A written explanation describing the ESC system basic operational characteristics. This explanation must include a discussion on the system's capability to apply brake torques at each wheel and how the system modifies engine torque during ESC system activation. The explanation must also identify the vehicle speed range and the driving phases (acceleration, deceleration, coasting, during activation of the ABS or traction control) under which the ESC system can activate.

S5.6.3 A logic diagram that supports the explanation provided in S5.6.2.

S5.6.4 Specifically for mitigating vehicle understeer, a discussion of the pertinent inputs to the computer or calculations within the computer and how its algorithm uses that information and controls ESC system hardware to limit vehicle understeer.

S6. *Test Conditions.*

S6.1 *Ambient conditions.*

S6.1.1 The ambient temperature is between 7 °C (45 °F) and 40 °C (104 °F).

S6.1.2 The maximum wind speed is no greater than 10 m/s (22 mph) for passenger cars and 5 m/s (11 mph) for multipurpose passenger vehicles, trucks and buses.

S6.2 *Road test surface.*

S6.2.1 The tests are conducted on a dry, uniform, solid-paved surface. Surfaces with irregularities and undulations, such as dips and large cracks, are unsuitable.

S6.2.2 The road test surface must produce a peak friction coefficient (PFC) of 1.02 when measured using an ASTM F2493 standard reference test tire, in accordance with ASTM E1337–19 (incorporated by reference, see §571.5) at a speed of 64.4 km/h (40 mph), without water delivery.

S6.2.3 The test surface has a consistent slope between level and 1%.

S6.3 *Vehicle conditions.*

S6.3.1 The ESC system is enabled for all testing, except when it is turned off directly or by simulating a malfunction in accordance with S7.3 and S7.10, respectively. The ESC system shall be initialized as follows: Place the vehicle in a forward gear and obtain a vehicle speed of 48 ±8 km/h (30 ±5 mph). Drive the vehicle for at least two minutes including at least one left and one right turning maneuver and at least one application of the service brake.

S6.3.2 *Test Weight.* The vehicle is loaded with the fuel tank filled to at least 75 percent of capacity, and total interior load of 168 kg (370 lbs) comprised of the test driver, approximately 59 kg (130 lbs) of test equipment (automated steering machine, data acquisition system and the power supply for the steering machine), and ballast as required by differences in the weight of test drivers and test equipment. Where required, ballast shall be placed on the

floor behind the passenger front seat or if necessary in the front passenger foot well area. All ballast shall be secured in a way that prevents it from becoming dislodged during test conduct.

S6.3.3 *Tires.* The vehicle is tested with the tires installed on the vehicle at time of initial vehicle sale. The tires are inflated to the vehicle manufacturer's recommended cold tire inflation pressure(s) specified on the vehicle's placard or the tire inflation pressure label. Tubes may be installed to prevent tire de-beading.

S6.3.4 *Outriggers.* Outriggers are used for testing trucks, multipurpose passenger vehicles, and buses. Vehicles with a baseline weight less than 1,588 kg (3,500 lbs) are equipped with ''light'' outriggers. Vehicles with a baseline weight equal to or greater than 1,588 kg (3,500 lbs) and less than 2,722 kg (6,000 lbs) are equipped with ''standard'' outriggers. Vehicles with a baseline weight equal to or greater than 2,722 kg (6,000 lbs) are equipped with ''heavy'' outriggers. A vehicle's baseline weight is the weight of the vehicle delivered from the dealer, fully fueled, with a 73 kg (160 lb) driver. Light outriggers are designed with a maximum weight of 27 kg (59.5 lb) and a maximum roll moment of inertia of 27 kg-m^2 (19.9 ft-lb-sec^2). Standard outriggers are designed with a maximum weight of 32 kg (70 lb) and a maximum roll moment of inertia of 35.9 kg-m^2 (26.5 ft-lb-sec^2). Heavy outriggers are designed with a maximum weight of 39 kg (86 lb) and a maximum roll moment of inertia of 40.7 kg-m^2 (30.0 ft-lb-sec^2).

S6.3.5 *Automated steering machine.* A steering machine programmed to execute the required steering pattern must be used in S7.5.2, S7.5.3, S7.6 and S7.9. The steering machine shall be capable of supplying steering torques between 40 to 60 Nm (29.5 to 44.3 lb-ft). The steering machine must be able to apply these torques when operating with steering wheel velocities up to 1200 degrees per second.

S7. *Test Procedure.*

S7.1 Inflate the vehicles' tires to the cold tire inflation pressure(s) provided on the vehicle's placard or the tire inflation pressure label.

S7.2 *Telltale bulb check.* With the vehicle stationary and the ignition locking system in the ''Lock'' or ''Off'' position, activate the ignition locking system to the ''On'' (''Run'') position or, where applicable, the appropriate position for the lamp check. The ESC malfunction telltale must be activated as a check of lamp function, as specified in S5.3.4, and if equipped, the ''ESC Off'' telltale must also be activated as a check of lamp function, as specified in S5.5.6. The telltale bulb check is not required for a telltale shown in a common space as specified in S5.3.6 and S5.5.8.

S7.3 *''ESC Off'' control check.* For vehicles equipped with an ''ESC Off'' control, with the vehicle stationary and the ignition locking system in the ''Lock'' or ''Off'' position, activate the ignition locking system to the ''On'' (''Run'') position. Activate the ''ESC Off'' control and verify that the ''ESC Off'' telltale is illuminated, as specified in S5.5.4. Turn the ignition locking system to the ''Lock'' or ''Off'' position. Again, activate the ignition locking system to the ''On'' (''Run'') position and verify that the ''ESC Off'' telltale has extinguished indicating that the ESC system has been reactivated as specified in S5.4.1.

S7.4 *Brake Conditioning.* Condition the vehicle brakes as follows:

S7.4.1 Ten stops are performed from a speed of 56 km/h (35 mph), with an average deceleration of approximately 0.5 g.

S7.4.2 Immediately following the series of 56 km/h (35 mph) stops, three additional stops are performed from 72 km/h (45 mph).

S7.4.3 When executing the stops in S7.4.2, sufficient force is applied to the brake pedal to activate the vehicle's antilock brake system (ABS) for a majority of each braking event.

S7.4.4 Following completion of the final stop in S7.4.2, the vehicle is driven at a speed of 72 km/h (45 mph) for five minutes to cool the brakes.

S7.5 *Tire Conditioning.* Condition the tires using the following procedure to wear away mold sheen and achieve operating temperature immediately before beginning the test runs of S7.6 and S7.9.

S7.5.1 The test vehicle is driven around a circle 30 meters (100 feet) in diameter at a speed that produces a

lateral acceleration of approximately 0.5 to 0.6 g for three clockwise laps followed by three counterclockwise laps.

S7.5.2 Using a sinusoidal steering pattern at a frequency of 1 Hz, a peak steering wheel angle amplitude corresponding to a peak lateral acceleration of 0.5–0.6 g, and a vehicle speed of 56 km/h (35 mph), the vehicle is driven through four passes performing 10 cycles of sinusoidal steering during each pass.

S7.5.3 The steering wheel angle amplitude of the final cycle of the final pass is twice that of the other cycles. The maximum time permitted between all laps and passes is five minutes.

S7.6 *Slowly Increasing Steer Test*. The vehicle is subjected to two series of runs of the Slowly Increasing Steer Test using a constant vehicle speed of 80 ±2 km/h (50 ±1 mph) and a steering pattern that increases by 13.5 degrees per second until a lateral acceleration of approximately 0.5 g is obtained. Three repetitions are performed for each test series. One series uses counterclockwise steering, and the other series uses clockwise steering. The maximum time permitted between each test run is five minutes.

S7.6.1 From the Slowly Increasing Steer tests, the quantity ''A'' is determined. ''A'' is the steering wheel angle in degrees that produces a steady state lateral acceleration (corrected using the methods specified in S7.11.3) of 0.3 g for the test vehicle. Utilizing linear regression, A is calculated, to the nearest 0.1 degrees, from each of the six Slowly Increasing Steer tests. The absolute value of the six A's calculated is averaged and rounded to the nearest 0.1 degrees to produce the final quantity, A, used below.

S7.7 After the quantity A has been determined, without replacing the tires, the tire conditioning procedure described in S7.5 is performed immediately prior to conducting the Sine with Dwell Test of S7.9. Initiation of the first Sine with Dwell test series shall begin within two hours after completion of the Slowly Increasing Steer tests of S7.6.

S7.8 Check that the ESC system is enabled by ensuring that the ESC malfunction and ''ESC Off'' (if provided) telltales are not illuminated.

S7.9 *Sine with Dwell Test of Oversteer Intervention and Responsiveness*. The vehicle is subjected to two series of test runs using a steering pattern of a sine wave at 0.7 Hz frequency with a 500 ms delay beginning at the second peak amplitude as shown in Figure 2 (the Sine with Dwell tests). One series uses counterclockwise steering for the first half cycle, and the other series uses clockwise steering for the first half cycle. The vehicle is provided a cool-down period between each test run of 90 seconds to five minutes, with the vehicle stationary.

S7.9.1 The steering motion is initiated with the vehicle coasting in high gear at 80 ±2 km/h (50 ±1 mph).

S7.9.2 In each series of test runs, the steering amplitude is increased from run to run, by 0.5A, provided that no such run will result in a steering amplitude greater than that of the final run specified in S7.9.4.

S7.9.3 The steering amplitude for the initial run of each series is 1.5A where A is the steering wheel angle determined in S7.6.1.

S7.9.4 The steering amplitude of the final run in each series is the greater of 6.5A or 270 degrees, provided the calculated magnitude of 6.5A is less than or equal to 300 degrees. If any 0.5A increment, up to 6.5A, is greater than 300 degrees, the steering amplitude of the final run shall be 300 degrees.

S7.9.5 Upon completion of the two series of test runs, post processing of yaw rate and lateral acceleration data is done as specified in S7.11.

S7.10 *ESC Malfunction Detection*.

S7.10.1 Simulate one or more ESC malfunction(s) by disconnecting the power source to any ESC component, or disconnecting any electrical connection between ESC components (with the vehicle power off). When simulating an ESC malfunction, the electrical connections for the telltale lamp(s) are not to be disconnected.

S7.10.2 With the vehicle initially stationary and the ignition locking system in the ''Lock'' or ''Off'' position, activate the ignition locking system to the ''Start'' position and start the engine. Place the vehicle in a forward gear and obtain a vehicle speed of 48 ±8 km/h (30 ±5 mph). Drive the vehicle for at least two minutes including

at least one left and one right turning maneuver and at least one application of the service brake. Verify that within two minutes after obtaining this vehicle speed the ESC malfunction indicator illuminates in accordance with S5.3.

S7.10.3 As of September 1, 2011, stop the vehicle, deactivate the ignition locking system to the ''Off'' or ''Lock'' position. After a five-minute period, activate the vehicle's ignition locking system to the ''Start'' position and start the engine. Verify that the ESC malfunction indicator again illuminates to signal a malfunction and remains illuminated as long as the engine is running or until the fault is corrected.

S7.10.4 Deactivate the ignition locking system to the ''Off'' or ''Lock'' position. Restore the ESC system to normal operation, activate the ignition system to the ''Start'' position and start the engine. Place the vehicle in a forward gear and obtain a vehicle speed of 48 ±8 km/h (30 ±5 mph). Drive the vehicle for at least two minutes including at least one left and one right turning maneuver and at least one application of the service brake. Verify that within two minutes after obtaining this vehicle speed that the ESC malfunction indicator has extinguished.

S7.11 *Post Data Processing—Calculations for Performance Metrics.* Yaw rate and lateral displacement measurements and calculations must be processed utilizing the following techniques:

S7.11.1 Raw steering wheel angle data is filtered with a 12-pole phaseless Butterworth filter and a cutoff frequency of 10Hz. The filtered data is then zeroed to remove sensor offset utilizing static pretest data.

S7.11.2 Raw yaw rate data is filtered with a 12-pole phaseless Butterworth filter and a cutoff frequency of 6Hz. The filtered data is then zeroed to remove sensor offset utilizing static pretest data.

S7.11.3 Raw lateral acceleration data is filtered with a 12-pole phaseless Butterworth filter and a cutoff frequency of 6Hz. The filtered data is then zeroed to remove sensor offset utilizing static pretest data. The lateral acceleration data at the vehicle center of gravity is determined by removing the effects caused by vehicle body roll and by correcting for sensor placement via use of coordinate transformation. For data collection, the lateral accelerometer shall be located as close as possible to the position of the vehicle's longitudinal and lateral centers of gravity.

S7.11.4 Steering wheel velocity is determined by differentiating the filtered steering wheel angle data. The steering wheel velocity data is then filtered with a moving 0.1 second running average filter.

S7.11.5 Lateral acceleration, yaw rate and steering wheel angle data channels are zeroed utilizing a defined ''zeroing range.'' The methods used to establish the zeroing range are defined in S7.11.5.1 and S7.11.5.2.

S7.11.5.1 Using the steering wheel rate data calculated using the methods described in S7.11.4, the first instant steering wheel rate exceeds 75 deg/sec is identified. From this point, steering wheel rate must remain greater than 75 deg/sec for at least 200 ms. If the second condition is not met, the next instant steering wheel rate exceeds 75 deg/sec is identified and the 200 ms validity check applied. This iterative process continues until both conditions are ultimately satisfied.

S7.11.5.2 The ''zeroing range'' is defined as the 1.0 second time period prior to the instant the steering wheel rate exceeds 75 deg/sec (*i.e.*, the instant the steering wheel velocity exceeds 75 deg/sec defines the end of the ''zeroing range'').

S7.11.6 The Beginning of Steer (BOS) is defined as the first instance filtered and zeroed steering wheel angle data reaches −5 degrees (when the initial steering input is counterclockwise) or + 5 degrees (when the initial steering input is clockwise) after time defining the end of the ''zeroing range.'' The value for time at the BOS is interpolated.

S7.11.7 The Completion of Steer (COS) is defined as the time the steering wheel angle returns to zero at the completion of the Sine with Dwell steering maneuver. The value for time at the zero degree steering wheel angle is interpolated.

S7.11.8 The second peak yaw rate is defined as the first local yaw rate peak produced by the reversal of the steering wheel. The yaw rates at 1.000 and 1.750 seconds after COS are determined by interpolation.

S7.11.9 Determine lateral velocity by integrating corrected, filtered and zeroed lateral acceleration data. Zero lateral velocity at BOS event. Determine lateral displacement by integrating zeroed lateral velocity. Zero lateral displacement at BOS event. Lateral displacement at 1.07 seconds from BOS event is determined by interpolation.

S8. Phase-in schedule.

S8.1 *Vehicles manufactured on or after September 1, 2008, and before September 1, 2009.* For vehicles manufactured on or after September 1, 2008, and before September 1, 2009, the number of vehicles complying with this standard must not be less than 55 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2005, and before September 1, 2008; or

(b) The manufacturer's production on or after September 1, 2008, and before September 1, 2009.

S8.2 *Vehicles manufactured on or after September 1, 2009, and before September 1, 2010.* For vehicles manufactured on or after September 1, 2009, and before September 1, 2010, the number of vehicles complying with this standard must not be less than 75 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2006, and before September 1, 2009; or

(b) The manufacturer's production on or after September 1, 2009, and before September 1, 2010.

S8.3 *Vehicles manufactured on or after September 1, 2010, and before September 1, 2011.* For vehicles manufactured on or after September 1, 2010, and before September 1, 2011, the number of vehicles complying with this standard must not be less than 95 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2007, and before September 1, 2010; or

(b) The manufacturer's production on or after September 1, 2010, and before September 1, 2011.

S8.4 *Vehicles manufactured on or after September 1, 2011.* All vehicles manufactured on or after September 1, 2011 must comply with this standard.

S8.5 *Calculation of complying vehicles.*

(a) For purposes of complying with S8.1, a manufacturer may count a vehicle if it is certified as complying with this standard and is manufactured on or after June 5, 2007, but before September 1, 2009.

(b) For purpose of complying with S8.2, a manufacturer may count a vehicle if it:

(1)(i) Is certified as complying with this standard and is manufactured on or after June 5, 2007, but before September 1, 2010; and

(ii) Is not counted toward compliance with S8.1; or

(2) Is manufactured on or after September 1, 2009, but before September 1, 2010.

(c) For purposes of complying with S8.3, a manufacturer may count a vehicle if it:

(1)(i) Is certified as complying with this standard and is manufactured on or after June 5, 2007, but before September 1, 2011; and

(ii) Is not counted toward compliance with S8.1 or S8.2; or

(2) Is manufactured on or after September 1, 2010, but before September 1, 2011.

S8.6 *Vehicles produced by more than one manufacturer.*

S8.6.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S8.1 through S8.4, a vehicle produced by more than one manufacturer must be attributed to a single manufacturer as follows, subject to S8.6.2:

(a) A vehicle that is imported must be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, must be attributed to the manufacturer that markets the vehicle.

S8.6.2 A vehicle produced by more than one manufacturer must be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration

under 49 CFR Part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S8.6.1.

S8.7 *Small volume manufacturers.*

Vehicles manufactured during any of the three years of the September 1, 2008 through August 31, 2011 phase-in by a manufacturer that produces fewer than 5,000 vehicles for sale in the United States during that year are not subject to the requirements of S8.1, S8.2, S8.3, and S8.5.

S8.8 *Final-stage manufacturers and alterers.*

Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S8.1 through S8.5. Instead, all vehicles produced by these manufacturers on or after September 1, 2012 must comply with this standard.

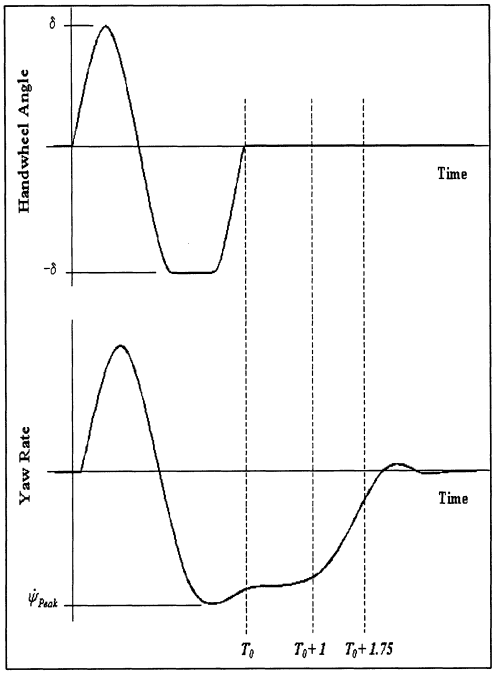


Figure 1. Steering wheel position and yaw velocity information used to assess lateral stability.

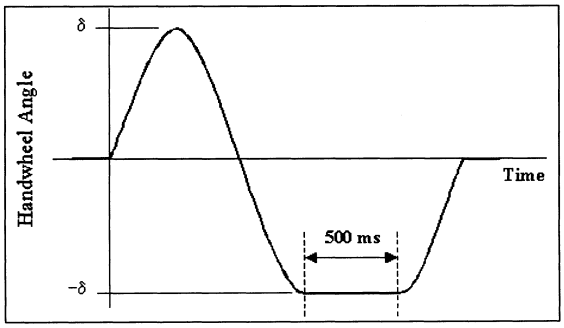


Figure 2. Sine with Dwell steering profile.

[72 FR 17310, Apr. 6, 2007, as amended at 72 FR 34410, June 22, 2007; 73 FR 54542, Sept. 22, 2008; 76 FR 55833, Sept. 9, 2011; 77 FR 760, Jan. 6, 2012; 87 FR 34810, June 8, 2022]

§ 571.127 Standard No. 127; Automatic emergency braking systems for light vehicles.

S1. *Scope.* This standard establishes performance requirements for automatic emergency braking (AEB) systems for light vehicles.

S2. *Purpose.* The purpose of this standard is to reduce the number of deaths and injuries that result from crashes in which drivers do not apply the brakes or fail to apply sufficient braking power to avoid or mitigate a crash.

S3. *Application.* This standard applies to passenger cars and to multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating (GVWR) of 4,536 kilograms (10,000 pounds) or less.

S4. *Definitions.*

Adaptive cruise control system is an automatic speed control system that allows the equipped vehicle to follow a lead vehicle at a pre-selected gap by controlling the engine, power train, and service brakes.

Ambient illumination is the illumination as measured at the test surface, not including any illumination provided by the subject vehicle.

Automatic emergency braking (AEB) system is a system that detects an imminent collision with vehicles, objects, and road users in or near the path of a vehicle and automatically controls the vehicle's service brakes to avoid or mitigate the collision.

Brake pedal application onset is when 11 N of force has been applied to the brake pedal.

Forward collision warning is an auditory and visual warning provided to the vehicle operator by the AEB system that is designed to induce immediate forward crash avoidance response by the vehicle operator.

Forward collision warning onset is the first moment in time when a forward collision warning is provided.

Headway is the distance between the subject vehicle's frontmost plane normal to its centerline and as applicable: the vehicle test device's rearmost plane normal to its centerline; a parallel contact plane (to the subject vehicle's frontmost plane) on the pedestrian test mannequin; and the leading edge of the steel trench plate.

Lead vehicle is a vehicle test device facing the same direction and preceding a subject vehicle within the same travel lane.

Lead vehicle braking onset is the point at which the lead vehicle achieves a deceleration of 0.05 g due to brake application.

Pedestrian test mannequin is a device used during AEB testing, when approaching pedestrians, meeting the specifications of subpart B of 49 CFR part 596.

Small-volume manufacturer means an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States.

Steel trench plate is a rectangular steel plate often used in road construction to temporarily cover sections of pavement unsafe to drive over directly.

Subject vehicle is the vehicle under examination for compliance with this standard.

Travel path is the path projected onto the road surface of a point located at the intersection of the subject vehicle's frontmost vertical plane and longitudinal vertical center plane, as the subject vehicle travels forward.

Subject vehicle braking onset is the point at which the subject vehicle achieves a deceleration of 0.15 g due to the automatic control of the service brakes.

Vehicle test device is a device meeting the specifications set forth in subpart C of 49 CFR part 596.

S5. *Requirements.*

(a) Except as provided in S5(b), vehicles manufactured on or after September 1, 2029 must meet the requirements of this standard.

(b) The requirements of S5(a) do not apply to small-volume manufacturers, final-stage manufacturers, and alterers until one year after the dates specified in S5(a).

S5.1. *Requirements when approaching a lead vehicle.*

S5.1.1. *Forward collision warning.* A vehicle is required to have a forward collision warning system, as defined in S4 that provides an auditory and visual signal to the driver of an impending collision with a lead vehicle. The system must operate under the conditions specified in S6 when traveling at any

forward speed that is greater than 10 km/h (6.2 mph) and less than 145 km/h (90.1 mph).

(a) *Auditory signal.*

(1) The auditory signal must have a high fundamental frequency of at least 800 Hz.

(2) The auditory signal must have a tempo in the range of 6–12 pulses per second and a duty cycle in the range of 0.25–0.95.

(3) The auditory signal as measured adjacent to a 50th percentile male driver's right ear (tragion) must have an intensity of 15–30 dB above the average noise level inside the vehicle when measured over a 5-second period under the range of test conditions specified in S6, at 100 km/h, with all vehicle openings closed, and all subject vehicle audio and sound-producing systems or functions that are not necessary for performing tests pursuant to the conditions in S6 and the procedures in S7, S8, S9 of this standard set to off.

(4) In-vehicle audio that is not related to a crash avoidance system warning must be muted, or reduced in volume during presentation of the FCW auditory signal to within 5 dB of the average noise level inside the vehicle (as measured in S5.1.1(a)(3)), for the duration of the first between-pulse period of the FCW auditory signal under the range of test conditions specified in S6, at 100 km/h, with all vehicle openings closed, and all subject vehicle audio and sound-producing systems or functions that are not necessary for performing tests pursuant to the conditions in S6 and the procedures in S7, S8, S9 of this standard set to off.

(b) *Visual signal.*

(1) The visual signal symbol must be located within an ellipse that extends ±18 degrees vertically and ±10 degrees horizontally of the driver forward line of sight based on the forward-looking eye midpoint (M_f) as described in S14 of 49 CFR 571.111.

(2) The visual signal must include the crash pictorial symbol in SAE J2400, 4.1.16, incorporated by reference (see §571.5).

(3) The visual signal symbol must be red in color and steady burning.

S5.1.2. *Automatic emergency braking.* A vehicle is required to have an automatic emergency braking system, as defined in S4, that applies the service brakes automatically when a collision with a lead vehicle is imminent. The system must operate under the conditions specified in S6 when the vehicle is traveling at any forward speed that is greater than 10 km/h (6.2 mph) and less than 145 km/h (90.1 mph).

S5.1.3. Performance test requirements. The vehicle must provide a forward collision warning and subsequently apply the service brakes automatically such that the subject vehicle does not collide with the lead vehicle when tested using the procedures in S7 under the conditions specified in S6. The forward collision warning is not required if adaptive cruise control is engaged.

S5.2. *Requirements when approaching pedestrians.*

S5.2.1. *Forward collision warning.* A vehicle is required to have a forward collision warning system, as defined in S4, that provides an auditory and visual signal to the driver of an impending collision with a pedestrian. The system must operate under the conditions specified in S6 when the vehicle is traveling at any forward speed that is greater than 10 km/h (6.2 mph) and less than 73 km/h (45.3 mph). The forward collision warning system must meet the auditory signal and visual signal requirements specified in S5.1.1.

S5.2.2. *Automatic emergency braking.* A vehicle is required to have an automatic emergency braking system, as defined in S4, that applies the service brakes automatically when a collision with a pedestrian is imminent when the vehicle is under the conditions specified in S6 and is traveling at any forward speed that is greater than 10 km/h (6.2 mph) and less than 73 km/h (45.3 mph).

S5.2.3. *Performance test requirements.* The vehicle must provide a forward collision warning and apply the brakes automatically such that the subject vehicle does not collide with the pedestrian test mannequin when tested using the procedures in S8 under the conditions specified in S6.

S5.3. *False activation.* The vehicle must not automatically apply braking that results in peak additional deceleration that exceeds what manual braking would produce by 0.25 g or

greater, when tested using the procedures in S9 under the conditions specified in S6.

S5.4. *Malfunction detection and controls.*

S5.4.1 The system must continuously detect system malfunctions, including performance degradation caused solely by sensor obstructions. If the system detects a malfunction, or if the system adjusts its performance such that it will not meet the requirements specified in S5.1, S5.2, or S5.3, the system must provide the vehicle operator with a telltale notification.

S5.4.2 Except as provided in S5.4.2.1 and S5.4.2.2, the manufacturer must not provide a control that will place the AEB system in a mode or modes in which it will no longer satisfy the performance requirements of S5.1, S5.2, and S5.3.

S5.4.2.1 The manufacturer may provide a control to allow AEB deactivation that is securely activated, provided the manufacturer enables such activation exclusively in a vehicle owned by a law enforcement agency.

S5.4.2.2 The manufacturer may allow AEB deactivation to occur during low-range four-wheel drive configurations, when the driver selects ''tow mode,'' or when another vehicle system is activated that will have a negative ancillary impact on AEB operation.

S5.4.3 The vehicle's AEB system must always return to the manufacturer's original default AEB mode that satisfies the requirements of S5.1, S5.2, and S5.3 at the initiation of each new ignition cycle, unless the vehicle is in a low-range four-wheel drive configuration selected by the driver on the previous ignition cycle designed for low-speed, off-road driving.

S6. *Test conditions.*

S6.1. *Environmental conditions.*

S6.1.1. *Temperature.* The ambient temperature is any temperature between 0 °C and 40 °C.

S6.1.2. *Wind.* The maximum wind speed is no greater than 10 m/s (22 mph) during lead vehicle avoidance tests and 6.7 m/s (15 mph) during pedestrian avoidance tests.

S6.1.3. *Ambient lighting.*

(a) *Daylight testing.*

(1) The ambient illumination on the test surface is any level at or above 2,000 lux.

(2) Testing is not performed while driving toward or away from the sun such that the horizontal angle between the sun and a vertical plane containing the centerline of the subject vehicle is less than 25 degrees and the solar elevation angle is less than 15 degrees.

(b) *Dark testing.*

(1) The ambient illumination on the test surface is any level at or below 0.2 lux.

(2) Testing is performed under any lunar phase.

(3) Testing is not performed while driving toward the moon such that the horizontal angle between the moon and a vertical plane containing the centerline of the subject vehicle is less than 25 degrees and the lunar elevation angle is less than 15 degrees.

S6.1.4. *Precipitation.* Testing is not conducted during periods of precipitation or when visibility is affected by fog, smoke, ash, or other particulate.

S6.2. *Road conditions.*

S6.2.1. *Test Track surface and construction.* The tests are conducted on a dry, uniform, solid-paved surface. Surfaces with debris, irregularities, or undulations, such as loose pavement, large cracks, or dips may not be used.

S6.2.2. *Surface friction.* The road test surface produces a peak friction coefficient (PFC) of 1.02 when measured using an ASTM F2493 standard reference test tire, in accordance with ASTM E1337–19 (incorporated by reference, see § 571.5), at a speed of 64 km/h (40 mph), without water delivery.

S6.2.3. *Slope.* The test surface has any consistent slope between 0 percent and 1 percent.

S6.2.4. *Markings.* The road surface within 2 m of the intended travel path is marked with zero, one, or two lines of any configuration or color. If one line is used, it is straight. If two lines are used, they are straight, parallel to each other, and at any distance from 2.7 m to 4.5 m apart.

S6.2.5. *Obstructions.* Testing is conducted such that the vehicle does not travel beneath any overhead structures, including but not limited to overhead signs, bridges, or gantries. No vehicles, obstructions, or stationary

objects are within 7.4 m of either side of the intended travel path except as specified.

S6.3. *Subject vehicle conditions.*

S6.3.1. *Malfunction notification.* Testing is not conducted while the AEB malfunction telltale specified in S5.4 is illuminated.

S6.3.2. *Sensor obstruction.* All sensors used by the system and any part of the vehicle immediately ahead of the sensors, such as plastic trim, the windshield, etc., are free of debris or obstructions.

S6.3.3. *Tires.* The vehicle is equipped with the original tires present at the time of initial sale. The tires are inflated to the vehicle manufacturer's recommended cold tire inflation pressure(s) specified on the vehicle's placard or the tire inflation pressure label.

S6.3.4. *Brake burnish.*

(a) Vehicles subject to §571.105 are burnished in accordance with S7.4 of §571.105.

(b) Vehicles subject to §571.135 are burnished in accordance with S7.1 of §571.135.

S6.3.5. *Brake temperature.* The average temperature of the service brakes on the hottest axle of the vehicle during testing, measured according to S6.4.1 of §571.135, is between 65 °C and 100 °C prior to braking.

S6.3.6. *Fluids.* All non-consumable fluids for the vehicle are at 100 percent capacity. All consumable fluids are at any level from 5 to 100 percent capacity.

S6.3.7. *Propulsion battery charge.* The propulsion batteries are charged at any level from 5 to 100 percent capacity.

S6.3.8. *Cruise control.* Cruise control, including adaptive cruise control, is configured under any available setting.

S6.3.9. *Adjustable forward collision warning.* Forward collision warning is configured in any operator-configurable setting.

S6.3.10. *Engine braking.* A vehicle equipped with an engine braking system that is engaged and disengaged by the operator is tested with the system in any selectable configuration.

S6.3.11. *Regenerative braking.* Regenerative braking is configured under any available setting.

S6.3.12. *Headlamps.*

(a) Daylight testing is conducted with the headlamp control in any selectable position.

(b) Darkness testing is conducted with the vehicle's lower beams active and separately with the vehicle's upper beams active.

(c) Prior to performing darkness testing, headlamps are aimed according to the vehicle manufacturer's instructions. The weight of the loaded vehicle at the time of headlamp aiming is within 10 kg of the weight of the loaded vehicle during testing.

S6.3.13. *Subject vehicle loading.* The vehicle load, which is the sum of any vehicle occupants and any test equipment and instrumentation, does not exceed 277 kg. The load does not cause the vehicle to exceed its GVWR or any axle to exceed its GAWR.

S6.3.14. *AEB system initialization.* The vehicle is driven at a speed of 10 km/h or higher for at least one minute prior to testing, and subsequently the starting system is not cycled off prior to testing.

S6.4. *Equipment and test devices.*

S6.4.1. The vehicle test device is specified in 49 CFR part 596, subpart C. Local fluttering of the lead vehicle's external surfaces does not exceed 10 mm perpendicularly from the reference surface, and distortion of the lead vehicle's overall shape does not exceed 25 mm in any direction.

S6.4.2. Adult pedestrian test mannequin is specified in 49 CFR part 596, subpart B.

S6.4.3. Child pedestrian test mannequin is specified in 49 CFR part 596, subpart B.

S6.4.4. The steel trench plate used for the false activation test has the dimensions 2.4 m x 3.7 m x 25 mm and is made of ASTM A36 steel. Any metallic fasteners used to secure the steel trench plate are flush with the top surface of the steel trench plate.

S7. *Testing when approaching a lead vehicle.*

S7.1. *Setup.*

(a) The testing area is set up in accordance with figure 2 to this section.

(b) Testing is conducted during daylight.

(c) For reference, table 1 to S7.1 specifies the subject vehicle speed

(V_{SV}), lead vehicle speed (V_{LV}), headway, and lead vehicle deceleration for each test that may be conducted.

(d) The intended travel path of the vehicle is a straight line toward the lead vehicle from the location corresponding to a headway of L_0.

(e) If the road surface is marked with a single or double lane line, the intended travel path is parallel to and 1.8 m from the inside of the closest line. If the road surface is marked with two lane lines bordering the lane, the intended travel path is centered between the two lines.

(f) For each test run conducted, the subject vehicle speed (V_{SV}), lead vehicle speed (V_{LV}), headway, and lead vehicle deceleration will be selected from the ranges specified in table 1 to S7.1.

TABLE 1 TO S7.1—TEST PARAMETERS WHEN APPROACHING A LEAD VEHICLE

	Speed (km/h)		Headway (m)	Lead vehicle decel (g)	Manual brake application
	V_{SV}	V_{LV}			
Stopped Lead Vehicle.	Any 10–80	0	—	—	No.
	Any 70–100	0	—	—	Yes.
Slower-Moving Lead Vehicle.	Any 40–80	20	—	—	No.
	Any 70–100	20	—	—	Yes.
Decelerating Lead Vehicle.	50	50	Any 12–40	Any 0.3–0.5	No.
	50	50	Any 12–40	Any 0.3–0.5	Yes.
	80	80	Any 12–40	Any 0.3–0.5	No.
	80	80	Any 12–40	Any 0.3–0.5	Yes.

S7.2. *Headway calculation.* For each test run conducted under S7.3 and S7.4, the headway (L_0), in meters, providing 5.0 seconds time to collision (TTC) is calculated. L_0 is determined with the following equation where V_{SV} is the speed of the subject vehicle in m/s and V_{LV} is the speed of the lead vehicle in m/s:

Equation 1 to S7.2

$$L_0 = TTC_0 \times (V_{SV} - V_{LV})$$
$$TTC_0 = 5.0$$

S7.3. *Stopped lead vehicle.*

S7.3.1. *Test parameters.*

(a) For testing with no subject vehicle manual brake application, the subject vehicle test speed is any speed between 10 km/h and 80 km/h, and the lead vehicle speed is 0 km/h.

(b) For testing with manual brake application of the subject vehicle, the subject vehicle test speed is any speed between 70 km/h and 100 km/h, and the lead vehicle speed is 0 km/h.

S7.3.2. *Test conduct prior to forward collision warning onset.*

(a) The lead vehicle is placed stationary with its longitudinal centerline coincident to the intended travel path.

(b) Before the headway corresponds to L_0, the subject vehicle is driven at any speed, in any direction, on any road surface, for any amount of time.

(c) The subject vehicle approaches the rear of the lead vehicle.

(d) Beginning when the headway corresponds to L_0, the subject vehicle speed is maintained within 1.6 km/h of the test speed with minimal and smooth accelerator pedal inputs.

(e) Beginning when the headway corresponds to L_0, the subject vehicle heading is maintained with minimal steering input such that the travel path does not deviate more than 0.3 m laterally from the intended travel path and the subject vehicle's yaw rate does not exceed ±1.0 deg/s.

S7.3.3. *Test conduct after forward collision warning onset.*

(a) The accelerator pedal is released at any rate such that it is fully released within 500 ms. This action is omitted for vehicles tested with cruise control active.

(b) For testing conducted with manual brake application, the service brakes are applied as specified in S10. The onset of brake pedal application occurs 1.0 ± 0.1 second after forward collision warning onset.

(c) For testing conducted without manual brake application, no manual brake application is made until the

test completion criteria of S7.3.4 are satisfied.

S7.3.4. *Test completion criteria.* The test run is complete when the subject vehicle comes to a complete stop without making contact with the lead vehicle or when the subject vehicle makes contact with the lead vehicle.

S7.4. *Slower-moving lead vehicle.*

S7.4.1. *Test parameters.*

(a) For testing with no subject vehicle manual brake application, the subject vehicle test speed is any speed between 40 km/h and 80 km/h, and the lead vehicle speed is 20 km/h.

(b) For testing with manual brake application of the subject vehicle, the subject vehicle test speed is any speed between 70 km/h and 100 km/h, and the lead vehicle speed is 20 km/h.

S7.4.2. *Test conduct prior to forward collision warning onset.*

(a) The lead vehicle is propelled forward in a manner such that the longitudinal center plane of the lead vehicle does not deviate laterally more than 0.3m from the intended travel path.

(b) The subject vehicle approaches the lead vehicle.

(c) Before the headway corresponds to L_0, the subject vehicle is driven at any speed, in any direction, on any road surface, for any amount of time.

(d) Beginning when the headway corresponds to L_0, the subject vehicle and lead vehicle speed is maintained within 1.6 km/h of the test speed with minimal and smooth accelerator pedal inputs.

(e) Beginning when the headway corresponds to L_0, the subject vehicle and lead vehicle headings are be maintained with minimal steering input such that the subject vehicle's travel path does not deviate more than 0.3 m laterally from the centerline of the lead vehicle, and the yaw rate of the subject vehicle does not exceed ±1.0 deg/s prior to the forward collision warning onset.

S7.4.3. *Test conduct after forward collision warning onset.*

(a) The subject vehicle's accelerator pedal is released at any rate such that it is fully released within 500 ms. This action is omitted for vehicles tested with cruise control active.

(b) For testing conducted with manual braking application, the service brakes are applied as specified in S10. The onset of brake pedal application is 1.0 ±0.1 second after the forward collision warning onset.

(c) For testing conducted without manual braking application, no manual brake application is made until the test completion criteria of S7.4.4 are satisfied.

S7.4.4. *Test completion criteria.* The test run is complete when the subject vehicle speed is less than or equal to the lead vehicle speed without making contact with the lead vehicle or when the subject vehicle makes contact with the lead vehicle.

S7.5. *Decelerating lead vehicle.*

S7.5.1. *Test parameters.*

(a) The subject vehicle test speed is 50 km/h or 80 km/h, and the lead vehicle speed is identical to the subject vehicle test speed.

(b) [Reserved]

S7.5.2. *Test conduct prior to lead vehicle braking onset.*

(a) Before the 3 seconds prior to lead vehicle braking onset, the subject vehicle is be driven at any speed, in any direction, on any road surface, for any amount of time.

(b) Between 3 seconds prior to lead vehicle braking onset and lead vehicle braking onset:

(1) The lead vehicle is propelled forward in a manner such that the longitudinal center plane of the vehicle does not deviate laterally more than 0.3 m from the intended travel path.

(2) The subject vehicle follows the lead vehicle at a headway of any distance between 12 m and 40 m.

(3) The subject vehicle's speed is maintained within 1.6 km/h of the test speed with minimal and smooth accelerator pedal inputs prior to forward collision warning onset.

(4) The lead vehicle's speed is maintained within 1.6 km/h.

(5) The subject vehicle and lead vehicle headings are maintained with minimal steering input such that their travel paths do not deviate more than 0.3 m laterally from the centerline of the lead vehicle, and the yaw rate of the subject vehicle does not exceed ±1.0 deg/s until onset of forward collision warning.

S7.5.3. *Test conduct following lead vehicle braking onset.*

(a) The lead vehicle is decelerated to a stop with a targeted average deceleration of any value between 0.3g and 0.5g. The targeted deceleration magnitude is achieved within 1.5 seconds of lead vehicle braking onset and is maintained until 250 ms prior to coming to a stop.

(b) After forward collision warning onset, the subject vehicle's accelerator pedal is released at any rate such that it is fully released within 500 ms. This action is omitted for vehicles with cruise control active.

(c) For testing conducted with manual braking application, the service brakes are applied as specified in S10. The brake pedal application onset occurs 1.0 ± 0.1 second after the forward collision warning onset.

(d) For testing conducted without manual braking application, no manual brake application is made until the test completion criteria of S7.5.4 are satisfied.

S7.5.4. *Test completion criteria.* The test run is complete when the subject vehicle comes to a complete stop without making contact with the lead vehicle or when the subject vehicle makes contact with the lead vehicle.

S8. *Testing when approaching a pedestrian.*

S8.1. *Setup.*

S8.1.1. *General.*

(a) For reference, table 2 to S8.1.1 specifies the pedestrian test mannequin direction of travel, overlap, obstruction condition and speed (V_P), the subject vehicle speed (V_{SV}), and the lighting condition for each test that may be conducted.

(b) The intended travel path of the vehicle is a straight line originating at the location corresponding to a headway of L_0.

(c) If the road surface is marked with a single or double lane line, the intended travel path is parallel to and 1.8 m from the inside of the closest line. If the road surface is marked with two lane lines bordering the lane, the intended travel path is centered between the two lines.

(d) For each test run conducted, the subject vehicle speed (V_{SV}) will be selected from the range specified in table 2 to S8.1.1.

TABLE 2 TO S8.1.1—TEST PARAMETERS WHEN APPROACHING A PEDESTRIAN

	Direction	Overlap	Obstructed	Speed (km/h)		Lighting condition
				V_{SV}	V_P	
Pedestrian Crossing Road.	Right	25	No	Any 10–60	5	Daylight
	Right	50	No	Any 10–60	5	Daylight Lower Beams Upper Beams
	Left	50	No	Any 10–60	8	Daylight
	Right	50	Yes	Any 10–50	5	Daylight
Stationary Pedestrian.	Right	25	No	Any 10–55	0	Daylight Lower Beams Upper Beams
Pedestrian Moving Along the Path.	Right	25	No	Any 10–65	5	Daylight Lower Beams Upper Beams

S8.1.2. *Overlap.* As depicted in figure 1 to this section, overlap describes the location of the point on the front of the subject vehicle that would make contact with a pedestrian if no braking occurred. Overlap is the percentage of the subject vehicle's overall width that the pedestrian test mannequin traverses. It is measured from the right or the left, depending on the side of the subject vehicle where the pedestrian test mannequin originates. For each test run, the actual overlap will be within 0.15 m of the specified overlap.

S8.1.3. *Pedestrian test mannequin.*

(a) For testing where the pedestrian test mannequin is secured to a moving apparatus, the pedestrian test mannequin is secured so that it faces the direction of motion. The pedestrian test mannequin leg articulation starts

on apparatus movement and stops when the apparatus stops.

(b) For testing where the pedestrian test mannequin is stationary, the pedestrian test mannequin faces away from the subject vehicle, and the pedestrian test mannequin legs remain still.

S8.2. *Headway calculation*. For each test run conducted under S8.3, S8.4, and S8.5, the headway (L_0), in meters, providing 4.0 seconds time to collision (TTC) is calculated. L_0 is determined with the following equation where V_{SV} is the speed of the subject vehicle in m/s and $V_{P\text{-}y}$ is the component of speed of the pedestrian test mannequin in m/s in the direction of the intended travel path:

Equation 2 to S8.2

$$L_0 = TTC_0 \times (V_{SV} - V_{P\text{-}y})$$
$$TTC_0 = 4.0$$

S8.3. *Pedestrian crossing road.*

S8.3.1. *Test parameters and setup (unobstructed from right).*

(a) The testing area is set up in accordance with figure 3 to this section.

(b) Testing is conducted in the daylight or darkness conditions, except that testing with the pedestrian at the 25 percent overlap is only conducted in daylight conditions.

(c) Testing is conducted using the adult pedestrian test mannequin.

(d) The movement of the pedestrian test mannequin is perpendicular to the subject vehicle's intended travel path.

(e) The pedestrian test mannequin is set up 4.0 ± 0.1 m to the right of the intended travel path.

(f) The intended overlap is 25 percent from the right or 50 percent.

(g) The subject vehicle test speed is any speed between 10 km/h and 60 km/h.

(h) The pedestrian test mannequin speed is 5 km/h.

S8.3.2 *Test parameters and setup (unobstructed from left).*

(a) The testing area is set up in accordance with figure 4 to this section.

(b) Testing is conducted in the daylight condition.

(c) Testing is conducted using the adult pedestrian mannequin.

(d) The movement of the pedestrian test mannequin is perpendicular to the intended travel path.

(e) The pedestrian test mannequin is set up 6.0 ± 0.1 m to the left of the intended travel path.

(f) The intended overlap is 50 percent.

(g) The subject vehicle test speed is any speed between 10 km/h and 60 km/h.

(h) The pedestrian test mannequin speed is 8 km/h.

S8.3.3. *Test parameters and setup (obstructed).*

(a) The testing area is set up in accordance with figure 5 to this section.

(b) Testing is conducted in the daylight condition.

(c) Testing is conducted using the child pedestrian test mannequin.

(d) The movement of the pedestrian test mannequin is perpendicular to the intended travel path.

(e) The pedestrian test mannequin is set up 4.0 ± 0.1 m to the right of the intended travel path.

(f) The intended overlap is 50 percent.

(g) Two vehicle test devices are secured in stationary positions parallel to the intended travel path. The two vehicle test devices face the same direction as the intended travel path. One vehicle test device is directly behind the other separated by 1.0 ± 0.1 m. The frontmost plane of the vehicle test device furthermost from the subject vehicle is located 1.0 ± 0.1 m from the parallel contact plane (to the subject vehicle's frontmost plane) on the pedestrian test mannequin. The left side of each vehicle test device is no less than 2.2 m to the right of the vertical plane through the intended travel path. The left side of each vehicle test device is no less than 1.15 m to the right of the vertical plane parallel to the plane through the intended travel path tangent to the 0 percent overlap point.

(h) The subject vehicle test speed is any speed between 10 km/h and 50 km/h.

(i) The pedestrian test mannequin speed is 5 km/h.

S8.3.4. *Test conduct prior to forward collision warning or subject vehicle braking onset.*

(a) Before the headway corresponds to L_0, the subject vehicle is driven at

any speed, in any direction, on any road surface, for any amount of time.

(b) The subject vehicle approaches the crossing path of the pedestrian test mannequin.

(c) Beginning when the headway corresponds to L_0, the subject vehicle speed is maintained within 1.6 km/h of the test speed with minimal and smooth accelerator pedal inputs.

(d) Beginning when the headway corresponds to L_0, the subject vehicle heading is maintained with minimal steering inputs such that the subject vehicle's travel path does not deviate more than 0.3 m laterally from the intended travel path, and the yaw rate of the subject vehicle does not exceed ±1.0 deg/s prior to any automated braking onset.

(e) The pedestrian test mannequin apparatus is triggered at a time such that the pedestrian test mannequin meets the intended overlap, subject to the criteria in S8.1.2. The pedestrian test mannequin achieves its intended speed within 1.5 m after the apparatus begins to move and maintains its intended speed within 0.4 km/h until the test completion criteria of S8.3.6 are satisfied.

S8.3.5. *Test conduct after either forward collision warning or subject vehicle braking onset.*

(a) After forward collision warning or subject vehicle braking onset, the subject vehicle's accelerator pedal is released at any rate such that it is fully released within 500 ms. This action is omitted for vehicles with cruise control active.

(b) No manual brake application is made until the test completion criteria of S8.3.6 are satisfied.

(c) The pedestrian mannequin continues to move until the completion criteria of S8.3.6 are satisfied.

S8.3.6. *Test completion criteria.* The test run is complete when the subject vehicle comes to a complete stop without making contact with the pedestrian test mannequin, when the pedestrian test mannequin is no longer in the path of the subject vehicle, or when the subject vehicle makes contact with the pedestrian test mannequin.

S8.4. *Stationary pedestrian.*

S8.4.1. *Test parameters and setup.*

(a) The testing area is set up in accordance with figure 6 to this section.

(b) Testing is conducted in the daylight or darkness conditions.

(c) Testing is conducted using the adult pedestrian test mannequin.

(d) The pedestrian mannequin is set up at the 25 percent right overlap position facing away from the approaching vehicle.

(e) The subject vehicle test speed is any speed between 10 km/h and 55 km/h.

(f) The pedestrian mannequin is stationary.

S8.4.2. *Test conduct prior to forward collision warning or subject vehicle braking onset.*

(a) Before the headway corresponds to L_0, the subject vehicle is driven at any speed, in any direction, on any road surface, for any amount of time.

(b) The subject vehicle approaches the pedestrian test mannequin.

(c) Beginning when the headway corresponds to L_0, the subject vehicle speed is maintained within 1.6 km/h of the test speed with minimal and smooth accelerator pedal inputs.

(d) Beginning when the headway corresponds to L_0, the subject vehicle heading is maintained with minimal steering inputs such that the subject vehicle's travel path does not deviate more than 0.3 m laterally from the intended travel path, and the yaw rate of the subject vehicle does not exceed ±1.0 deg/s prior to any automated braking onset.

S8.4.3. *Test conduct after either forward collision warning or subject vehicle braking onset.*

(a) After forward collision warning or subject vehicle braking onset, the subject vehicle's accelerator pedal is released at any rate such that it is fully released within 500 ms. This action is omitted with vehicles with cruise control active.

(b) No manual brake application is made until the test completion criteria of S8.4.4 are satisfied.

S8.4.4. *Test completion criteria.* The test run is complete when the subject vehicle comes to a complete stop without making contact with the pedestrian test mannequin, or when the subject vehicle makes contact with the pedestrian test mannequin.

S8.5. *Pedestrian moving along the path.*

S8.5.1. *Test parameters and setup.*

(a) The testing area is set up in accordance with figure 7 to this section.

(b) Testing is conducted in the daylight or darkness conditions.

(c) Testing is conducted using the adult pedestrian test mannequin.

(d) The movement of the pedestrian test mannequin is parallel to and in the same direction as the subject vehicle.

(e) The pedestrian test mannequin is set up in the 25 percent right offset position.

(f) The subject vehicle test speed is any speed between 10 km/h and 65 km/h.

(g) The pedestrian test mannequin speed is 5 km/h.

S8.5.2. *Test conduct prior to forward collision warning or subject vehicle braking onset.*

(a) Before the headway corresponds to L_0, the subject vehicle is driven at any speed, in any direction, on any road surface, for any amount of time.

(b) The subject vehicle approaches the pedestrian test mannequin.

(c) Beginning when the headway corresponds to L_0, the subject vehicle speed is maintained within 1.6 km/h of the test speed with minimal and smooth accelerator pedal inputs.

(d) Beginning when the headway corresponds to L_0, the subject vehicle heading is maintained with minimal steering inputs such that the travel path does not deviate more than 0.3 m laterally from the intended travel path, and the yaw rate of the subject vehicle does not exceed ±1.0 deg/s prior to any automated braking onset.

(e) The pedestrian test mannequin apparatus is triggered any time after the distance between the front plane of the subject vehicle and a parallel contact plane on the pedestrian test mannequin corresponds to L_0. The pedestrian test mannequin achieves its intended speed within 1.5 m after the apparatus begins to move and maintains its intended speed within 0.4 km/h until the test completion criteria of S8.5.4 are satisfied.

S8.5.3. *Test conduct after either forward collision warning or subject vehicle braking onset.*

(a) After forward collision warning or subject vehicle braking onset, the subject vehicle's accelerator pedal is released at any rate such that it is fully released within 500 ms. This action is omitted for vehicles with cruise control active.

(b) No manual brake application is made until the test completion criteria of S8.5.4 are satisfied.

S8.5.4. *Test completion criteria.* The test run is complete when the subject vehicle slows to speed below the pedestrian test mannequin travel speed without making contact with the pedestrian test mannequin or when the subject vehicle makes contact with the pedestrian test mannequin.

S9. *False AEB activation.*

S9.1. *Headway calculation.* For each test run to be conducted under S9.2 and S9.3, the headway (L_0, $L_{2.1}$, $L_{1.1}$), in meters, providing 5.0 seconds, 2.1 seconds, and 1.1 seconds time to collision (TTC) is calculated. L_0, $L_{2.1}$, and $L_{1.1}$ are determined with the following equation where V_{SV} is the speed of the subject vehicle in m/s:

Equation 3 to S9.1

$$L_X = TTC_X \times (V_{SV})$$

$TTC_0 = 5.0$

$TTC_{2.1} = 2.1$

$TTC_{1.1} = 1.1$

S9.2. *Steel trench plate.*

S9.2.1. *Test parameters and setup.*

(a) The testing area is set up in accordance with figure 8 to this section.

(b) The steel trench plate is secured flat on the test surface so that its longest side is parallel to the vehicle's intended travel path and horizontally centered on the vehicle's intended travel path.

(c) The subject vehicle test speed is 80 km/h.

(d) Testing is conducted with manual brake application and without manual brake application.

(e) Testing is conducted during daylight.

S9.2.2. *Test conduct.*

(a) Before the headway corresponds to L_0, the subject vehicle is driven at any speed, in any direction, on any road surface, for any amount of time.

(b) The subject vehicle approaches the steel trench plate.

(c) Beginning when the headway corresponds to L_0, the subject vehicle speed is maintained within 1.6 km/h of the test speed with minimal and smooth accelerator pedal inputs.

(d) Beginning when the headway corresponds to L_0, the subject vehicle heading is maintained with minimal steering input such that the travel path does not deviate more than 0.3 m laterally from the intended travel path, and the yaw rate of the subject vehicle does not exceed ±1.0 deg/s.

(e) If forward collision warning occurs, the subject vehicle's accelerator pedal is released at any rate such that it is fully released within 500 ms. This action is omitted for vehicles with cruise control active.

(f) For tests where no manual brake application occurs, manual braking is not applied until the test completion criteria of S9.2.3 are satisfied.

(g) For tests where manual brake application occurs, the subject vehicle's accelerator pedal, if not already released, is released when the headway corresponds to $L_{2.1}$ at any rate such that it is fully released within 500 ms.

(h) For tests where manual brake application occurs, the service brakes are applied as specified in S10. The brake application pedal onset occurs at headway $L_{1.1}$.

S9.2.3. *Test completion criteria.* The test run is complete when the subject vehicle comes to a stop prior to crossing over the leading edge of the steel trench plate or when the subject vehicle crosses over the leading edge of the steel trench plate.

S9.3. *Pass-through.*

S9.3.1. *Test parameters and setup.*

(a) The testing area is set up in accordance with figure 9 to this section.

(b) Two vehicle test devices are secured in a stationary position parallel to one another with a lateral distance of 4.5 m ±0.1 m between the vehicles' closest front wheels. The centerline between the two vehicles is parallel to the intended travel path.

(c) The subject vehicle test speed is 80 km/h.

(d) Testing is conducted with manual brake application and without manual brake application.

(e) Testing is conducted during daylight.

S9.3.2. *Test conduct.*

(a) Before the headway corresponds to L_0, the subject vehicle is driven at any speed, in any direction, on any road surface, for any amount of time.

(b) The subject vehicle approaches the gap between the two vehicle test devices.

(c) Beginning when the headway corresponds to L_0, the subject vehicle speed is maintained within 1.6 km/h with minimal and smooth accelerator pedal inputs.

(d) Beginning when the headway corresponds to L_0, the subject vehicle heading is maintained with minimal steering input such that the travel path does not deviate more than 0.3 m laterally from the intended travel path, and the yaw rate of the subject vehicle does not exceed ±1.0 deg/s.

(e) If forward collision warning occurs, the subject vehicle's accelerator pedal is released at any rate such that it is fully released within 500 ms.

(f) For tests where no manual brake application occurs, manual braking is not applied until the test completion criteria of S9.3.3 are satisfied.

(g) For tests where manual brake application occurs, the subject vehicle's accelerator pedal, if not already released, is released when the headway corresponds to $L_{2.1}$ at any rate such that it is fully released within 500 ms.

(h) For tests where manual brake application occurs, the service brakes are applied as specified in S10. The brake application onset occurs when the headway corresponds to $L_{1.1}$.

S9.3.3. *Test completion criteria.* The test run is complete when the subject vehicle comes to a stop prior to its rearmost point passing the vertical plane connecting the forwardmost point of the vehicle test devices or when the rearmost point of the subject vehicle passes the vertical plane connecting the forwardmost point of the vehicle test devices.

S10. *Subject vehicle brake application procedure.*

S10.1. The procedure begins with the subject vehicle brake pedal in its natural resting position with no preload or position offset.

S10.2. At the option of the manufacturer, either displacement feedback,

hybrid feedback, or force feedback control is used.

S10.3. *Displacement feedback procedure.* For displacement feedback, the commanded brake pedal position is the brake pedal position that results in a mean deceleration of 0.4 g in the absence of AEB system activation.

(a) The mean deceleration is the deceleration over the time from the brake pedal achieving the commanded position to 250 ms before the vehicle comes to a stop.

(b) The pedal displacement controller displaces the brake pedal at a rate of 254 mm/s ±25.4 mm/s to the commanded brake pedal position.

(c) The pedal displacement controller may overshoot the commanded position by any amount up to 20 percent. If such an overshoot occurs, it is corrected within 250 ms from when the commanded position is first achieved.

(d) The achieved brake pedal position is any position within 10 percent of the commanded position from 250 ms after the commanded brake pedal position is first achieved to the end of the test.

S10.4. *Hybrid brake pedal feedback procedure.* For hybrid brake pedal feedback, the commanded brake pedal application is the brake pedal position and a subsequent commanded brake pedal force that results in a mean deceleration of 0.4 g in the absence of AEB system activation.

(a) The mean deceleration is the deceleration over the time from the brake pedal achieving the commanded position to 250 ms before the vehicle comes to a stop.

(b) The hybrid controller displaces the brake pedal at a rate of 254 mm/s ±25.4 mm/s to the commanded pedal position.

(c) The hybrid controller may overshoot the commanded position by any amount up to 20 percent. If such an overshoot occurs, it is corrected within 250 ms from then the commanded position is first achieved.

(d) The hybrid controller begins to control the force applied to the brake pedal and stops controlling pedal displacement within 100 ms after the commanded brake pedal displacement occurs.

(e) The hybrid controller applies a pedal force of at least 11.1 N from the onset of the brake application until the end of the test.

(f) The average pedal force is maintained within 10 percent of the commanded brake pedal force from 350 ms after commended pedal displacement occurs until test completion.

S10.5. *Force feedback procedure.* For force feedback, the commanded brake pedal application is the brake pedal force that results in a mean deceleration of 0.4 g in the absence of AEB system activation.

(a) The mean deceleration is the deceleration over the time from when the commanded brake pedal force is first achieved to 250 ms before the vehicle comes to a stop.

(b) The force controller achieves the commanded brake pedal force within 250 ms. The application rate is unrestricted.

(c) The force controller may overshoot the commanded force by any amount up to 20 percent. If such an overshoot occurs, it is corrected within 250 ms from when the commanded force is first achieved.

(d) The force controller applies a pedal force of at least 11.1 N from the onset of the brake application until the end of the test.

(e) The average pedal force is maintained within 10 percent of the commanded brake pedal force from 250 ms after commended pedal force occurs until test completion.

Figure 1 to § 571.127—Percentage Overlap Nomenclature

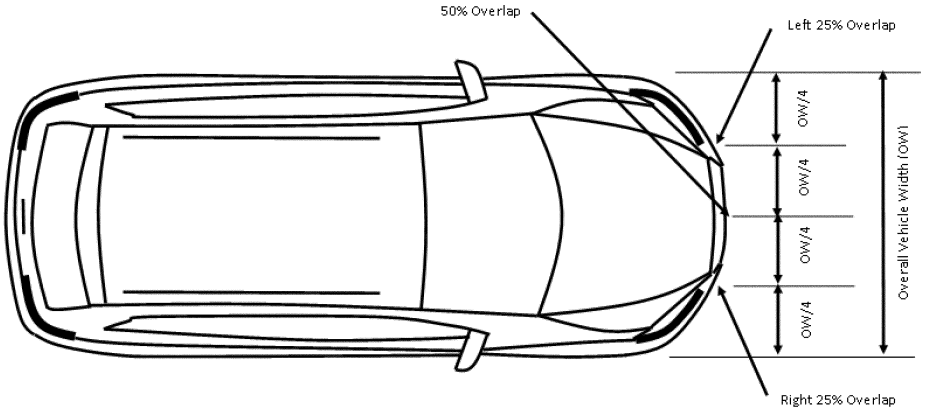


Figure 2 to § 571.127—Setup for Lead Vehicle Automatic Emergency Braking

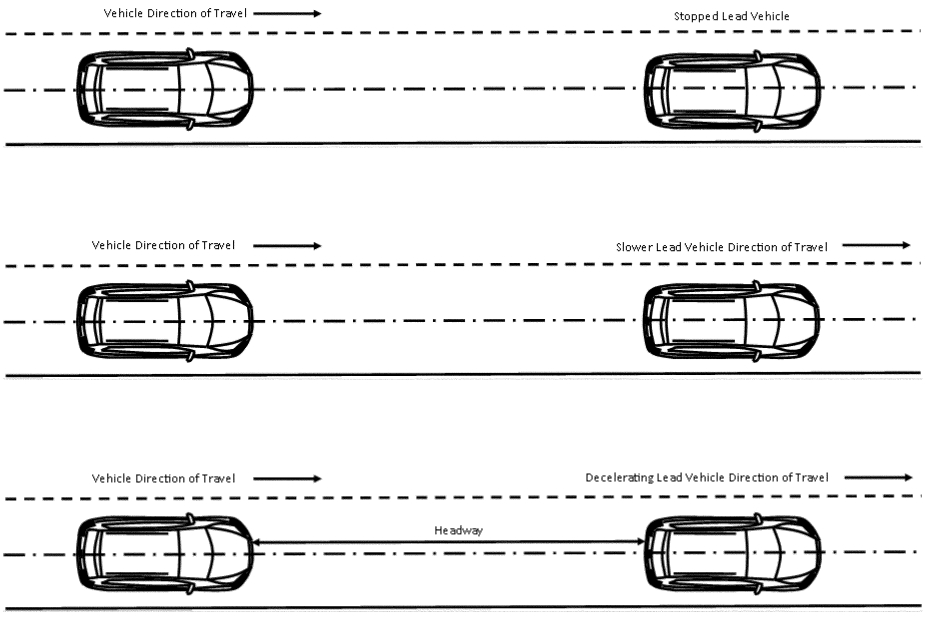


Figure 3 to §571.127—Setup for Pedestrian, Crossing Path, Right

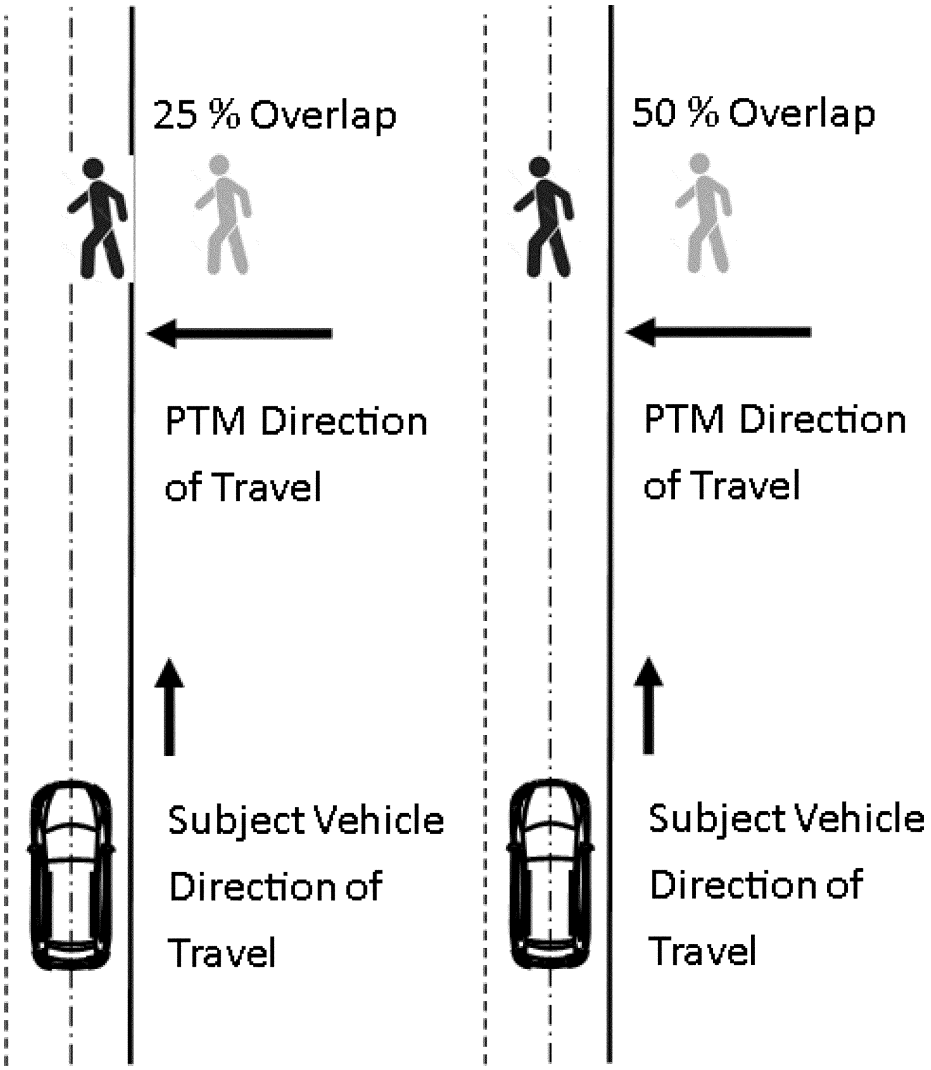


Figure 4 to § 571.127—Setup for Pedestrian, Crossing Path, Left

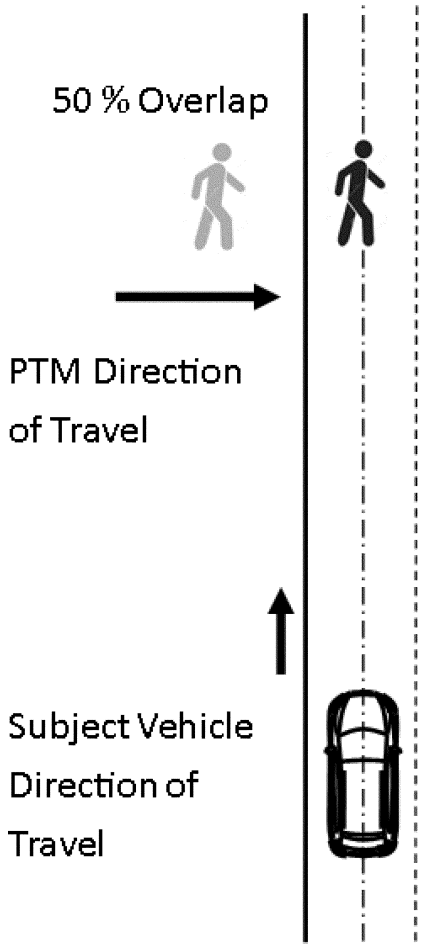


Figure 5 to §571.127—Setup for Pedestrian, Obstructed

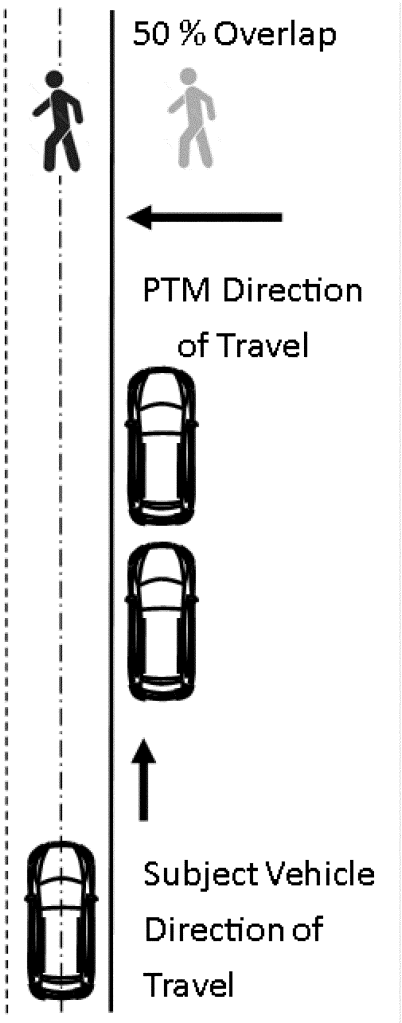


Figure 6 to § 571.127—Setup for Pedestrian Along-Path Stationary

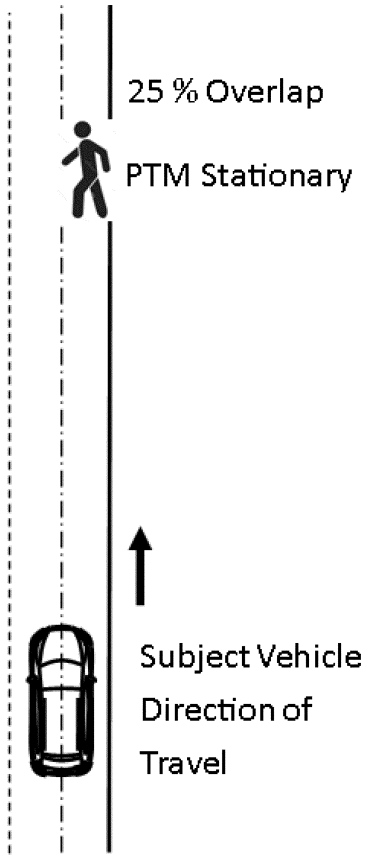


Figure 7 to §571.127—Setup for Pedestrian Along-Path Moving

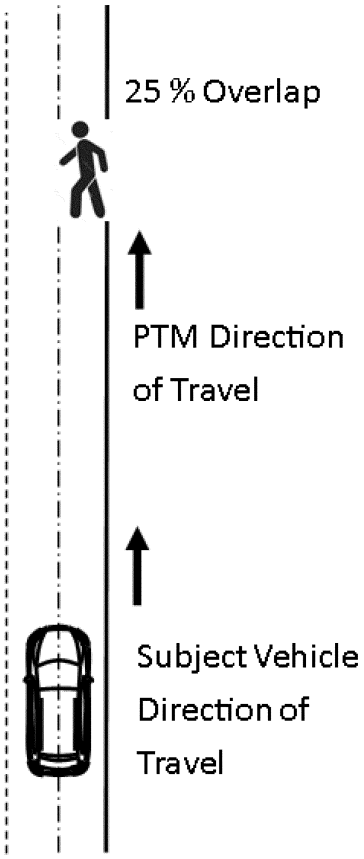


Figure 8 to §571.127—Steel Trench Plate

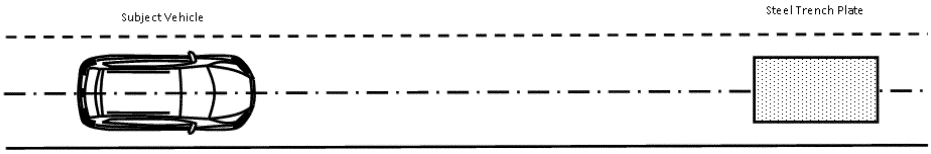
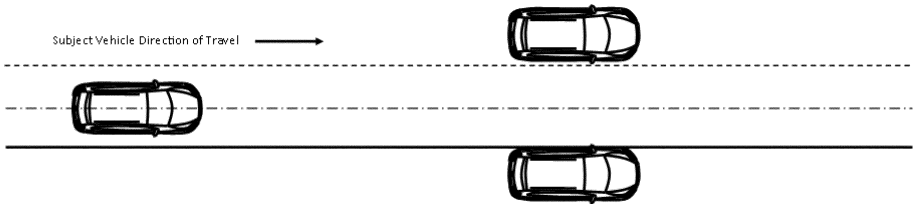


Figure 9 to §571.127—Pass-through



[89 FR 39779, May 9, 2024, as amended at 89 FR 93220, Nov. 26, 2024; 89 FR 99732, Dec. 11, 2024]

§ 571.128 [Reserved]

§ 571.129 Standard No. 129; New non-pneumatic tires for passenger cars.

S1 *Scope.* This standard specifies tire dimensions and laboratory test requirements for lateral strength, strength, endurance, and high speed performance; defines the tire load rating; and specifies labeling requirements for non-pneumatic spare tires.

S2 *Application.* This standard applies to new temporary spare non-pneumatic tires for use on passenger cars.

S3 *Definitions.*

Carcass means the tire structure except for the tread which provides the major portion of the tire's capability to deflect in response to the vertical loads and tractive forces that the tire transmits from the roadway to the non-pneumatic rim, the wheel center member, or the vehicle and which attaches to the vehicle or attaches, either integrally or separably, to the wheel center member or non-pneumatic rim.

Carcass separation means the pulling away of the carcass from the non-pneumatic rim or wheel center member.

Chunking means the breaking away of pieces of the carcass or tread.

Cracking means any parting within the carcass, tread, or any components that connect the tire to the non-pneumatic rim or wheel center member and, if the non-pneumatic tire is integral with the non-pneumatic rim or wheel center member, any parting within the non-pneumatic rim, or wheel center member.

Load rating means the maximum load a tire is rated to carry.

Maximum tire width means the greater of either the linear distance between the exterior edges of the carcass or the linear distance between the exterior edges of the tread, both being measured parallel to the rolling axis of the tire.

Non-pneumatic rim means a mechanical device which, when a non-pneumatic tire assembly incorporates a wheel, supports the tire, and attaches, either integrally or separably, to the wheel center member and upon which the tire is attached.

Non-pneumatic test rim means with reference to a tire to be tested, any non-pneumatic rim that is listed as appropriate for use with that tire in accordance with S4.4.

Non-pneumatic tire means a mechanical device which transmits, either directly or through a wheel or wheel center member, the vertical load and tractive forces from the roadway to the vehicle, generates the tractive forces that provide the directional control of the vehicle and does not rely on the containment of any gas or fluid for providing those functions.

Non-pneumatic tire assembly means a non-pneumatic tire, alone or in combination with a wheel or wheel center member, which can be mounted on a vehicle.

Non-pneumatic tire identification code means an alphanumeric code that is assigned by the manufacturer to identify the tire with regard to its size, application to a specific non-pneumatic rim or wheel center member or application to a specific vehicle.

Test wheel center member means with reference to a tire to be tested, any wheel center member that is listed as appropriate for use with that tire in accordance with S4.4.

Tread means that portion of the tire that comes in contact with the road.

Tread separation means pulling away of the tread from the carcass.

Wheel means a mechanical device which consists of a non-pneumatic rim and wheel center member and which, in the case of a non-pneumatic tire assembly incorporating a wheel, provides the connection between the tire and the vehicle.

Wheel center member means, in the case of a non-pneumatic tire assembly incorporating a wheel, a mechanical device which attaches, either integrally or separably, to the non-pneumatic rim and provides the connection between the non-pneumatic rim and the vehicle; or in the case of a non-pneumatic tire assembly not incorporating a wheel, a mechanical device which attaches, either integrally or separably, to the non-pneumatic tire and provides the connection between the tire and the vehicle.

S4 *Requirements.*

S4.1 *Size and Construction.* Each tire shall be designed to fit each non-pneumatic rim or wheel center member specified for its non-pneumatic tire identification code designation in a listing in accordance with section S4.4.

S4.2 *Performance Requirements*

S4.2.1 *General.* Each tire shall conform to the following:

(a) Its load rating shall be that specified in a submission made by a manufacturer, pursuant to S4.4(a), or in one of the publications described in S4.4(b) for its non-pneumatic tire identification code designation.

(b) It shall incorporate a tread wear indicator that will provide a visual indication that the tire has worn to a tread depth of 1/16 inch.

(c) It shall, before being subjected to either the endurance test procedure specified in S5.4 or the high speed performance procedure specified in S5.5, exhibit no visual evidence of tread or carcass separation, chunking or cracking.

(d) It shall meet the requirements of S4.2.2.5 and S4.2.2.6 when tested on a test wheel described in S5.4.2.1 either alone or simultaneously with up to 5 tires.

S4.2.2 *Test Requirements.*

S.4.2.2.1 *Test Sample.* For each test sample use:

(a) One tire for physical dimensions, lateral strength, and strength in sequence;

(b) A second tire for tire endurance; and

(c) A third tire for high speed performance.

S4.2.2.2 *Physical Dimensions.* For a non-pneumatic tire assembly in which the tire is separable from the non-pneumatic rim or wheel center member, the dimensions, measured in accordance with S5.1, for that portion of the tire that attaches to that non-pneumatic rim or wheel center member shall satisfy the dimensional specifications contained in the submission made by an individual manufacturer, pursuant to S4.4(a), or in one of the publications described in S4.4(b) for that tire's non-pneumatic tire identification code designation.

S4.2.2.3 *Lateral Strength.* There shall be no visual evidence of tread or carcass separation, cracking or chunking, when a tire is tested in accordance with S5.2 to a load of:

(a) 1,500 pounds for tires with a load rating less than 880 pounds;

(b) 2,000 pounds for tires with a load rating of 880 pounds or more but less than 1,400 pounds.

(c) 2,500 pounds for tires with a load rating of 1,400 pounds or more, using the load rating marked on the tire or tire assembly.

S4.2.2.4 *Tire Strength.* There shall be no visual evidence of tread carcass separation, cracking or chunking, when a tire is tested in accordance with S5.3 to a minimum energy level of:

Load rating	Minimum energy level
Below 880 pounds	1950 inch pounds.
880 pounds and above	2600 inch pounds.

S4.2.2.5 *Tire Endurance.* When the tire has been subjected to the laboratory endurance test specified in S5.4, using, if applicable, a non-pneumatic test rim or test wheel center member that undergoes no permanent deformation, there shall be no visual evidence of tread or carcass separation, cracking or chunking. In the case of a non-pneumatic tire assembly in which the non-pneumatic tire is an integral part of the assembly, the assembly shall undergo no permanent deformation with the exception of wear of the tread.

S4.2.2.6 *High Speed Performance.* When the tire has been subjected to the laboratory high speed performance test specified in S5.5, using if applicable, a non-pneumatic test rim or test wheel center member that undergoes no permanent deformation, there shall be no visual evidence of tread or carcass separation, cracking or chunking. In the case of a non-pneumatic tire assembly in which the non-pneumatic tire is an integral part of the assembly, the assembly shall undergo no permanent deformation with the exception of wear of the tread.

S4.3 *Labeling requirements.* Each new non-pneumatic tire shall comply, according to the phase-in schedule specified in S7 of this standard, with the requirements of S5.5 and S5.5.1 of §571.139.

S4.4 *Non-Pneumatic Tire Identification Code and Non-Pneumatic Rim/Wheel Center Member Matching Information.*

For purposes of this standard, S8 of 49 CFR 571.110 and S10 of 49 CFR 571.120, each manufacturer of a non-pneumatic tire that is not an integral part of a non-pneumatic tire assembly shall ensure that it provides a listing to the public for each non-pneumatic tire that it produces. The listing shall include the non-pneumatic tire identification code, tire load rating, dimensional specifications and a diagram of the portion of the tire that attaches to the non-pneumatic rim or wheel center member, and a list of the non-pneumatic rims or wheel center members that may be used with that tire. For each non-pneumatic rim or wheel center member included in such a listing, the information provided shall include a size and type designation for the non-pneumatic rim or wheel center member, and dimensional specifications and a diagram of the non-pneumatic rim or portion of the wheel center member that attaches to the tire. A listing compiled in accordance with paragraph (a) of this section need not include dimensional specifications or a diagram of the non-pneumatic rim or portion of the wheel center member that attaches to the tire if the non-pneumatic rim's or portion of the wheel center member's dimensional specifications and diagram are contained in each listing published in accordance with paragraph (b) of this section. The listing shall be in one of the following forms:

(a) Listed by manufacturer name or brand name in a document furnished to dealers of the manufacturer's tires or, in the case of non-pneumatic tires supplied only as a temporary spare tire on a vehicle, in a document furnished to dealers of vehicles equipped with the tires, to any person upon request, and in duplicate to the Office of Vehicle Safety Standards, Crash Avoidance Division, National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC 20590; or

(b) Contained in publications, current at the date of manufacture of the tire or any later date, of at least one of the following organizations:

The Tire and Rim Association
The European Tyre and Rim Technical Organization
Japan Automobile Tire Manufacturers' Association, Inc.
Deutche Industrie Norm
British Standards Institute
Scandinavian Tire and Rim Organization
Tyre and Rim Association of Australia

S5. *Test Procedures.*

S5.1 *Physical Dimensions.* After conditioning the tire at room temperature for at least 24 hours, using equipment with minimum measurement capabilities of one-half the smallest tolerance specified in the listing contained in the submission made by a manufacturer pursuant to S4.4(a), or in one of the publications described in S4.4(b) for that tire's non-pneumatic tire identification code designation, measure the portion of the tire that attaches to the non-pneumatic rim or the wheel center member. For any inner diameter dimensional specifications, or other dimensional specifications that are uniform or uniformly spaced around some circumference of the tire, these measurements shall be taken at least six points around the tire, or, if specified, at the points specified in the listing contained in the submission made by an individual manufacturer, pursuant to S4.4(a), or in one of the publications described in S4.4(b) for that tire's non-pneumatic tire identification code designation.

S5.2 *Lateral Strength.*

S5.2.1 *Preparation of the tire.*

S5.2.1.1 If applicable, mount a new tire on a non-pneumatic test rim or test wheel center member.

S5.2.1.2 Mount the tire assembly in a fixture as shown in Figure 1 with the surface of the tire assembly that would face outward when mounted on a vehicle facing toward the lateral strength test block shown in Figure 2 and force the lateral strength test block against the tire.

S5.2.2 *Test Procedure.*

S5.2.2.1 Apply a load through the block to the tire at a rate of 2 inches per minute, with the load arm parallel to the tire assembly at the time of engagement and the first point of contact with the test block being the test block centerline shown in Figure 2, at the following distances, B, in sequence, as shown in Figure 1:

B = A—1 inch
B = A—2 inches

B = A—3 inches
B = A—4 inches
B = A—5 inches, and
B = A—6 inches.

However, if at any time during the conduct of the test, the test block comes in contact with the non-pneumatic test rim or test wheel center member, the test shall be suspended and no further testing at smaller values of the distance B shall be conducted. When tested to the above procedure, satisfying the requirements of S4.2.2.3 for all values of B greater than that for which contact between the non-pneumatic test rim or test wheel center member and the test block is made, shall constitute compliance to the requirements set forth in S4.2.2.3.

S5.3 *Tire Strength.*

S5.3.1 *Preparation of the Tire.*

S5.3.1.1 If applicable, mount the tire on a non-pneumatic test rim or test wheel center member.

S5.3.1.2 Condition the tire assembly at room temperature for at least three hours.

S5.3.2 *Test Procedures.*

S5.3.2.1 Force the test cleat, as defined in S5.3.2.2, with its length axis (see S5.3.2.2(a)) parallel to the rolling axis of the non-pneumatic tire assembly, and its height axis (see S5.3.2.2(c)), coinciding with a radius of the non-pneumatic tire assembly, into the tread of the tire at five test points equally spaced around the circumference of the tire. At each test point, the test cleat is forced into the tire at a rate of two inches per minute until the applicable minimum energy level, as shown in S4.2.2.4, calculated using the formula contained in S5.3.2.3, is reached.

S5.3.2.2 The test cleat is made of steel and has the following dimensions;

(a) Minimum length of one inch greater than the maximum tire width of the tire,

(b) Width of one-half inch with the surface which contacts the tire's tread having one-quarter inch radius, and

(c) Minimum height of one inch greater than the difference between the unloaded radius of the non-pneumatic tire assembly and the maximum radius of the non-pneumatic rim or wheel center member, if used with the non-pneumatic tire assembly being tested.

S5.3.2.3 The energy level is calculated by the following formula:

$$E = \frac{F \times P}{2}$$

where

E = Energy level, inch-pounds;
F = Force, pounds; and
P = Penetration, inches

S5.4 *Tire Endurance.*

S5.4.1 *Preparation of the tire.*

S5.4.1.1 If applicable, mount a new tire on a non-pneumatic test rim or test wheel center member.

S5.4.1.2 Condition the tire assembly to 100 ±5 °F. for at least three hours.

S5.4.2 *Test Procedure.*

S5.4.2.1 Mount the tire assembly on a test axle and press it against a flat-faced steel test wheel 67.23 inches in diameter and at least as wide as the maximum tire width of the tire to be tested or an approved equivalent test wheel, with the applicable test load specified in the table in S5.4.2.3 for the tire's non-pneumatic tire identification code designation.

S5.4.2.2 During the test, the air surrounding the test area shall be 100 ±5 °F.

S5.4.2.3 Conduct the test at 50 miles per hour (m.p.h.) in accordance with the following schedule without interruption: The loads for the following periods are the specified percentage of the load rating marked on the tire or tire assembly:

	Percent
4 hours	85
86 hours	90
24 hours	100

S5.4.2.4 Immediately after running the tire the required time, allow the tire to cool for one hour, then, if applicable, detach it from the non-pneumatic test rim or test wheel center member, and inspect it for the conditions specified in S4.2.2.5.

S5.5 *High Speed Endurance.*

S5.5.1 After preparing the tire in accordance with S5.4.1, if applicable, mount the tire assembly in accordance with S5.4.2.1, and press it against the test wheel with a load of 88 percent of the tire's load rating as marked on the tire or tire assembly.

S5.5.2 Break in the tire by running it for 2 hours at 50 m.p.h.

S5.5.3 Allow to cool to 100 ±5 °F.

S5.5.4 Test at 75 m.p.h. for 30 minutes, 80 m.p.h. for 30 minutes and 85 m.p.h. for 30 minutes.

S5.5.5 Immediately after running the tire for the required time, allow the tire to cool for one hour, then, if applicable, detach it from the nonpneumatic test rim or test wheel center member, and inspect it for the conditions specified in S4.2.2.6.

S6. *Nonconforming tires.* Any nonpneumatic tire that is designed for use on passenger cars that does not conform to all the requirements of this standard, shall not be sold, offered for sale, introduced or delivered for introduction into interstate commerce, or imported into the United States, for any purpose.

S7 *Phase-In Schedule for labeling requirements.*

S7.1 *Tires manufactured on or after September 1, 2005 and before September 1, 2006.* For tires manufactured on or after September 1, 2005 and before September 1, 2006, the number of tires complying with S4.3 of this standard must be equal to not less than 40% of the manufacturer's production during that period.

S7.2 *Tires manufactured on or after September 1, 2006 and before September 1, 2007.* For tires manufactured on or after September 1, 2006 and before September 1, 2007, the number of tires complying with S4.3 of this standard must be equal to not less than 70% of the manufacturer's production during that period.

S7.3 *Tires manufactured on or after September 1, 2007.* Each tire must comply with S6.3 of this standard.

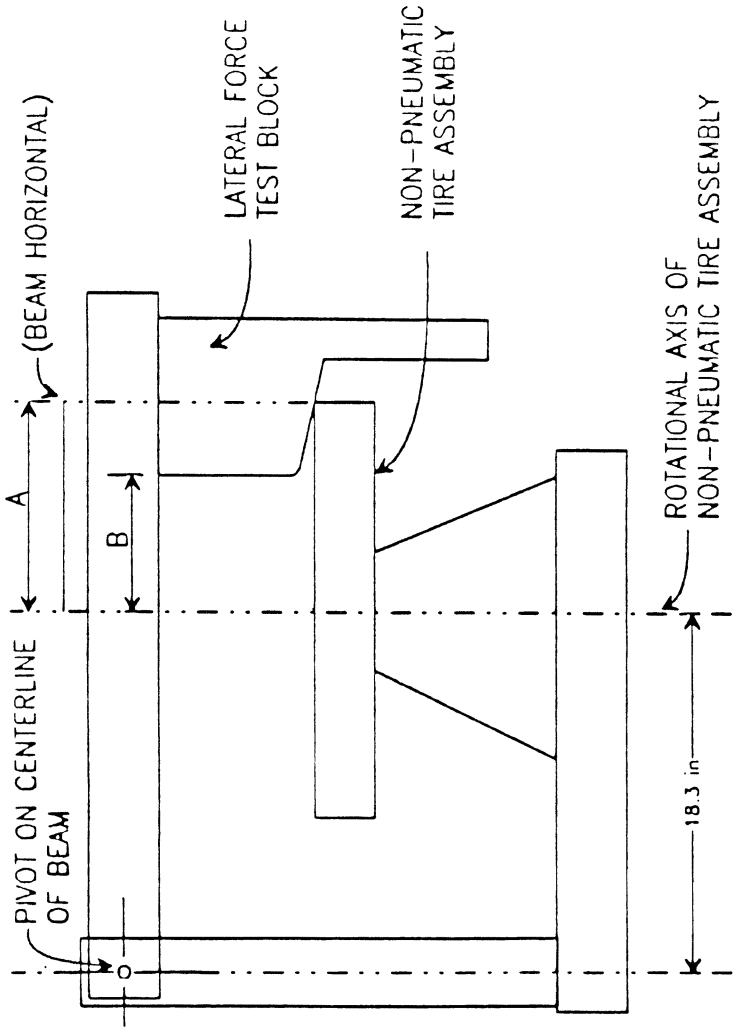


FIGURE 1 – LATERAL FORCE TEST FIXTURE
(DIMENSIONS IN INCHES)

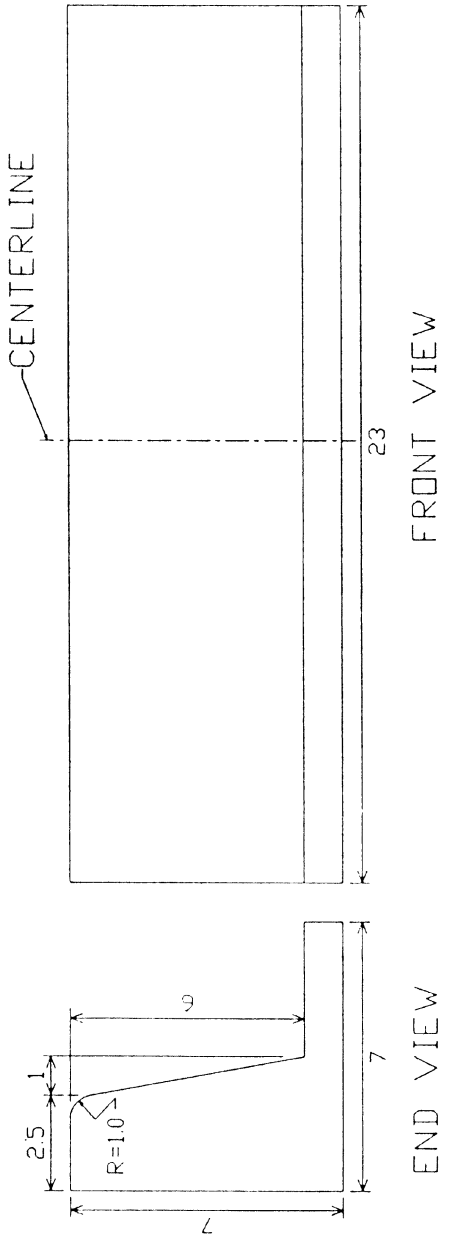


FIGURE 2 - LATERAL FORCE TEST BLOCK

DIMENSIONAL TOLERANCE IS +/- 0.050 INCH

DIMENSIONS ARE IN INCHES

[55 FR 29590, July 20, 1990, as amended at 56 FR 19312, Apr. 26, 1991; 67 FR 69627, Nov. 18, 2002; 69 FR 31319, June 3, 2004]

§571.131 Standard No. 131; School bus pedestrian safety devices.

S1. *Scope.* This standard establishes requirements for devices that can be installed on school buses to improve the safety of pedestrians in the vicinity of stopped school buses.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries by minimizing the likelihood of vehicles passing a stopped school bus and striking pedestrians in the vicinity of the bus.

S3. *Application.* This standard applies to school buses other than multifunction school activity buses.

S4. *Definitions.*

Stop signal arm means a device that can be extended outward from the side of a school bus to provide a signal to other motorists not to pass the bus because it has stopped to load or discharge passengers.

S5. *Requirements.* Each school bus shall be equipped with a stop signal arm meeting the requirements of S5.1 through S5.5 as depicted in Figure 1.

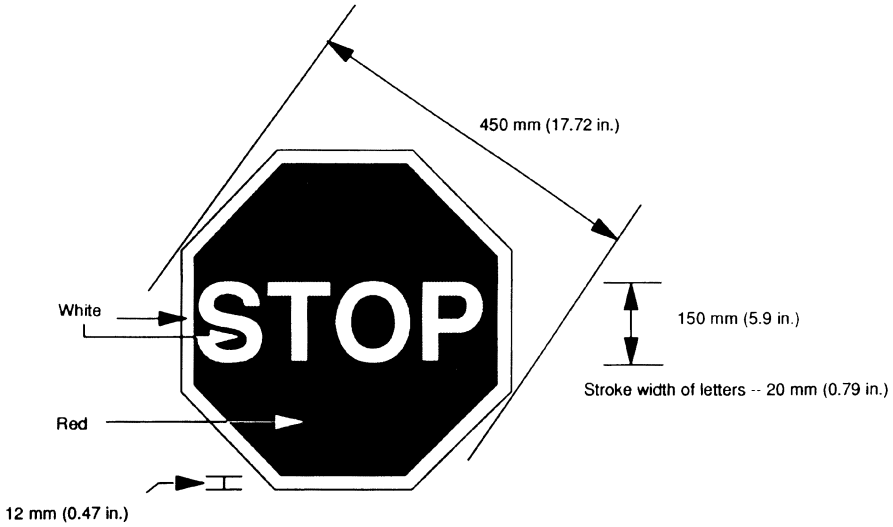


Figure 1. Characteristics of Stop Signal Device

S5.1 The stop signal arm shall be a regular octagon which is at least 450 mm × 450 mm (17.72 inches × 17.72 inches) in diameter.

S5.2 The stop signal arm shall be red on both sides, except as provided in S5.2.1 and S5.2.2, and S5.2.3.

S5.2.1 The stop signal arm shall have a white border at least 12 mm (0.47 inches) wide on both sides, except as provided in S5.2.3. Mounting brackets, clips, bolts, or other components necessary to the mechanical or electrical operation of the stop signal arm may not obscure more than 15 percent of the border on each side of the stop arm. The portion of the border that may be obscured is in addition to that portion which may be obscured by the two red lamps specified in S5.3.2.

S.5.2.2 The stop signal arm shall have the word ''STOP'' displayed in white upper-case letters on both sides, except as provided in S5.2.3. The letters shall be at least 150 mm (5.9 inches) in height. The letters shall have a stroke width of at least 20 mm (0.79 inches), except as provided in S.5.3.1.1.

S5.2.3 When two stop signal arms are installed on a school bus, the rearmost stop signal arm shall not contain any lettering, symbols, or markings on the forward side.

S5.3 *Conspicuity*. The stop signal arm shall comply with either S5.3.1 or S5.3.2, or both.

S5.3.1 Except as provided in S5.3.1.1, S5.3.1.2, or S5.3.1.3, the entire surface of both sides of each stop signal arm shall be reflectorized with Type III retroreflectorized material that meets the minimum specific intensity requirements of S6.1 and Table I.

S.5.3.1.1 The legend of the retroreflective stop arm may be illuminated in a manner such that light is emitted from the surface of each letter or from the area immediately surrounding each letter. Only red lamps may be used. They shall form the complete shape of each letter of the legend, and shall be affixed to all letters (or to the areas immediately surrounding all letters) in the legend. The shape of each letter shall remain constant and, if the lamps are contained within each letter, the net stroke width (stroke width minus the width of the lamp(s)) of each letter of the legend, specified in S5.2.2, shall not be less than 15 mm (0.59 inch). When the stop arm is extended, the lamps shall flash at the rate specified in S6.2.2, with a current ''on'' time specified in S6.2.2.1. All lamps shall be positioned in one of the two following ways:

(1) centered within the stroke of each letter of the legend, or

(2) outlining each letter of the legend.

S5.3.1.2 Nonreflectorized mounting brackets, clips, bolts, or other components necessary to the mechanical or electrical operation of the stop signal arm shall not obscure more than 7.5 percent of the total surface area of either side of the stop signal arm.

S5.3.1.3 When two stop signal arms are installed on a school bus, the forward side of the rearmost stop signal arm shall not be reflectorized.

S5.3.2 Each side of the stop signal arm shall have at least two red lamps that meet the requirements of S6.2. The lamps shall be centered on the vertical centerline of the stop arm. One of the lamps shall be located at the extreme top of the stop arm and the other at its extreme bottom.

S5.4 The stop signal arm shall be installed on the left side of the bus.

S5.4.1 The stop signal arm shall be located such that, when in the extended position:

(a) The stop signal arm is perpendicular to the side of the bus, plus or minus five degrees;

(b) The top edge of the stop signal arm is parallel to and not more than 6 inches from a horizontal plane tangent to the lower edge of the frame of the passenger window immediately behind the driver's window; and

(c) The vertical centerline of the stop signal arm is not less than 9 inches away from the side of the school bus.

S5.4.2 A second stop signal arm may be installed on a school bus. That stop signal arm shall comply with S5.4 and S5.4.1.

S5.5 The stop signal arm shall be automatically extended in such a manner that it complies with S5.4.1, at a minimum whenever the red signal lamps required by S5.1.4 of Standard No. 108 are activated; except that a device may be installed that prevents the automatic extension of a stop signal arm. The mechanism for activating the device shall be within the reach of the driver. While the device is activated, a continuous or intermittent signal audible to the driver shall sound. The audible signal may be equipped with a timing device requiring the signal to sound for at least 60 seconds. If a timing device is used, it shall automatically recycle every time the service entry door is opened while the engine is running and the manual override is engaged.

S6 *Test Procedures*.

S6.1 *Reflectivity Test*. When tested under the conditions specified in S6.2 (b), (c), and (d) of Federal motor vehicle safety standard 125, Warning Devices, (49 CFR 571.125), the retroreflective materials shall meet the criteria specified in table 1.

TABLE 1—MINIMUM SPECIFIC INTENSITY PER UNIT AREA (SIA)

(Candelas per Footcandle per Square Foot)

Observation Angle (°)	Entrance Angle (°)	White	Red
Type III Retroreflective Element Material			
A—Glass Bead Retroreflective Element Material			
0.2	−4	250	45
0.2	+ 30	150	25
0.5	−4	95	15
0.5	+ 30	65	10
B—Prismatic Retroreflective Element Material			
0.2	−4	250	45
0.2	+ 30	95	13.3
0.5	−4	200	28
0.5	+ 30	65	10

S6.2 *Lighting Tests.*

S6.2.1 *Color.* The procedure shall be done in accordance with SAE Recommended Practice J578–1988 (incorporated by reference, see §571.5). When visually compared to the light emitted from a filter/source with a combination of chromaticity coordinates as explained in SAE Recommended Practice J578–1988 within specific boundaries [y = 0.33 (yellow boundary) and y = 0.98—× (purple boundary)] the color of light emitted from the test object shall not be less saturated (paler), yellower, or purpler. The test object shall be placed perpendicular to the light source to simulate lamps on stop signal arms. In making visual comparisons, the light from the test object shall light one portion of a comparison field and the light from the filter/source standard shall light an adjacent area. To make a valid visual comparison, the two fields to be viewed shall be of near equal luminance.

S6.2.2. *Flash rate.* The lamps on each side of the stop signal arm, when operated at the manufacturer's design load, shall flash alternately at a rate of 60 to 120 flashes per minute.

S6.2.2.1 Lamps, except those subject to S6.2.2.2, shall have a current ''on'' time of 30 to 75 percent of the total flash cycle. The total current ''on'' time for the two terminals shall be between 90 and 110 percent of the total flash cycle.

S6.2.2.2 Xenon short-arc gaseous discharge lamps shall have an ''off'' time before each flash of at least 50 percent of the total flash cycle.

S6.2.3 *Vibration, Moisture, Dust, Corrosion, Photometry, and Warpage Tests.* The procedure shall be done in accordance with SAE Recommended Practice J575–1983 (incorporated by reference, see §571.5) and SAE Recommended Practice J1133 (1984) (incorporated by reference, see §571.5). Lamps and lighting components shall meet the criteria for vibration, moisture, dust, corrosion, photometry, and warpage in SAE Recommended Practice J575–1983 and SAE Recommended Practice J1133 (1984) under the test conditions specified herein.

[56 FR 20370, May 3, 1991, as amended at 57 FR 40134, Sept. 2, 1992; 59 FR 26761, May 24, 1994; 63 FR 29143, May 28, 1998; 68 FR 44901, July 31, 2003; 77 FR 760, Jan. 6, 2012]

§571.135 Standard No. 135; Light vehicle brake systems.

S1. *Scope.* This standard specifies requirements for service brake and associated parking brake systems.

S2. *Purpose.* The purpose of this standard is to ensure safe braking performance under normal and emergency driving conditions.

S3. Application. This standard applies to passenger cars manufactured on or after September 1, 2000 and to multi-purpose passenger vehicles, trucks and buses with a gross vehicle weight rating (GVWR) of 3,500 kilograms (7,716 pounds) or less, manufactured on or after September 1, 2002. In addition, at the option of the manufacturer, passenger cars manufactured before September 1, 2000, and multi-purpose passenger vehicles, trucks and buses with a GVWR of 3,500 kilograms (7,716 pounds) or less, manufactured before September 1, 2002, may meet the requirements of this standard instead of Federal Motor Vehicle No. 105, Hydraulic Brake Systems.

S4. *Definitions.*

Adhesion utilization curves means curves showing, for specified load conditions, the adhesion utilized by each axle of a vehicle plotted against the braking ratio of the vehicle.

Antilock brake system or *ABS* means a portion of a service brake system that automatically controls the degree of rotational wheel slip during braking by:

(1) Sensing the rate of angular rotation of the wheels;

(2) Transmitting signals regarding the rate of wheel angular rotation to one or more controlling devices which interpret those signals and generate responsive controlling output signals; and

(3) Transmitting those controlling signals to one or more modulator devices which adjust brake actuating forces in response to those signals.

Backup system means a portion of a service brake system, such as a pump, that automatically supplies energy in the event of a primary brake power source failure.

Brake factor means the slope of the linear least squares regression equation best representing the measured torque output of a brake as a function of the measured applied line pressure during a given brake application for which no wheel lockup occurs.

Brake hold-off pressure means the maximum applied line pressure for which no brake torque is developed, as predicted by the pressure axis intercept of the linear least squares regression equation best representing the measured torque output of a brake as a function of the measured applied line pressure during a given brake application.

Brake power assist unit means a device installed in a hydraulic brake system that reduces the amount of muscular force that a driver must apply to actuate the system, and that, if inoperative, does not prevent the driver from braking the vehicle by a continued application of muscular force on the service brake control.

Brake power unit means a device installed in a brake system that provides the energy required to actuate the brakes, either directly or indirectly through an auxiliary device, with driver action consisting only of modulating the energy application level.

Braking ratio means the deceleration of the vehicle divided by the gravitational acceleration constant.

Electric vehicle or *EV* means a motor vehicle that is powered by an electric motor drawing current from rechargeable storage batteries, fuel cells, or other portable sources of electrical current, and which may include a non-electrical source of power designed to charge batteries and components thereof.

Electrically-actuated service brakes means service brakes that utilize electrical energy to actuate the foundation brakes.

Functional failure means a failure of a component (either electrical or mechanical in nature) which renders the system totally or partially inoperative yet the structural integrity of the system is maintained.

Hydraulic brake system means a system that uses hydraulic fluid as a medium for transmitting force from a service brake control to the service brake and that may incorporate a brake power assist unit, or a brake power unit.

Initial brake temperature or *IBT* means the average temperature of the service brakes on the hottest axle of the vehicle 0.32 km (0.2 miles) before any brake application.

Lightly loaded vehicle weight or *LLVW* means unloaded vehicle weight plus the weight of a mass of 180 kg (396 pounds), including driver and instrumentation.

Maximum speed of a vehicle or *VMax* means the highest speed attainable by accelerating at a maximum rate from a standing start for a distance of 3.2 km (2 miles) on a level surface, with the vehicle at its lightly loaded vehicle weight, and, if an EV, with the propulsion batteries at a state of charge of not less than 95 percent at the beginning of the run.

Objective brake factor means the arithmetic average of all the brake factors measured over the twenty brake applications defined in S7.4, for all wheel positions having a given brake configuration.

Peak friction coefficient or *PFC* means the ratio of the maximum value of braking test wheel longitudinal force to the simultaneous vertical force occurring prior to wheel lockup, as the braking torque is progressively increased.

Pressure component means a brake system component that contains the brake system fluid and controls or senses the fluid pressure.

Regenerative braking system or *RBS* means an electrical energy system that is installed in an EV for recovering or

dissipating kinetic energy, and which uses the propulsion motor(s) as a retarder for partial braking of the EV while returning electrical energy to the propulsion battery(s) or dissipating electrical energy.

Snub means the braking deceleration of a vehicle from a higher reference speed to a lower reference speed that is greater than zero.

Split service brake system means a brake system consisting of two or more subsystems actuated by a single control, designed so that a single failure in any subsystem (such as a leakage-type failure of a pressure component of a hydraulic subsystem except structural failure of a housing that is common to two or more subsystems, or an electrical failure in an electric subsystem) does not impair the operation of any other subsystem.

Stopping distance means the distance traveled by a vehicle from the point of application of force to the brake control to the point at which the vehicle reaches a full stop.

Variable brake proportioning system means a system that has one or more proportioning devices which automatically change the brake pressure ratio between any two or more wheels to compensate for changes in wheel loading due to static load changes and/or dynamic weight transfer, or due to deceleration.

Wheel lockup means 100 percent wheel slip.

S5. *Equipment requirements.*

S5.1. *Service brake system.* Each vehicle shall be equipped with a service brake system acting on all wheels.

S5.1.1. *Wear adjustment.* Wear of the service brakes shall be compensated for by means of a system of automatic adjustment.

S5.1.2. *Wear status.* The wear condition of all service brakes shall be indicated by either:

(a) Acoustic or optical devices warning the driver at his or her driving position when lining replacement is necessary, or

(b) A means of visually checking the degree of brake lining wear, from the outside or underside of the vehicle, utilizing only the tools or equipment normally supplied with the vehicle. The removal of wheels is permitted for this purpose.

S5.1.3 *Regenerative braking system.* (a) For an EV equipped with RBS, the RBS is considered to be part of the service brake system if it is automatically activated by an application of the service brake control, if there is no means provided for the driver to disconnect or otherwise deactivate it, and if it is activated in all transmission positions, including neutral.

(b) For an EV that is equipped with both ABS and RBS that is part of the service brake system, the ABS must control the RBS.

S5.2. *Parking brake system.* Each vehicle shall be equipped with a parking brake system of a friction type with solely mechanical means to retain engagement.

S5.3. *Controls.*

S5.3.1. The service brakes shall be activated by means of a foot control. The control of the parking brake shall be independent of the service brake control, and may be either a hand or foot control.

S5.3.2. For vehicles equipped with ABS, a control to manually disable the ABS, either fully or partially, is prohibited.

S5.4. *Reservoirs.*

S5.4.1. *Master cylinder reservoirs.* A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment.

S5.4.2. *Reservoir capacity.* Reservoirs, whether for master cylinders or other type systems, shall have a total minimum capacity equivalent to the fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoirs move from a new lining, fully retracted position (as adjusted initially to the manufacturer's recommended setting) to a fully worn, fully applied position, as determined in accordance with S7.17(c) of this standard. Reservoirs shall have completely separate compartments for each subsystem except that in reservoir systems utilizing a portion of the reservoir for a common supply to two or more subsystems, individual partial

compartments shall each have a minimum volume of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem, during a full stroke of the piston. Each brake power unit reservoir servicing only the brake system shall have a minimum capacity equivalent to the fluid displacement required to charge the system piston(s) or accumulator(s) to normal operating pressure plus the displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir or accumulator(s) move from a new lining, fully retracted position (as adjusted initially to the manufacturer's recommended setting) to a fully worn, fully applied position.

S5.4.3. *Reservoir labeling.* Each vehicle equipped with hydraulic brakes shall have a brake fluid warning statement that reads as follows, in letters at least 3.2 mm (⅛ inch) high: ''WARNING: Clean filler cap before removing. Use only _____ fluid from a sealed container.'' (Inserting the recommended type of brake fluid as specified in 49 CFR 571.116, *e.g.*, ''DOT 3.'') The lettering shall be:

(a) Permanently affixed, engraved or embossed;

(b) Located so as to be visible by direct view, either on or within 100 mm (3.94 inches) of the brake fluid reservoir filler plug or cap; and

(c) Of a color that contrasts with its background, if it is not engraved or embossed.

S5.4.4. *Fluid level indication.* Brake fluid reservoirs shall be so constructed that the level of fluid can be checked without need for the reservoir to be opened. This requirement is deemed to have been met if the vehicle is equipped with a transparent brake fluid reservoir or a brake fluid level indicator meeting the requirements of S5.5.1(a)(1).

S5.5. *Brake system warning indicator.* Each vehicle shall have one or more visual brake system warning indicators, mounted in front of and in clear view of the driver, which meet the requirements of S5.5.1 through S5.5.5. In addition, a vehicle manufactured without a split service brake system shall be equipped with an audible warning signal that activates under the conditions specified in S5.5.1(a).

S5.5.1. *Activation.* An indicator shall be activated when the ignition (start) switch is in the ''on'' (''run'') position and whenever any of conditions (a) through (g) occur:

(a) A gross loss of fluid or fluid pressure (such as caused by rupture of a brake line but not by a structural failure of a housing that is common to two or more subsystems) as indicated by one of the following conditions (chosen at the option of the manufacturer):

(1) A drop in the level of the brake fluid in any master cylinder reservoir compartment to less than the recommended safe level specified by the manufacturer or to one-fourth of the fluid capacity of that reservoir compartment, whichever is greater.

(2) For vehicles equipped with a split service brake system, a differential pressure of 1.5 MPa (218 psi) between the intact and failed brake subsystems measured at a master cylinder outlet or a slave cylinder outlet.

(3) A drop in the supply pressure in a brake power unit to one-half of the normal system pressure.

(b) Any electrical functional failure in an antilock or variable brake proportioning system.

(c) Application of the parking brake.

(d) Brake lining wear-out, if the manufacturer has elected to use an electrical device to provide an optical warning to meet the requirements of S5.1.2(a).

(e) For a vehicle with electrically-actuated service brakes, failure of the source of electric power to those brakes, or diminution of state of charge of the batteries to less than a level specified by the manufacturer for the purpose of warning a driver of degraded brake performance.

(f) For a vehicle with electric transmission of the service brake control signal, failure of a brake control circuit.

(g) For an EV with a regenerative braking system that is part of the service brake system, failure of the RBS.

S5.5.2. *Function check.* (a) All indicators shall be activated as a check function by either:

(1) Automatic activation when the ignition (start) switch is turned to the

''on'' (''run'') position when the engine is not running, or when the ignition (''start'') switch is in a position between ''on'' (''run'') and ''start'' that is designated by the manufacturer as a check position, or

(2) A single manual action by the driver, such as momentary activation of a test button or switch mounted on the instrument panel in front of and in clear view of the driver, or, in the case of an indicator for application of the parking brake, by applying the parking brake when the ignition is in the ''on'' (''run'') position.

(b) In the case of a vehicle that has an interlock device that prevents the engine from being started under one or more conditions, check functions meeting the requirements of S5.5.2(a) need not be operational under any condition in which the engine cannot be started.

(c) The manufacturer shall explain the brake check function test procedure in the owner's manual.

S5.5.3. *Duration.* Each indicator activated due to a condition specified in S5.5.1 shall remain activated as long as the condition exists, whenever the ignition (''start'') switch is in the ''on'' (''run'') position, whether or not the engine is running.

S5.5.4. *Function.* When a visual warning indicator is activated, it may be continuous or flashing, except that the visual warning indicator on a vehicle not equipped with a split service brake system shall be flashing. The audible warning required for a vehicle manufactured without a split service brake system may be continuous or intermittent.

S5.5.5. *Labeling.* (a) Each visual indicator shall display a word or words in accordance with the requirements of Standard No. 101 (49 CFR 571.101) and this section, which shall be legible to the driver under all daytime and nighttime conditions when activated. Unless otherwise specified, the words shall have letters not less than 3.2 mm (⅛ inch) high and the letters and background shall be of contrasting colors, one of which is red. Words or symbols in addition to those required by Standard No. 101 and this section may be provided for purposes of clarity.

(b) Vehicles manufactured with a split service brake system may use a common brake warning indicator to indicate two or more of the functions described in S5.5.1(a) through S5.5.1(g). If a common indicator is used, it shall display the word ''Brake.''

(c) A vehicle manufactured without a split service brake system shall use a separate indicator to indicate the failure condition in S5.5.1(a). This indicator shall display the words ''STOP—BRAKE FAILURE'' in block capital letters not less than 6.4 mm (¼ inch) in height.

(d) If separate indicators are used for one or more of the conditions described in S5.5.1(a) through S5.5.1(g), the indicators shall display the following wording:

(1) If a separate indicator is provided for the low brake fluid condition in S5.5.1(a)(1), the words ''Brake Fluid'' shall be used except for vehicles using hydraulic system mineral oil.

(2) If a separate indicator is provided for the gross loss of pressure condition in S5.5.1(a)(2), the words ''Brake Pressure'' shall be used.

(3) If a separate indicator is provided for the condition specified in S5.5.1(b), the letters and background shall be of contrasting colors, one of which is yellow. The indicator shall be labeled with the words ''Antilock'' or ''Anti-lock'' or ''ABS''; or ''Brake Proportioning,'' in accordance with Table 1 of Standard No. 101.

(4) If a separate indicator is provided for application of the parking brake as specified for S5.5.1(c), the single word ''Park'' or the words ''Parking Brake'' may be used.

(5) If a separate indicator is provided to indicate brake lining wear-out as specified in S5.5.1(d), the words ''Brake Wear'' shall be used.

(6) If a separate indicator is provided for the condition specified in S5.5.1(g), the letters and background shall be of contrasting colors, one of which is yellow. The indicator shall be labeled with the symbol ''RBS.'' RBS failure in a system that is part of the service brake system may also be indicated by a yellow lamp that also indicates ''ABS'' failure and displays the symbol ''ABS/RBS.''

(7) If a separate indicator is provided for any other function, the display

shall include the word ''Brake'' and the appropriate additional labeling.

S5.6. *Brake system integrity.* Each vehicle shall meet the complete performance requirements of this standard without:

(a) Detachment or fracture of any component of the braking system, such as brake springs and brake shoes or disc pad facings other than minor cracks that do not impair attachment of the friction facings. All mechanical components of the braking system shall be intact and functional. Friction facing tearout (complete detachment of lining) shall not exceed 10 percent of the lining on any single frictional element.

(b) Any visible brake fluid or lubricant on the friction surface of the brake, or leakage at the master cylinder or brake power unit reservoir cover, seal, and filler openings.

S6. *General test conditions.* Each vehicle must meet the performance requirements specified in S7 under the following test conditions and in accordance with the test procedures and test sequence specified. Where a range of conditions is specified, the vehicle must meet the requirements at all points within the range.

S6.1. *Ambient conditions.*

S6.1.1. *Ambient temperature.* The ambient temperature is any temperature between 0 °C (32 °F) and 40 °C (104 °F).

S6.1.2. *Wind speed.* The wind speed is not greater than 5 m/s (11.2 mph).

S6.2. *Road test surface.*

S6.2.1. *Pavement friction.* Unless otherwise specified, the road test surface produces a peak friction coefficient (PFC) of 1.02 when measured using an ASTM F2493 standard reference test tire, in accordance with ASTM E1337–19 (incorporated by reference, see § 571.5), at a speed of 64.4 km/h (40 mph), without water delivery.

S6.2.2. *Gradient.* Except for the parking brake gradient holding test, the test surface has no more than a 1% gradient in the direction of testing and no more than a 2% gradient perpendicular to the direction of testing.

S6.2.3. *Lane width.* Road tests are conducted on a test lane 3.5 m (11.5 ft) wide.

S6.3. *Vehicle conditions.*

S6.3.1. *Vehicle weight.*

S6.3.1.1. For the tests at GVWR, the vehicle is loaded to its GVWR such that the weight on each axle as measured at the tire-ground interface is in proportion to its GAWR, with the fuel tank filled to 100% of capacity. However, if the weight on any axle of a vehicle at LLVW exceeds the axle's proportional share of the GVWR, the load required to reach GVWR is placed so that the weight on that axle remains the same as at LLVW.

S6.3.1.2. For the test at LLVW, the vehicle is loaded to its LLVW such that the added weight is distributed in the front passenger seat area.

S6.3.2. *Fuel tank loading.* The fuel tank is filled to 100% of capacity at the beginning of testing and may not be less than 75% of capacity during any part of the testing.

S6.3.3. *Lining preparation.* At the beginning of preparation for the road tests, the brakes of the vehicle are in the same condition as when the vehicle was manufactured. No burnishing or other special preparation is allowed, unless all vehicles sold to the public are similarly prepared as a part of the manufacturing process.

S6.3.4. *Adjustments and repairs.* These requirements must be met without replacing any brake system parts or making any adjustments to the brake system except as specified in this standard. Where brake adjustments are specified (S7.1.3), adjust the brakes, including the parking brakes, in accordance with the manufacturer's recommendation. No brake adjustments are allowed during or between subsequent tests in the test sequence.

S6.3.5. *Automatic brake adjusters.* Automatic adjusters are operational throughout the entire test sequence. They may be adjusted either manually or by other means, as recommended by the manufacturer, only prior to the beginning of the road test sequence.

S6.3.6. *Antilock brake system (ABS).* If a car is equipped with an ABS, the ABS is fully operational for all tests, except where specified in the following sections.

S6.3.7. *Variable brake proportioning valve.* If a car is equipped with a variable brake proportioning system, the proportioning valve is fully operational

for all tests except the test for failed variable brake proportioning system.

S6.3.8. *Tire inflation pressure.* Tires are inflated to the pressure recommended by the vehicle manufacturer for the GVWR of the vehicle.

S6.3.9. *Engine.* Engine idle speed and ignition timing are set according to the manufacturer's recommendations. If the vehicle is equipped with an adjustable engine speed governor, it is adjusted according to the manufacturer's recommendations.

S6.3.10. *Vehicle openings.* All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) are closed except as required for instrumentation purposes.

S6.3.11 *State of charge of batteries for EVs.*

S6.3.11.1 The state of charge of the propulsion batteries is determined in accordance with SAE Recommended Practice J227a (1976) (incorporated by reference, see §571.5). The applicable sections of J227a (1976) are 3.2.1 through 3.2.4, 3.3.1 through 3.3.2.2, 3.4.1 and 3.4.2, 4.2.1, 5.2, 5.2.1 and 5.3.

S6.3.11.2 At the beginning of the burnish procedure (S7.1 of this standard) in the test sequence, each propulsion battery is at the maximum state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, of, if the manufacturer has made no recommendation, not less than 95 percent. During the 200-stop burnish procedure, the propulsion batteries are restored to the maximum state of charge determined as above, after each increment of 40 burnish stops until the burnish procedure is complete. The batteries may be charged at a more frequent interval during a particular 40-stop increment only if the EV is incapable of achieving the initial burnish test speed during that increment. During the burnish procedure, the propulsion batteries may be charged by external means or replaced by batteries that are at a state of charge of not less than 95 percent. For an EV having a manual control for setting the level of regenerative braking, the manual control, at the beginning of the burnish procedure, is set to provide maximum regenerative braking throughout the burnish.

S6.3.11.3 At the beginning of each performance test in the test sequence (S7.2 through S7.17 of this standard), unless otherwise specified, an EV's propulsion batteries are at the state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. No further charging of any propulsion battery occurs during any of the performance tests in the test sequence of this standard. If the propulsion batteries are depleted during a test sequence such that the vehicle reaches automatic shut-down, will not accelerate, or the low state of charge brake warning lamp is illuminated, the vehicle is to be accelerated to brake test speed by auxiliary means. If a battery is replaced rather than recharged, the replacement battery shall be charged and measured for state of charge in accordance with these procedures.

S6.3.12 *State of charge of batteries for electrically-actuated service brakes.* A vehicle equipped with electrically-actuated service brakes also performs the following test series. Conduct 10 stopping tests from a speed of 100 kph or the maximum vehicle speed, whichever is less. At least two of the 10 stopping distances must be less than or equal to 70 meters. The vehicle is loaded to GVWR and the transmission is in the neutral position when the service brake control is actuated and throughout the remainder of the test. Each battery providing power to the electrically-actuated service brakes, shall be in a depleted state of charge for conditions (a), (b), or (c) of this paragraph as appropriate. An auxiliary means may be used to accelerate an EV to test speed.

(a) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries and with automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at not more than five percent above the EV actual automatic shut-down critical value. The critical value is determined by measuring the state-of-charge of

each propulsion battery at the instant that automatic shut-down occurs.

(b) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries and with no automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at an average of not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.5.1(e) of this standard, is illuminated.

(c) For a vehicle which has one or more auxiliary batteries that provides electrical energy to operate the electrically-actuated service brakes, each auxiliary battery is at not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.5.1(e) of this standard, is illuminated.

S6.3.13 *Electric vehicles.*

S6.3.13.1 (a) For an EV equipped with an RBS that is part of the service brake system, the RBS is operational during the burnish and all tests, except for the test of a failed RBS.

(b) For an EV equipped with an RBS that is not part of the service brake system, the RBS is operational and set to produce the maximum regenerative braking effect during the burnish, and is disabled during the test procedures. If the vehicle is equipped with a neutral gear that automatically disables the RBS, the test procedures which are designated to be conducted in gear may be conducted in neutral.

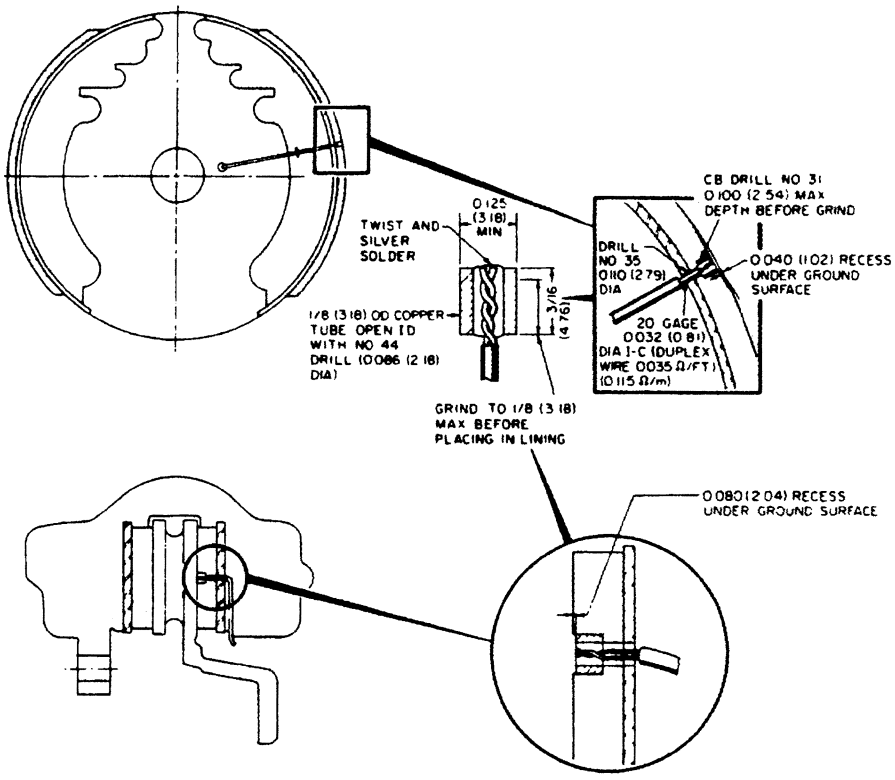
S6.3.13.2 For tests conducted ''in neutral'', the operator of an EV with no ''neutral'' position (or other means such as a clutch for disconnecting the drive train from the propulsion motor(s)) does not apply any electromotive force to the propulsion motor(s). Any electromotive force that is applied to the propulsion motor(s) automatically remains in effect unless otherwise specified by the test procedure.

S6.4. *Instrumentation.*

S6.4.1. *Brake temperature measurement.* The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in Figure 1. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the metal rubbing surface of a drum or rotor. For center-grooved shoes or pads, thermocouples are installed within 3 mm (.12 in) to 6 mm (.24 in) of the groove and as close to the center as possible.

S6.4.2. *Brake line pressure measurement for the torque wheel test.* The vehicle shall be fitted with pressure transducers in each hydraulic circuit. On hydraulically proportioned circuits, the pressure transducer shall be downstream of the operative proportioning valve.

S6.4.3. *Brake torque measurement for the torque wheel test.* The vehicle shall be fitted with torque wheels at each wheel position, including slip ring assemblies and wheel speed indicators to permit wheel lock to be detected.



DIMENSIONS ARE IN (mm)

Figure 1–Typical Plug-Type Thermocouple Installations

S6.5. *Procedural conditions.*

S6.5.1. *Brake control.* All service brake system performance requirements, including the partial system requirements of S7.7, S7.10 and S7.11, must be met solely by use of the service brake control.

S6.5.2. *Test speeds.* If a vehicle is incapable of attaining the specified normal test speed, it is tested at a speed that is a multiple of 5 km/h (3.1 mph) that is 4 to 8 km/h (2.5 to 5.0 mph) less than its maximum speed and its performance must be within a stopping distance given by the formula provided for the specific requirement.

S6.5.3. *Stopping distance.*

S6.5.3.1. The braking performance of a vehicle is determined by measuring the stopping distance from a given initial speed.

S6.5.3.2. Unless otherwise specified, the vehicle is stopped in the shortest distance achievable (best effort) on all stops. Where more than one stop is required for a given set of test conditions, a vehicle is deemed to comply with the corresponding stopping distance requirements if at least one of the stops is made within the prescribed distance.

S6.5.3.3. In the stopping distance formulas given for each applicable test (such as $S \leq 0.10V + 0.0060V^2$), S is the maximum stopping distance in meters, and V is the test speed in km/h.

S6.5.4. *Vehicle position and attitude.*

S6.5.4.1. The vehicle is aligned in the center of the lane at the start of each brake application. Steering corrections are permitted during each stop.

S6.5.4.2. Stops are made without any part of the vehicle leaving the lane and without rotation of the vehicle about its vertical axis of more than ±15° from the center line of the test lane at any time during any stop.

S6.5.5. *Transmission selector control.*

S6.5.5.1. For tests in neutral, a stop or snub is made in accordance with the following procedures:

(a) Exceed the test speed by 6 to 12 km/h (3.7 to 7.5 mph);

(b) Close the throttle and coast in gear to approximately 3 km/h (1.9 mph) above the test speed;

(c) Shift to neutral; and

(d) When the test speed is reached, apply the brakes.

S6.5.5.2. For tests in gear, a stop or snub is made in accordance with the following procedures:

(a) With the transmission selector in the control position recommended by the manufacturer for driving on a level surface at the applicable test speed, exceed the test speed by 6 to 12 km/h (3.7 to 7.5 mph);

(b) Close the throttle and coast in gear; and

(c) When the test speed is reached apply the brakes.

(d) To avoid engine stall, a manual transmission may be shifted to neutral (or the clutch disengaged) when the vehicle speed is below 30 km/h (18.6 mph).

S6.5.6. *Initial brake temperature (IBT).* If the lower limit of the specified IBT for the first stop in a test sequence (other than a parking brake grade holding test) has not been reached, the brakes are heated to the IBT by making one or more brake applications from a speed of 50 km/h (31.1 mph), at a deceleration rate not greater than 3 m/s^2 (9.8 fps^2).

S7. *Road test procedures and performance requirements.* Each vehicle shall meet all the applicable requirements of this section, when tested according to the conditions and procedures set forth below and in S6, in the sequence specified in Table 1:

TABLE 1—ROAD TEST SEQUENCE

Testing order	Section No.
Vehicle loaded to GVWR:	
1 Burnish	S7.1
2 Wheel lock sequence	S7.2
Vehicle loaded to LLVW:	
3 Wheel lock sequence	S7.2
4 ABS performance	S7.3
5 Torque wheel	S7.4
Vehicle loaded to GVWR:	
6 Torque wheel	S7.4
7 Cold effectiveness	S7.5
8 High speed effectiveness	S7.6
9 Stops with engine off	S7.7
Vehicle loaded to LLVW:	
10 Cold effectiveness	S7.5
11 High speed effectiveness	S7.6
12 Failed antilock	S7.8
13 Failed proportioning valve	S7.9
14 Hydraulic circuit failure	S7.10
Vehicle loaded to GVWR:	
15 Hydraulic circuit failure	S7.10
16 Failed antilock	S7.8
17 Failed proportioning valve	S7.9
18 Power brake unit failure	S7.11
19 Parking brake	S7.12
20 Heating Snubs	S7.13
21 Hot Performance	S7.14
22 Brake cooling	S7.15
23 Recovery Performance	S7.16
24 Final Inspection	S7.17

S7.1. *Burnish.*

S7.1.1. *General information.* Any pretest instrumentation checks are conducted as part of the burnish procedure, including any necessary rechecks after instrumentation repair, replacement or adjustment. Instrumentation check test conditions must be in accordance with the burnish test procedure specified in S7.1.2 and S7.1.3.

S7.1.2. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In gear.

S7.1.3. *Test conditions and procedures.* The road test surface conditions specified in S6.2 do not apply to the burnish procedure.

(a) IBT: ≤100 °C (212 °F).

(b) Test speed: 80 km/h (49.7 mph).

(c) Pedal force: Adjust as necessary to maintain specified constant deceleration rate.

(d) Deceleration rate: Maintain a constant deceleration rate of 3.0 m/s^2 (9.8 fps^2).

(e) Wheel lockup: No lockup of any wheel allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(f) Number of runs: 200 stops.

(g) Interval between runs: The interval from the start of one service brake application to the start of the next is either the time necessary to reduce the IBT to 100 °C (212 °F) or less, or the distance of 2 km (1.24 miles), whichever occurs first.

(h) Accelerate to 80 km/h (49.7 mph) after each stop and maintain that speed until making the next stop.

(i) After burnishing, adjust the brakes as specified in S6.3.4.

S7.2 *Wheel lockup sequence.*

S7.2.1 *General information.* (a) The purpose of this test is to ensure that lockup of both front wheels occurs either simultaneously with, or at a lower deceleration rate than, the lockup of both rear wheels, when tested on road surfaces affording adhesion such that wheel lockup of the first axle occurs at a braking ratio of between 0.15 and 0.80, inclusive.

(b) This test is for vehicles without antilock brake systems.

(c) This wheel lock sequence test is to be used as a screening test to evaluate a vehicle's axle lockup sequence and to determine whether the torque wheel test in S7.4 must be conducted.

(d) For this test, a simultaneous lockup of the front and rear wheels refers to the conditions when the time interval between the first occurrence of lockup of the last (second) wheel on the rear axle and the first occurrence of lockup of the last (second) wheel on the front axle is ≤0.1 second for vehicle speeds >15 km/h (9.3 mph).

(e) A front or rear axle lockup is defined as the point in time when the last (second) wheel on an axle locks up.

(f) Vehicles that lock their front axle simultaneously or at lower deceleration rates than their rear axle need not be tested to the torque wheel procedure.

(g) Vehicles which lock their rear axle at deceleration rates lower than the front axle shall also be tested in accordance with the torque wheel procedure in S7.4.

(h) Any determination of noncompliance for failing adhesion utilization requirements shall be based on torque wheel test results.

S7.2.2 *Vehicle conditions.* (a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In neutral.

S7.2.3. *Test Conditions and Procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 65 km/h (40.4 mph) for a braking ratio ≤0.50; 100 km/h (62.1 mph) for a braking ratio >0.50.

(c) Pedal force:

(1) Pedal force is applied and controlled by the vehicle driver or by a mechanical brake pedal actuator.

(2) Pedal force is increased at a linear rate such that the first axle lockup occurs no less than one-half (0.5) second and no more than one and one-half (1.5) seconds after the initial application of the pedal.

(3) The pedal is released when the second axle locks, or when the pedal force reaches 1kN (225 lbs), or 0.1 seconds after first axle lockup, whichever occurs first.

(d) Wheel lockup: Only wheel lockups above a vehicle speed of 15 km/h (9.3 mph) are considered in determining the results of this test.

(e) Test surfaces: This test is conducted, for each loading condition, on two different test surfaces that will result in a braking ratio of between 0.15 and 0.80, inclusive. NHTSA reserves the right to choose the test surfaces to be used based on adhesion utilization curves or any other method of determining ''worst case'' conditions.

(f) The data recording equipment shall have a minimum sampling rate of 40 Hz.

(g) Data to be recorded. The following information must be automatically recorded in phase continuously throughout each test run such that values of the variables can be cross referenced in real time.

(1) Vehicle speed.

(2) Brake pedal force.

(3) Angular velocity at each wheel.

(4) Actual instantaneous vehicle deceleration or the deceleration calculated by differentiation of the vehicle speed.

(h) Speed channel filtration. For analog instrumentation, the speed channel shall be filtered by using a low-pass filter having a cut-off frequency of less than one fourth the sampling rate.

(i) Test procedure. For each test surface, three runs meeting the pedal force application and time for wheel lockup requirements shall be made. Up to a total of six runs will be allowed to obtain three valid runs. Only the first three valid runs obtained shall be used for data analysis purposes.

S7.2.4. *Performance requirements.* (a) In order to pass this test a vehicle shall be capable of meeting the test requirements on all test surfaces that will result in a braking ratio of between 0.15 and 0.80, inclusive.

(b) If all three valid runs on each surface result in the front axle locking before or simultaneously with the rear axle, or the front axle locks up with only one or no wheels locking on the rear axle, the torque wheel procedure need not be run, and the vehicle is considered to meet the adhesion utilization requirements of this Standard. This performance requirement shall be met for all vehicle braking ratios between 0.15 and 0.80.

(c) If any one of the three valid runs on any surface results in the rear axle locking before the front axle or the rear axle locks up with only one or no wheels locking on the front axle the torque wheel procedure shall be performed. This performance requirement shall be met for all vehicle braking ratios between 0.15 and 0.80.

(d) If any one of the three valid runs on any surface results in neither axle locking (i.e., only one or no wheels locked on each axle) before a pedal force of 1kN (225 lbs) is reached, the vehicle shall be tested to the torque wheel procedure.

(e) If the conditions listed in paragraph (c) or (d) of this section occur, vehicle compliance shall be determined from the results of a torquesults of a torque wheel test performed in accordance with S7.4.

(f) An EV with RBS that is part of the service brake system shall meet the performance requirements over the entire normal operating range of the RBS.

S7.3. *ABS performance.* [Reserved]

S7.4. *Adhesion utilization (Torque Wheel Method).*

S7.4.1. *General information.* This test is for vehicles without any ABS. The purpose of the test is to determine the adhesion utilization of a vehicle.

S7.4.2. *Vehicle conditions.* (a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In neutral.

(c) Tires: For this test, a separate set of tires, identical to those used for all other tests under Section 7.0, may be used.

S7.4.3. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speeds: 100 km/h (62.1 mph), and 50 km/h (31.1 mph).

(c) Pedal force: Pedal force is increased at a linear rate between 100 and 150 N/sec (22.5 and 33.7 lbs/sec) for the 100 km/h test speed, or between 100 and 200 N/sec (22.5 and 45.0 lbs/sec) for the 50 km/h test speed, until the first axle locks or until a pedal force of 1 kN (225 lbs) is reached, whichever occurs first.

(d) Cooling: Between brake applications, the vehicle is driven at speeds up to 100 km/h (62.1 mph) until the IBT specified in S7.4.3(a) is reached.

(e) Number of runs: With the vehicle at LLVW, run five stops from a speed of 100 km/h (62.1 mph) and five stops from a speed of 50 km/h (31.1 mph), while alternating between the two test speeds after each stop. With the vehicle at GVWR, repeat the five stops at each test speed while alternating between the two test speeds.

(f) Test surface: PFC of at least 1.02.

(g) Data to be recorded. The following information must be automatically recorded in phase continuously throughout each test run such that values of the variables can be cross referenced in real time:

(1) Vehicle speed.

(2) Brake pedal force.

(3) Angular velocity at each wheel.

(4) Brake torque at each wheel.

(5) Hydraulic brake line pressure in each brake circuit. Hydraulically proportioned circuits shall be fitted with transducers on at least one front wheel and one rear wheel downstream of the operative proportioning or pressure limiting valve(s).

(6) Vehicle deceleration.

(h) Sample rate: All data acquisition and recording equipment shall support a minimum sample rate of 40 Hz on all channels.

(i) Determination of front versus rear brake pressure. Determine the front

versus rear brake pressure relationship over the entire range of line pressures. Unless the vehicle has a variable brake proportioning system, this determination is made by static test. If the vehicle has a variable brake proportioning system, dynamic tests are run with the vehicle both empty and loaded. 15 snubs from 50 km/h (31.1 mph) are made for each of the two load conditions, using the same initial conditions specified in this section.

S7.4.4. *Data reduction*. (a) The data from each brake application under S7.4.3 is filtered using a five-point, on-center moving average for each data channel.

(b) For each brake application under S7.4.3 determine the slope (brake factor) and pressure axis intercept (brake hold-off pressure) of the linear least squares equation best describing the measured torque output at each braked wheel as a function of measured line pressure applied at the same wheel. Only torque output values obtained from data collected when the vehicle deceleration is within the range of 0.15g to 0.80g are used in the regression analysis.

(c) Average the results of paragraph (b) of this section to calculate the average brake factor and brake hold-off pressure for all brake applications for the front axle.

(d) Average the results of paragraph (b) of this section to calculate the average brake factor and brake hold-off pressure for all brake applications for the rear axle.

(e) Using the relationship between front and rear brake line pressure determined in S7.4.3(i) and the tire rolling radius, calculate the braking force at each axle as a function of front brake line pressure.

(f) Calculate the braking ratio of the vehicle as a function of the front brake line pressure using the following equation:

$$z = \frac{T_1 + T_2}{P}$$

Where:
z = braking ratio at a given front line pressure;
T_1, T_2 = Braking forces at the front and rear axles, respectively, corresponding to the same front brake line pressure, and
P = total vehicle weight.

(g) Calculate the adhesion utilized at each axle as a function of braking ratio using the following equations:

$$f_1 = \frac{T_1}{P_1 + zhP/E}$$

$$f_2 = \frac{T_2}{P_2 - zhP/E}$$

Where:
f_i = adhesion utilized by axle i
T_i = braking force at axle i (from (e))
P_i = static weight on axle i
i = 1 for the front axle, or 2 for the rear axle
z = braking ratio (from (f))
h = height of center of gravity of the vehicle
P = total vehicle weight
E = wheelbase

(h) Plot f_1 and f_2 obtained in (g) as a function of z, for both GVWR and LLVW load conditions. These are the adhesion utilization curves for the vehicle, which are compared to the performance requirements in S7.4.5. shown graphically in Figure 2:

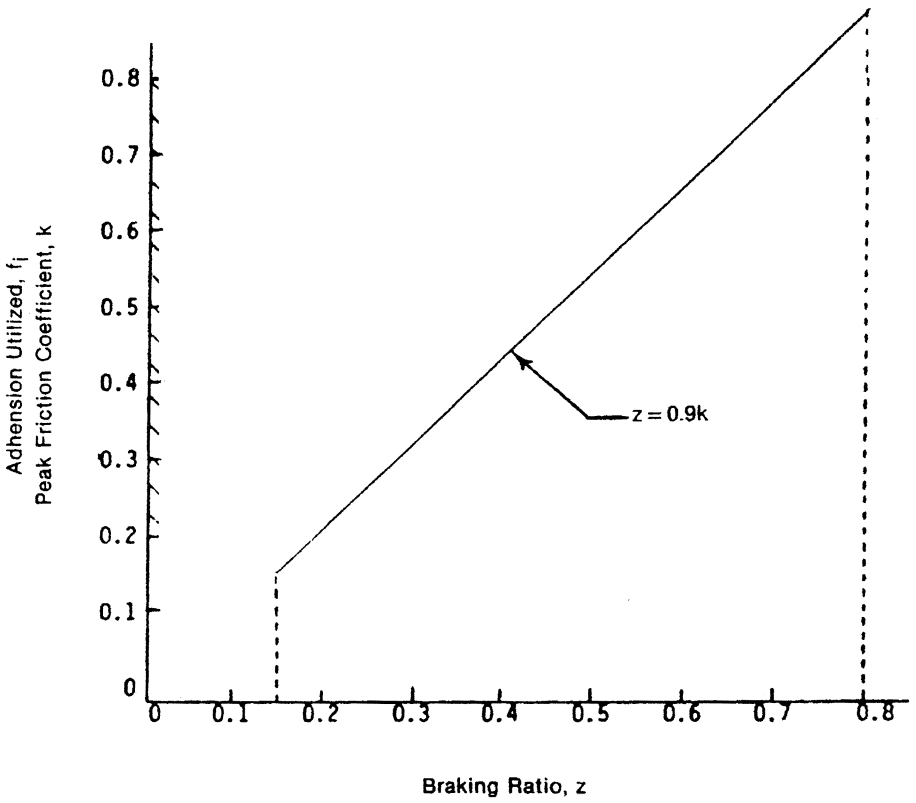


Figure 2–Adhesion Utilization Requirements

S7.4.5. *Performance requirements.* For all braking ratios between 0.15 and 0.80, each adhesion utilization curve for a rear axle shall be situated below a line defined by z = 0.9k where z is the braking ratio and k is the PFC.

S7.4.5.1 An EV with RBS that is part of the service brake system shall meet the performance requirement over the entire normal operating range of the RBS.

S7.5. *Cold effectiveness.*

S7.5.1. *Vehicle conditions.* (a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In neutral.

S7.5.2. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force: ≤65N (14.6 lbs), ≤500N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) For each stop, bring the vehicle to test speed and then stop the vehicle in the shortest possible distance under the specified conditions.

S7.5.3. *Performance requirements.* (a) Stopping distance for 100 km/h test speed: ≤70m (230 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0060V^2$.

S7.6. *High speed effectiveness.* This test is not run if vehicle maximum speed is less than or equal to 125 km/h (77.7 mph).

S7.6.1. *Vehicle conditions.* (a) Vehicle load: GVWR and LLVW.

(b) Transmission position: In gear.

S7.6.2. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 80% of vehicle maximum speed if 125 km/h (77.7 mph) <vehicle maximum speed <200 km/h (124.3 mph), or 160 km/h (99.4 mph) if vehicle maximum speed ≤200 km/h (124.3 mph).

(c) Pedal force: ≤65N (14.6 lbs), ≤500N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

S7.6.3. *Performance requirements.*

Stopping distance: $S \leq 0.10V + 0.0067V^2$.

S7.7. *Stops with Engine Off.*

S7.7.1. *General information.* This test is for vehicles equipped with one or more brake power units or brake power assist units. This test is also for EVs.

S7.7.2. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

(c) Vehicle engine: Off (not running).

(d) Ignition key position: May be returned to ''on'' position after turning engine off, or a device may be used to ''kill'' the engine while leaving the ignition key in the ''on'' position.

S7.7.3. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force: ≤65N (14.6 lbs), ≤500N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel allowed for longer than 0.1 seconds at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) All system reservoirs (brake power and/or assist units) are fully charged and the vehicle's engine is off (not running) at the beginning of each stop.

(h) For an EV, this test is conducted with no electrical power supplied to the vehicle's propulsion motor(s), but with the RBS and brake power or power assist still operating, unless cutting off the supply of electrical power to the propulsion motor(s) also disables those systems.

S7.7.4. *Performance requirements.* (a) Stopping distance for 100 km/h test speed: ≤70m (230 ft.)

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0060V^2$.

S7.8. *Antilock functional failure.*

S7.8.1. *Vehicle conditions.* (a) Vehicle loading: LLVW and GVWR.

(b) Transmission position: In neutral.

S7.8.2. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force: ≤65 N (14.6 lbs), ≤500 N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel for more than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) Functional failure simulation:

(1) Disconnect the functional power source, or any other electrical connector that creates a functional failure.

(2) Determine whether the brake system indicator is activated when any electrical functional failure of the antilock system is created.

(3) Restore the system to normal at the completion of this test.

(h) If more than one antilock brake subsystem is provided, repeat test for each subsystem.

S7.8.3. *Performance requirements.* For service brakes on a vehicle equipped with one or more antilock systems, in the event of any single functional failure in any such system, the service brake system shall continue to operate and shall stop the vehicle as specified in S7.8.3(a) or S7.8.3(b).

(a) Stopping distance for 100 km/h test speed: ≤85 m (279 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0075V^2$.

S7.9. *Variable brake proportioning system functional failure.*

S7.9.1. *Vehicle conditions.* (a) Vehicle load: LLVW and GVWR.

(b) Transmission position: In neutral.

S7.9.2. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force: ≤65 N (14.6 lbs), ≤500 N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) Functional failure simulation:

(1) Disconnect the functional power source or mechanical linkage to render the variable brake proportioning system inoperative.

(2) If the system utilizes electrical components, determine whether the brake system indicator is activated when any electrical functional failure of the variable proportioning system is created.

(3) Restore the system to normal at the completion of this test.

(h) If more than one variable brake proportioning subsystem is provided, repeat the test for each subsystem.

S7.9.3. *Performance requirements.* The service brakes on a vehicle equipped with one or more variable brake proportioning systems, in the event of any single functional failure in any such system, shall continue to operate and shall stop the vehicle as specified in S7.9.3(a) or S7.9.3(b).

(a) Stopping distance for 100 km/h test speed: ≤110 m (361 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0100V^2$.

S7.10. *Hydraulic circuit failure.*

S7.10.1. *General information.* This test is for vehicles manufactured with or without a split service brake system.

S7.10.2. *Vehicle conditions.* (a) Vehicle load: LLVW and GVWR.

(b) Transmission position: In neutral.

S7.10.3. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force: ≤65N (14.6 lbs), ≤500 N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Test surface: PFC of 1.02.

(f) Alter the service brake system to produce any single failure. For a hydraulic circuit, this may be any single rupture or leakage type failure, other than a structural failure of a housing that is common to two or more subsystems. For a vehicle in which the brake signal is transmitted electrically between the brake pedal and some or all of the foundation brakes, regardless of the means of actuation of the foundation brakes, this may be any single failure in any circuit that electrically transmits the brake signal. For an EV with RBS that is part of the service brake system, this may be any single failure in the RBS.

(g) Determine the control force pressure level or fluid level (as appropriate for the indicator being tested) necessary to activate the brake warning indicator.

(h) Number of runs: After the brake warning indicator has been activated, make the following stops depending on the type of brake system:

(1) 4 stops for a split service brake system.

(2) 10 consecutive stops for a non-split service brake system.

(i) Each stop is made by a continuous application of the service brake control.

(j) Restore the service brake system to normal at the completion of this test.

(k) Repeat the entire sequence for each of the other subsystems.

S7.10.4 *Performance requirements.* For vehicles manufactured with a split service brake system, in the event of any failure in a single subsystem, as specified in S7.10.3(f) of this standard, and after activation of the brake system indicator as specified in S5.5.1, the remaining portions of the service brake system shall continue to operate and shall stop the vehicle as specified in S7.10.4(a) or S7.10.4(b). For vehicles not manufactured with a split service brake system, in the event of any failure in any component of the service brake system, as specified in S7.10.3(f), and after activation of the brake system indicator as specified in S5.5.1 of this standard, the vehicle shall, by operation of the service brake control, stop 10 times consecutively as specified in S7.10.4(a) or S7.10.4(b).

(a) Stopping distance from 100 km/h test speed: ≤168 m (551 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0158V^2$.

S7.11. *Brake power unit or brake power assist unit inoperative (System depleted).*

S7.11.1. *General information.* This test is for vehicles equipped with one or more brake power units or brake power assist units.

S7.11.2. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

S7.11.3. *Test conditions and procedures.* (a) IBT: ≤65 °C (149 °F), ≤100 °C (212 °F).

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force: ≤65 N (14.6 lbs), ≤500 N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 6 stops.

(f) Test surface: PFC of 1.02.

(g) Disconnect the primary source of power for one brake power assist unit or brake power unit, or one of the brake power unit or brake power assist unit subsystems if two or more subsystems are provided.

(h) If the brake power unit or power assist unit operates in conjunction with a backup system and the backup system is automatically activated in the event of a primary power service failure, the backup system is operative during this test.

(i) Exhaust any residual brake power reserve capability of the disconnected system.

(j) Make each of the 6 stops by a continuous application of the service brake control.

(k) Restore the system to normal at completion of this test.

(l) For vehicles equipped with more than one brake power unit or brake power assist unit, conduct tests for each in turn.

(m) For vehicles with electrically-actuated service brakes (brake power unit), this test is conducted with any single electrical failure in the electrically-actuated service brakes instead of a failure of any other brake power or brake power assist unit, and all other systems intact.

S7.11.4. *Performance requirements.* The service brakes on a vehicle equipped with one or more brake power assist units or brake power units, with one such unit inoperative and depleted of all reserve capability, shall stop the vehicle as specified in S7.11.4(a) or S7.11.4(b).

(a) Stopping distance from 100 km/h test speed: ≤168 m (551 ft).

(b) Stopping distance for reduced test speed: $S \leq 0.10V + 0.0158V^2$.

S7.12. *Parking brake.*

S7.12.1. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

(c) Parking brake burnish:

(1) For vehicles with parking brake systems not utilizing the service friction elements, the friction elements of such a system are burnished prior to the parking brake test according to the published recommendations furnished to the purchaser by the manufacturer.

(2) If no recommendations are furnished, the vehicle's parking brake system is tested in an unburnished condition.

(d) Parking brake applications: 1 application and up to 2 reapplications, if necessary.

S7.12.2. *Test conditions and procedures.* (a) IBT:

(1) Parking brake systems utilizing service brake friction materials shall be tested with the IBT ≤100 °C (212 °F) and shall have no additional burnishing or artificial heating prior to the start of the parking brake test.

(2) Parking brake systems utilizing non-service brake friction materials shall be tested with the friction materials at ambient temperature at the start of the test. The friction materials shall have no additional burnishing or artificial heating prior to or during the parking brake test.

(b) Parking brake control force: Hand control ≤400 N (89.9 lbs); foot control ≤500 N (112.4 lbs).

(c) Hand force measurement locations: The force required for actuation of a hand-operated brake system is measured at the center of the hand grip area or at a distance of 40 mm (1.57 in) from the end of the actuation lever as illustrated in Figure 3.

(d) Parking brake applications: 1 application and up to 2 reapplications, if necessary.

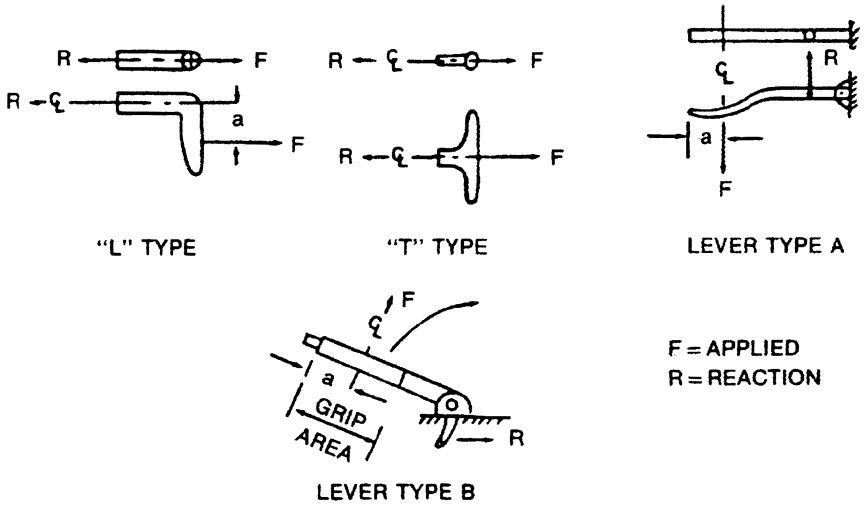


Figure 3–Location for Measuring Brake Application Force (Hand Brake)

(e) Test surface gradient: 20% grade.

(f) Drive the vehicle onto the grade with the longitudinal axis of the vehicle in the direction of the slope of the grade.

(g) Stop the vehicle and hold it stationary by applying the service brake control and place the transmission in neutral.

(h) With the service brake applied sufficiently to just keep the vehicle from rolling, apply the parking brake as specified in S7.12.2(i) or S7.12.2(j).

(i) For a vehicle equipped with mechanically-applied parking brakes, make a single application of the parking brake control with a force not exceeding the limits specified in S7.12.2(b). For a vehicle using an electrically-activated parking brake, apply the parking brake by activating the parking brake control.

(j) In the case of a parking brake system that does not allow application of the specified force in a single application, a series of applications may be made to achieve the specified force.

(k) Following the application of the parking brakes, release all force on the service brake control and, if the vehicle remains stationary, start the measurement of time.

(l) If the vehicle does not remain stationary, reapplication of a force to the parking brake control at the level specified in S7.12.2(b) as appropriate for the vehicle being tested (without release of the ratcheting or other holding mechanism of the parking brake) is used up to two times to attain a stationary position.

(m) Verify the operation of the parking brake application indicator.

(n) Following observation of the vehicle in a stationary condition for the specified time in one direction, repeat

the same test procedure with the vehicle orientation in the opposite direction on the same grade.

S7.12.3. *Performance requirement.* The parking brake system shall hold the vehicle stationary for 5 minutes in both a forward and reverse direction on the grade.

S7.13. *Heating Snubs.*

S7.13.1. *General information.* The purpose of the snubs is to heat up the brakes in preparation for the hot performance test which follows immediately.

S7.13.2. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In gear.

S7.13.3. *Test conditions and procedures.* (a) IBT:

(1) Establish an IBT before the first brake application (snub) of ≤55 °C (131 °F), ≤65 °C (149 °F).

(2) IBT before subsequent snubs are those occurring at the distance intervals.

(b) Number of snubs: 15.

(c) Test speeds: The initial speed for each snub is 120 km/h (74.6 mph) or 80% of Vmax, whichever is slower. Each snub is terminated at one-half the initial speed.

(d) Deceleration rate:

(1) Maintain a constant deceleration rate of 3.0 m/s^2 (9.8 fps^2).

(2) Attain the specified deceleration within one second and maintain it for the remainder of the snub.

(e) Pedal force: Adjust as necessary to maintain the specified constant deceleration rate.

(f) Time interval: Maintain an interval of 45 seconds between the start of brake applications (snubs).

(g) Accelerate as rapidly as possible to the initial test speed immediately after each snub.

(h) Immediately after the 15th snub, accelerate to 100 km/h (62.1 mph) and commence the hot performance test.

S7.14. *Hot performance.*

S7.14.1. *General information.* The hot performance test is conducted immediately after completion of the 15th heating snub.

S7.14.2. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

S7.14.3. *Test conditions and procedures.* (a) IBT: Temperature achieved at completion of heating snubs.

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force:

(1) The first stop is done with an average pedal force not greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop.

(2) The second stop is done with a pedal force not greater than 500 N (112.4 lbs).

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 2 stops.

(f) Immediately after the 15th heating snub, accelerate to 100 km/h (62.1 mph) and commence the first stop of the hot performance test.

(g) If the vehicle is incapable of attaining 100 km/h, it is tested at the same speed used for the GVWR cold effectiveness test.

(h) Immediately after completion of the first hot performance stop, accelerate as rapidly as possible to the specified test speed and conduct the second hot performance stop.

(i) Immediately after completion of the second hot performance stop, drive 1.5 km (0.93 mi) at 50 km/h (31.1 mph) before the first cooling stop.

S7.14.4. *Performance requirements.* (a) For the first hot stop, the stopping distance must be less than or equal to a calculated distance which is based on 60 percent of the deceleration actually achieved on the shortest GVWR cold effectiveness stop. The following equations shall be used in calculating the performance requirement:

$$d_c = \frac{0.0386V^2}{S_c - 0.10V}$$

$$S = 0.10V + \frac{0.0386V^2}{0.60(d_c)}$$

Where:

d_c = the average deceleration actually achieved during the shortest cold effectiveness stop at GVWR (m/s^2),

S_c = actual stopping distance measured on the shortest cold effectiveness stop at GVWR (m), and

V = cold effectiveness test speed (km/h).

(b) In addition to the requirement in S7.14.4(a), the stopping distance for at least one of the two hot stops must be S ≤89 m (292 ft) from a test speed of 100 km/h (62.1 mph) or, for reduced test speed, S ≤0.10V + 0.0079V^2. The results of the second stop may not be used to meet the requirements of S7.14.4(a).

S7.15. *Brake cooling stops.*

S7.15.1. *General information.* The cooling stops are conducted immediately after completion of the hot performance test.

S7.15.2. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In gear.

S7.15.3. *Test conditions and procedures.* (a) IBT: Temperature achieved at completion of hot performance.

(b) Test speed: 50 km/h (31.1 mph).

(c) Pedal force: Adjust as necessary to maintain specified constant deceleration rate.

(d) Deceleration rate: Maintain a constant deceleration rate of 3.0 m/s^2 (9.8 fps^2).

(e) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(f) Number of runs: 4 stops.

(g) Immediately after the hot performance stops drive 1.5 km (0.93 mi) at 50 km/h (31.1 mph) before the first cooling stop.

(h) For the first through the third cooling stops:

(1) After each stop, immediately accelerate at the maximum rate to 50 km/h (31.1 mph).

(2) Maintain that speed until beginning the next stop at a distance of 1.5 km (0.93 mi) from the beginning of the previous stop.

(i) For the fourth cooling stop:

(1) Immediately after the fourth stop, accelerate at the maximum rate to 100 km/h (62.1 mph).

(2) Maintain that speed until beginning the recovery performance stops at a distance of 1.5 km (0.93 mi) after the beginning of the fourth cooling stop.

S7.16. *Recovery performance.*

S7.16.1. *General information.* The recovery performance test is conducted immediately after completion of the brake cooling stops.

S7.16.2. *Vehicle conditions.* (a) Vehicle load: GVWR only.

(b) Transmission position: In neutral.

S7.16.3. *Test conditions and procedures.* (a) IBT: Temperature achieved at completion of cooling stops.

(b) Test speed: 100 km/h (62.1 mph).

(c) Pedal force: The average pedal force shall not be greater than the average pedal force recorded during the shortest GVWR cold effectiveness stop.

(d) Wheel lockup: No lockup of any wheel for longer than 0.1 seconds allowed at speeds greater than 15 km/h (9.3 mph).

(e) Number of runs: 2 stops.

(f) Immediately after the fourth cooling stop, accelerate at the maximum rate to 100 km/h (62.1 mph).

(g) Maintain that speed until beginning the first recovery performance stop at a distance of 1.5 km (0.93 mi) after the beginning of the fourth cooling stop.

(h) If the vehicle is incapable of attaining 100 km/h, it is tested at the same speed used for the GVWR cold effectiveness test.

(i) Immediately after completion of the first recovery performance stop accelerate as rapidly as possible to the specified test speed and conduct the second recovery performance stop.

S7.16.4. *Performance requirements.*

The stopping distance, S, for at least one of the two stops must be within the following limits:

$$\frac{0.0386V^2}{1.50d_c} \leq S - 0.10V \leq \frac{0.0386V^2}{0.70d_c}$$

where d_c and V are defined in S7.14.4(a).

S7.17. *Final Inspection.* Inspect:

(a) The service brake system for detachment or fracture of any components, such as brake springs and brake shoes or disc pad facings.

(b) The friction surface of the brake, the master cylinder or brake power unit reservoir cover, and seal and filler openings, for leakage of brake fluid or lubricant.

(c) The master cylinder or brake power unit reservoir for compliance with the volume and labeling requirements of S5.4.2 and S5.4.3. In determining the fully applied worn condition, assume that the lining is worn to (1) rivet or bolt heads on riveted or bolted linings or (2) within 0.8 mm (1/32

inch) of shoe or pad mounting surface on bonded linings or (3) the limit recommended by the manufacturer, whichever is larger relative to the total possible shoe or pad movement. Drums or rotors are assumed to be at nominal design drum diameter or rotor thickness. Linings are assumed adjusted for normal operating clearance in the released position.

(d) The brake system indicators, for compliance with operation in various key positions, lens color, labeling, and location, in accordance with S5.5.

[60 FR 6434, Feb. 2, 1995, as amended at 60 FR 37847, July 24, 1995; 60 FR 44548, Aug. 28, 1995; 62 FR 46917, Sept. 5, 1997; 62 FR 51070, Sept. 30, 1997; 65 FR 6332, Feb. 9, 2000; 70 FR 37713, June 30, 2005; 77 FR 760, Jan. 6, 2012; 86 FR 1300, Jan. 8, 2021; 87 FR 34810, June 8, 2022]

§571.136 Standard No. 136; Electronic stability control systems for heavy vehicles.

S1 *Scope.* This standard establishes performance and equipment requirements for electronic stability control (ESC) systems on heavy vehicles.

S2 *Purpose.* The purpose of this standard is to reduce crashes caused by rollover or by directional loss-of-control.

S3 *Application.* This standard applies to the following vehicles:

S3.1 Truck tractors with a gross vehicle weight rating of greater than 11,793 kilograms (26,000 pounds). However, it does not apply to:

(a) Any truck tractor equipped with an axle that has a gross axle weight rating of 13,154 kilograms (29,000 pounds) or more;

(b) Any truck tractor that has a speed attainable in 3.2 km (2 miles) of not more than 53 km/h (33 mph); and

(c) Any truck tractor that has a speed attainable in 3.2 km (2 miles) of not more than 72 km/h (45 mph), an unloaded vehicle weight that is not less than 95 percent of its gross vehicle weight rating, and no capacity to carry occupants other than the driver and operating crew.

S3.2 Buses with a gross vehicle weight rating of greater than 11,793 kilograms (26,000 pounds). However, it does not apply to

(a) School buses;

(b) Perimeter-seating buses;

(c) Transit buses;

(d) Any bus equipped with an axle that has a gross axle weight rating of 13,154 kilograms (29,000 pounds) or more; and

(e) Any bus that has a speed attainable in 3.2 km (2 miles) of not more than 53 km/h (33 mph.)

S4 *Definitions.*

Ackerman Steer Angle means the angle whose tangent is the wheelbase divided by the radius of the turn at a very low speed.

Electronic stability control system or *ESC system* means a system that has all of the following attributes:

(1) It augments vehicle directional stability by having the means to apply and adjust the vehicle brake torques individually at each wheel position on at least one front and at least one rear axle of the truck tractor or bus to induce correcting yaw moment to limit vehicle oversteer and to limit vehicle understeer;

(2) It enhances rollover stability by having the means to apply and adjust the vehicle brake torques individually at each wheel position on at least one front and at least one rear axle of the truck tractor or bus to reduce lateral acceleration of a vehicle;

(3) It is computer-controlled with the computer using a closed-loop algorithm to induce correcting yaw moment and enhance rollover stability;

(4) It has a means to determine the vehicle's lateral acceleration;

(5) It has a means to determine the vehicle's yaw rate and to estimate its side slip or side slip derivative with respect to time;

(6) It has a means to estimate vehicle mass or, if applicable, combination vehicle mass;

(7) It has a means to monitor driver steering inputs;

(8) It has a means to modify engine torque, as necessary, to assist the driver in maintaining control of the vehicle and/or combination vehicle; and

(9) When installed on a truck tractor, it has the means to provide brake pressure to automatically apply and modulate the brake torques of a towed trailer.

ESC service brake application means the time when the ESC system applies a service brake pressure at any wheel for a continuous duration of at least 0.5

second of at least 34 kPa (5 psi) for air-braked systems and at least 172 kPa (25 psi) for hydraulic-braked systems.

Initial brake temperature means the average temperature of the service brakes on the hottest axle of the vehicle immediately before any stability control system test maneuver is executed.

Lateral acceleration means the component of the vector acceleration of a point in the vehicle perpendicular to the vehicle x-axis (longitudinal) and parallel to the road plane.

Oversteer means a condition in which the vehicle's yaw rate is greater than the yaw rate that would occur at the vehicle's speed as result of the Ackerman Steer Angle.

Over-the-road bus means a bus characterized by an elevated passenger deck located over a baggage compartment, except a school bus.

Peak friction coefficient or *PFC* means the ratio of the maximum value of braking test wheel longitudinal force to the simultaneous vertical force occurring prior to wheel lockup, as the braking torque is progressively increased.

Perimeter-seating bus means a bus with 7 or fewer designated seating positions rearward of the driver's seating position that are forward-facing or can convert to forward-facing without the use of tools and is not an over-the-road bus.

Side slip or side slip angle means the arctangent of the lateral velocity of the center of gravity of the vehicle divided by the longitudinal velocity of the center of gravity.

Snub means the braking deceleration of a vehicle from a higher speed to a lower speed that is greater than zero.

Stop-request system means a vehicle-integrated system for passenger use to signal to a vehicle operator that they are requesting a stop.

Tandem axle means a group or set of two or more axles placed in close arrangement, one behind the other, with the centerlines of adjacent axles not more than 72 inches apart.

Transit bus means a bus that is equipped with a stop-request system sold for public transportation provided by, or on behalf of, a State or local government and that is not an over-the-road bus.

Understeer means a condition in which the vehicle's yaw rate is less than the yaw rate that would occur at the vehicle's speed as result of the Ackerman Steer Angle.

Wheelbase means the longitudinal distance between the center of the front axle and the center of the rear axle. For vehicles with tandem axles, the center of the axle is the midpoint between the centers of the most forward and most rearward tandem axles, measured when all liftable axles are in the lowered position.

Yaw Rate means the rate of change of the vehicle's heading angle measure in degrees per second of rotation about a vertical axis through the vehicle's center of gravity.

S5 *Requirements.* Each vehicle must be equipped with an ESC system that meets the requirements specified in S5 under the test conditions specified in S6 and the test procedures specified in S7 of this standard.

S5.1 *Required Equipment.* Each vehicle to which this standard applies must be equipped with an electronic stability control system, as defined in S4.

S5.2 *System Operational Capabilities.*

S5.2.1 The ESC system must be operational over the full speed range of the vehicle except at vehicle speeds less than 20 km/h (12.4 mph), when being driven in reverse, or during system initialization.

S5.2.2 The ESC must remain capable of activation even if the antilock brake system or traction control is also activated.

S5.3 *Performance Requirements.*

S5.3.1 *Lane Keeping During Reference Speed Determination.* During each series of four consecutive test runs conducted at the same entrance speed as part of the test procedure to determine the Preliminary Reference Speed and the Reference Speed (see S7.7.1), the wheels of the truck tractor or bus must remain within the lane between the start gate (0 degrees of radius arc angle) and the end gate (120 degrees of radius arc angle) during at least two of the four test runs.

S5.3.2 *Engine Torque Reduction.* During each series of four consecutive test runs for the determination of engine

torque reduction (see S7.7.2), the vehicle must satisfy the criteria of S5.3.2.1 and S5.3.2.2 during at least two of the four test runs.

S5.3.2.1 The ESC system must reduce the driver-requested engine torque by at least 10 percent for a minimum continuous duration of 0.5 second during the time period from 1.5 seconds after the vehicle crosses the start gate (0 degree of radius arc angle) to when it crosses the end gate (120 degrees of radius arc angle).

S5.3.2.2 The wheels of the truck tractor or bus must remain within the lane between the start gate (0 degrees of radius arc angle) and the end gate (120 degrees of radius arc angle).

S5.3.3 *Roll Stability Control Test.* During each series of eight consecutive test runs for the determination of roll stability control (see S7.7.3) conducted at the same entrance speed, the vehicle must satisfy the criteria of S5.3.3.1, S5.3.3.2, S5.3.3.3, and S5.3.3.4 during at least six of the eight consecutive test runs.

S5.3.3.1 The vehicle speed measured at 3.0 seconds after vehicle crosses the start gate (0 degrees of radius arc angle) must not exceed 47 km/h (29 mph).

S5.3.3.2 The vehicle speed measured at 4.0 seconds after vehicle crosses the start gate (0 degrees of radius arc angle) must not exceed 45 km/h (28 mph).

S5.3.3.3 The wheels of the truck tractor or bus must remain within the lane between the start gate (0 degrees of radius arc angle) and the end gate (120 degrees of radius arc angle).

S5.3.3.4 There must be ESC service brake activation.

S5.4 *ESC Malfunction Detection.* Each vehicle must be equipped with an indicator lamp, mounted in front of and in clear view of the driver, which is activated whenever there is a malfunction that affects the generation or transmission of control or response signals in the vehicle's electronic stability control system.

S5.4.1 Except as provided in S5.4.3 and S5.4.6, the ESC malfunction telltale must illuminate only when a malfunction exists and must remain continuously illuminated for as long as the malfunction exists, whenever the ignition locking system is in the ''On'' (''Run'') position.

S5.4.2 The ESC malfunction telltale must be identified by the symbol shown for ''Electronic Stability Control System Malfunction'' or the specified words or abbreviations listed in Table 1 of Standard No. 101 (§571.101).

S5.4.3 The ESC malfunction telltale must be activated as a check-of-lamp function either when the ignition locking system is turned to the ''On'' (''Run'') position when the engine is not running, or when the ignition locking system is in a position between the ''On'' (''Run'') and ''Start'' that is designated by the manufacturer as a check-light position.

S5.4.4 The ESC malfunction telltale need not be activated when a starter interlock is in operation.

S5.4.5 The ESC malfunction telltale lamp must extinguish at the next ignition cycle after the malfunction has been corrected.

S5.4.6 The manufacturer may use the ESC malfunction telltale in a flashing mode to indicate ESC operation.

S6 *Test Conditions.* The requirements of S5 must be met by a vehicle when it is tested according to the conditions set forth in the S6, without replacing any brake system part or making any adjustments to the ESC system except as specified. On vehicles equipped with automatic brake adjusters, the automatic brake adjusters will remain activated at all times.

S6.1 *Ambient Conditions.*

S6.1.1 The ambient temperature is any temperature between 2 °C (35 °F) and 40 °C (104 °F).

S6.1.2 The maximum wind speed is no greater than 5 m/s (11 mph).

S6.2 *Road Test Surface.*

S6.2.1 The tests are conducted on a dry, uniform, solid-paved surface. Surfaces with irregularities and undulations, such as dips and large cracks, are unsuitable.

S6.2.2 The road test surface produces a peak friction coefficient (PFC) of 1.02 when measured using an ASTM F2493 standard reference test tire, in accordance with ASTM E1337–19, at a speed of 64.4 km/h (40 mph), without water delivery (incorporated by reference, see §571.5).

S6.2.3 The test surface has a consistent slope between 0% and 1%.

S6.2.4 *J-Turn Test Maneuver Test Course.* The test course for the J-Turn test maneuver is used for the Reference Speed Test in S7.7.1, the Engine Torque Reduction Test in S7.7.2, and the Roll Stability Control Test in S7.7.3.

S6.2.4.1 The test course consists of a straight entrance lane with a length of 22.9 meters (75 feet) tangentially connected to a curved lane section with a radius of 45.7 meters (150 feet) measured from the center of the lane.

S6.2.4.2 For truck tractors, the lane width of the test course is 3.7 meters (12 feet). At the manufacturer's option, for truck tractors with a wheelbase equal to or greater than 7112 mm (280 inches) the lane width of the test course is 3.7 meters (12 feet) for the straight section and is 4.3 meters (14 feet) for the curved section. For buses, the lane width of the test course is 3.7 meters (12 feet) for the straight section and is 4.3 meters (14 feet) for the curved section.

S6.2.4.3 The start gate is the tangent point on the radius (the intersection of the straight lane and the curved lane sections) and is designated as zero degrees of radius of arc angle. The end gate is the point on the radius that is 120 degrees of radius arc angle measured from the tangent point.

S6.2.4.4 Figure 1 shows the test course with the curved lane section configured in the counter-clockwise steering direction relative to the entrance lane. The course is also arranged with the curved lane section configured in the clockwise steering direction relative to the entrance lane. The cones depicted in Figure 1 defining the lane width are positioned solely for illustrative purposes.

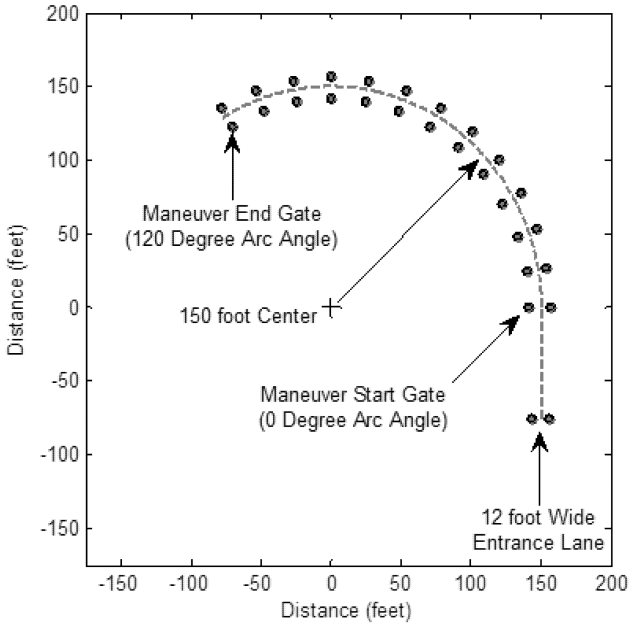


Figure 1. J-Turn Test Maneuver Course (shown with the curved lane section in the counter-clockwise direction)

S6.3 *Vehicle Conditions.*

S6.3.1 The ESC system is enabled for all testing, except for the ESC malfunction test (see S7.8).

S6.3.2 All vehicle openings (doors, windows, hood, trunk, cargo doors, etc.) are in a closed position except as required for instrumentation purposes.

S6.3.3 *Test Weight.*

S6.3.3.1 *Truck Tractors.* A truck tractor is loaded to its GVWR by coupling it to a control trailer (see S6.3.5). The tractor is loaded with the test driver, test instrumentation, and an anti-jackknife system (see S6.3.8).

S6.3.3.2 *Buses.* A bus is loaded with ballast (weight) to its GVWR to simulate a multi-passenger and baggage configuration. For this configuration the bus is loaded with test driver, test instrumentation, outriggers (see S6.3.6), ballast, and a simulated occupant in each of the vehicle's designated seating positions. The simulated occupant loads are attained by securing 68 kilograms (150 pounds) of ballast in each of the test vehicle's designated seating positions. If the simulated occupant loads result in the bus being loaded to less than its GVWR, additional ballast is added to the bus in the following manner until the bus is loaded to its GVWR without exceeding any axle's GAWR: First, ballast is added to the lowest baggage compartment; second, ballast is added to the floor of the passenger compartment. If the simulated occupant loads result in the GAWR of any axle being exceeded or the GVWR of the bus being exceeded, simulated occupant loads are removed until the vehicle's GVWR and all axles' GAWR are no longer exceeded.

S6.3.4 *Transmission and Brake Controls.* The transmission selector control is in a forward gear during all maneuvers. A vehicle equipped with an engine braking system that is engaged and disengaged by the driver is tested with the system disengaged.

S6.3.5 *Control Trailer.*

S6.3.5.1 The control trailer is an unbraked, flatbed semi-trailer that has a single axle with a GAWR of 8,165 kg (18,000 lb.). The control trailer has a length of at least 6,400 mm (252 inches), but no more than 7,010 mm (276 inches), when measured from the transverse centerline of the axle to the centerline of the kingpin (the point where the trailer attaches to the truck tractor). At the manufacturer's option, truck tractors with four or more axles may use a control trailer with a length of more than 7,010 mm (276 inches), but no more than 13,208 mm (520 inches) when measured from the transverse centerline of the axle to the centerline of the kingpin.

S6.3.5.2 The location of the center of gravity of the ballast on the control trailer is directly above the kingpin. The height of the center of gravity of the ballast on the control trailer is less than 610 mm (24 inches) above the top of the tractor's fifth-wheel hitch (the area where the truck tractor attaches to the trailer).

S6.3.5.3 The control trailer is equipped with outriggers (see S6.3.6).

S6.3.5.4 A truck tractor is loaded to its GVWR by placing ballast (weight) on the control trailer which loads the tractor's non-steer axles. The control trailer is loaded with ballast without exceeding the GAWR of the trailer axle. If the tractor's fifth-wheel hitch position is adjustable, the fifth-wheel hitch is adjusted to proportionally distribute the load on each of the tractor's axle(s), according to each axle's GAWR, without exceeding the GAWR of any axle(s). If the fifth-wheel hitch position cannot be adjusted to prevent the load from exceeding the GAWR of the tractor's axle(s), the ballast is reduced until the axle load is equal to or less than the GAWR of the tractor's rear axle(s), maintaining load proportioning as close as possible to specified proportioning.

S6.3.6 *Outriggers.* Outriggers are used for testing each vehicle. The outriggers are designed with a maximum weight of 1,134 kg (2,500 lb.), excluding mounting fixtures.

S6.3.7 *Tires.* The tires are inflated to the vehicle manufacturer's specified pressure for the GVWR of the vehicle.

S6.3.8 *Truck Tractor Anti-Jackknife System.* A truck tractor is equipped with an anti-jackknife system that allows a minimum articulation angle of 30 degrees between the tractor and the control trailer.

S6.3.9 *Special Drive Conditions.* A vehicle equipped with an interlocking axle system or a front wheel drive system

that is engaged and disengaged by the driver is tested with the system disengaged.

S6.3.10 *Liftable Axles.* A vehicle with one or more liftable axles is tested with the liftable axles down.

S6.3.11 *Initial Brake Temperature.* The initial brake temperature of the hottest brake for any performance test is between 66 °C (150 °F) and 204 °C (400 °F).

S6.3.12 *Thermocouples.* The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the rubbing surface of a drum or rotor. The second thermocouple is installed at a depth of 0.080 inch and located within 1.0 inch circumferentially of the thermocouple installed at 0.040 inch depth. For center-grooved shoes or pads, thermocouples are installed within 0.125 inch to 0.250 inch of the groove and as close to the center as possible.

S6.4 *Selection of Compliance Options.* Where manufacturer options are specified, the manufacturer must select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S7 *Test Procedure.* S7.1 *Tire Inflation.* Inflate the vehicle's tires as specified in S6.3.7.

S7.2 *Telltale Lamp Check.* With the vehicle stationary and the ignition locking system in the ''Lock'' or ''Off'' position, activate the ignition locking system to the ''On'' (''Run'') position or, where applicable, the appropriate position for the lamp check. The ESC system must perform a check-of-lamp function for the ESC malfunction telltale, as specified in S5.4.3.

S7.3 *Tire Conditioning.* Condition the tires to wear away mold sheen and achieve operating temperature immediately before beginning the J-Turn test runs. The test vehicle is driven around a circle 150 feet (46 meters) in radius at a speed that produces a lateral acceleration of approximately 0.1g for two clockwise laps followed by two counterclockwise laps.

S7.4 *Brake Conditioning and Temperature.* Conditioning and warm-up of the vehicle brakes are completed before and monitored during the execution of the J-Turn test maneuver.

S7.4.1 *Brake Conditioning.* Condition the brakes in accordance with S7.4.1.1 and S7.4.1.2.

S7.4.1.1 Prior to executing the J-Turn test maneuver, the vehicle's brakes are burnished as follows: With the transmission in the highest gear appropriate for a speed of 64 km/h (40 mph), make 500 snubs between 64 km/h (40 mph) and 32 km/h (20 mph) at a deceleration rate of 0.3g, or at the vehicle's maximum deceleration rate if less than 0.3g. After each brake application accelerate to 64 km/h (40 mph) and maintain that speed until making the next brake application at a point 1.6 km (1.0 mile) from the initial point of the previous brake application. If the vehicle cannot attain a speed of 64 km/h (40 mph) in 1.6 km (1.0 mile), continue to accelerate until the vehicle reaches 64 km/h (40 mph) or until the vehicle has traveled 2.4 km (1.5 miles) from the initial point of the previous brake application, whichever occurs first. The brakes may be adjusted up to three times during the burnish procedure, at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing, in accordance with the vehicle manufacturer's recommendation.

S7.4.1.2 Prior to executing the performance tests in S7.7, the brakes are conditioned using 40 brake application snubs from a speed of 64 km/h (40 mph) to a speed of 32 km/h (20 mph), with a target deceleration of approximately 0.3g. After each brake application, accelerate to 64 km/h (40 mph) and maintain that speed until making the next brake application at a point 1.6 km (1.0 mile) from the initial point of the previous brake application.

S7.4.2 *Brake Temperature.* Prior to testing or any time during testing, if the hottest brake temperature is above

204 °C (400 °F) a cool down period is performed until the hottest brake temperature is measured within the range of 66 °C–204 °C (150 °F–400 °F). Prior to testing or any time during testing, if the hottest brake temperature is below 66 °C (150 °F) individual brake stops are repeated to increase any one brake temperature to within the target temperature range of 66 °C–204 °C (150 °F–400 °F) before a test maneuver is performed.

S7.5 *Mass Estimation Cycle.* Perform the mass estimation procedure for the ESC system according to the manufacturer's instructions. This procedure will be repeated if an ignition cycle occurs or is needed at any time between the initiation and completion of S7.7.

S7.6 *ESC System Malfunction Check.* Check that the ESC system is enabled by ensuring that the ESC malfunction telltale is not illuminated.

S7.7 *J-Turn Test Maneuver.* The truck tractor or bus is subjected to multiple series of test runs using the J-Turn test maneuver. The truck tractor or bus travels through the course by driving down the entrance lane, crossing the start gate at the designated entrance speed, turning through the curved lane section, and crossing the end gate, while the driver attempts to keep all of the wheels of the truck tractor or bus within the lane.

S7.7.1 *Reference Speed Test.* The vehicle is subjected to J-Turn test maneuvers to determine the Reference Speed for each steering direction. The Reference Speeds are used in S7.7.2 and S7.7.3.

S7.7.1.1 *Preliminary Reference Speed Determination.* The vehicle is subjected to two series of test runs using the J-Turn test maneuver at increasing entrance speeds. One series uses clockwise steering, and the other series uses counterclockwise steering. The entrance speed of a test run is the 0.5 second average of the raw speed data prior to any ESC system activation of the service brakes and rounded to the nearest 1.0 mph. During each test run, the driver attempts to maintain the selected entrance speed throughout the J-Turn test maneuver. For the first test run of each series, the entrance speed is 32 km/h ±1.6 km/h (20 mph ±1.0 mph) and is incremented 1.6 km/h (1.0 mph) for each subsequent test run until ESC service brake application occurs or any of the truck tractor's or bus's wheels departs the lane. The vehicle entrance speed at which ESC service brake application occurs is the Preliminary Reference Speed. The Preliminary Reference Speed is determined for each direction: Clockwise steering and counter-clockwise steering. During any test run, if any of the wheels of the truck tractor or bus depart the lane at any point within the first 120 degrees of radius arc angle, the test run is repeated at the same entrance speed. If any of the wheels of the truck tractor or bus depart the lane again, then four consecutive test runs are repeated at the same entrance speed (±1.6 km/h (±1.0 mph)).

S7.7.1.2 *Reference Speed Determination.* Using the Preliminary Reference Speed determined in S7.7.1.1, perform two series of test runs using the J-Turn test maneuver to determine the Reference Speed. The first series consists of four consecutive test runs performed using counter-clockwise steering. The second series consists of four consecutive test runs performed using clockwise steering. During each test run, the driver attempts to maintain a speed equal to the Preliminary Reference Speed throughout the J-Turn test maneuver. The Reference Speed is the minimum entrance speed at which ESC service brake application occurs for at least two of four consecutive test runs of each series conducted at the same entrance speed (within ±1.6 km/h (±1.0 mph)). The Reference Speed is determined for each direction: clockwise steering and counter-clockwise steering. If ESC service brake application does not occur during at least two test runs of either series, the Preliminary Reference Speed is increased by 1.6 km/h (1.0 mph), and the procedure in this section is repeated.

S7.7.2 *Engine Torque Reduction Test.* The vehicle is subjected to two series of test runs using the J-Turn test maneuver at an entrance speed equal to the Reference Speed determined in S7.7.1.2. One series uses clockwise steering, and the other series uses counter-clockwise steering. Each series consists of four test runs with the vehicle at an entrance speed equal to the

Reference Speed and the driver fully depressing the accelerator pedal from the time when the vehicle crosses the start gate until the vehicle reaches the end gate. ESC engine torque reduction is confirmed by comparing the engine torque output and driver requested torque data collected from the vehicle communication network or CAN bus. During the initial stages of each maneuver the two torque signals with respect to time will parallel each other. Upon ESC engine torque reduction, the two signals will diverge when the ESC system causes a commanded engine torque reduction and the driver depresses the accelerator pedal attempting to accelerate the vehicle.

S7.7.2.1 Perform two series of test runs using the J-Turn test maneuver at the Reference Speed determined in S7.7.1.2 (±1.6 km/h (±1.0 mph)). The first series consists of four consecutive test runs performed using counter-clockwise steering. The second series consists of four consecutive test runs performed using clockwise steering. During each test run, the driver fully depresses the accelerator pedal from the time when the vehicle crosses the start gate until the vehicle reaches the end gate.

S7.7.2.2 During each of the engine torque reduction test runs, verify the commanded engine torque and the driver requested torque signals diverge according to the criteria specified in S5.3.2.1.

S7.7.3 *Roll Stability Control Test.* The vehicle is subjected to multiple series of test runs using the J-Turn test maneuver in both the clockwise and the counter-clockwise direction.

S7.7.3.1 Before each test run, the brake temperatures are monitored and the hottest brake is confirmed to be between 66 °C (150 °F) and 204 °C (400 °F). If the hottest brake temperature is not between 66 °C (150 °F) and 204 °C (400 °F), the brake temperature is adjusted in accordance with S7.4.2.

S7.7.3.2 During each test run, the driver will release the accelerator pedal after the ESC system has slowed vehicle by more than 4.8 km/h (3.0 mph) below the entrance speed.

S7.7.3.3 The maximum test speed is the greater of 130 percent of the Reference Speed (see S7.7.1.2) or 48 km/h (30 mph). The maximum test speed is determined for each direction: clockwise steering and counter-clockwise steering.

S7.7.3.4 For each series of Roll Stability Control test runs, the vehicle will perform eight consecutive test runs at the same entrance speed, which is any speed between 48 km/h (30 mph) and the maximum test speed determined according to S7.7.3.3.

S7.7.3.5 Upon completion of testing, post processing is done as specified in S7.9.

S7.8 *ESC Malfunction Detection.*

S7.8.1 Simulate one or more ESC malfunction(s) by disconnecting the power source to any ESC component, or disconnecting any electrical connection between ESC components (with the vehicle power off). When simulating an ESC malfunction, the electrical connections for the telltale lamp(s) are not disconnected.

S7.8.2 With the vehicle initially stationary and the ignition locking system in the ''Lock'' or ''Off'' position, activate the ignition locking system to the ''Start'' position and start the engine. Place the vehicle in a forward gear and accelerate to 48 ±8 km/h (30 ±5 mph). Drive the vehicle for at least two minutes including at least one left and one right turning maneuver and at least one service brake application. Verify that, within two minutes of attaining this speed, the ESC malfunction indicator illuminates in accordance with S5.4.

S7.8.3 Stop the vehicle, deactivate the ignition locking system to the ''Off'' or ''Lock'' position. After a five-minute period, activate the vehicle's ignition locking system to the ''Start'' position and start the engine. Verify that the ESC malfunction indicator again illuminates to signal a malfunction and remains illuminated as long as the engine is running until the fault is corrected.

S7.8.4 Deactivate the ignition locking system to the ''Off'' or ''Lock'' position. Restore the ESC system to normal operation, activate the ignition system to the ''Start'' position and start the engine. Verify that the telltale has extinguished.

S7.9 *Post Data Processing.*

S7.9.1 Raw vehicle speed data is filtered with a 0.1 second running average filter.

S7.9.2 The torque data collected from the vehicle communication network or CAN bus as a digital signal does not get filtered. The torque data collected from the vehicle communication network or CAN bus as an analog signal is filtered with a 0.1-second running average.

S7.9.3 The activation point of the ESC engine torque reduction is the point where the measured driver demanded torque and the engine torque first begin to deviate from one another (engine torque decreases while the driver requested torque increases) during the Engine Torque Reduction Test. The torque values are obtained directly from the vehicle communication network or CAN bus. Torque values used to determine the activation point of the ESC engine torque reduction are interpolated.

S7.9.4 The time measurement for the J-Turn test maneuver is referenced to ''time zero'', which is defined as the instant the center of the front tires of the vehicle reach the start gate, the line within the lane at zero degrees of radius arc angle. The completion of the maneuver occurs at the instant the center of the front tires of the vehicle reach the end gate, which is the line within the lane at 120 degrees of radius arc angle.

S7.9.5 Raw service brake pressure measurements are zeroed (calibrated). Zeroed brake pressure data are filtered with 0.1 second running average filters. Zeroed and filtered brake pressure data are dynamically offset corrected using a defined ''zeroed range''. The ''zeroing range'' is defined as the 0.5 second time period prior to ''time zero'' defined in S7.9.4.

S8 *Compliance Dates.* Vehicles that are subject to this standard must meet the requirements of this standard according to the implementation schedule set forth in S8.

S8.1 *Buses.*

S8.1.1 All buses with a gross vehicle weight rating of greater than 14,969 kilograms (33,000 pounds) manufactured on or after June 24, 2018 must comply with this standard.

S8.1.2 All buses manufactured on or after August 1, 2019 must comply with this standard.

S8.2 *Trucks.*

S8.2.1 All three-axle truck tractors with a front axle that has a GAWR of 6,622 kilograms (14,600 pounds) or less and with two rear drive axles that have a combined GAWR of 20,412 kilograms (45,000 pounds) or less manufactured on or after August 1, 2017 must comply with this standard.

S8.2.2 All truck tractors manufactured on or after August 1, 2019 must comply with this standard.

[80 FR 36105, June 23, 2015, as amended at 82 FR 50092, Oct. 30, 2017; 87 FR 34810, June 8, 2022]

§571.138 Standard No. 138; Tire pressure monitoring systems.

S1 *Purpose and scope.* This standard specifies performance requirements for tire pressure monitoring systems (TPMSs) to warn drivers of significant under-inflation of tires and the resulting safety problems.

S2 *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses that have a gross vehicle weight rating of 4,536 kilograms (10,000 pounds) or less, except those vehicles with dual wheels on an axle, according to the phase-in schedule specified in S7 of this standard.

S3 *Definitions.* The following definitions apply to this standard:

Lightly loaded vehicle weight means unloaded vehicle weight plus the weight of a mass of 180 kg (396 pounds), including test driver and instrumentation.

Tire pressure monitoring system means a system that detects when one or more of a vehicle's tires is significantly under-inflated and illuminates a low tire pressure warning telltale.

Vehicle Placard and *Tire inflation pressure label* mean the sources of information for the vehicle manufacturer's recommended cold tire inflation pressure pursuant to §571.110 of this Part.

S4 *Requirements.*

S4.1 *General.* To the extent provided in S7, each vehicle must be equipped with a tire pressure monitoring system that meets the requirements specified

in S4 under the test conditions specified in S5 and the test procedures specified in S6 of this standard.

S4.2 *TPMS detection requirements.* The tire pressure monitoring system must:

(a) Illuminate a low tire pressure warning telltale not more than 20 minutes after the inflation pressure in one or more of the vehicle's tires, up to a total of four tires, is equal to or less than either the pressure 25 percent below the vehicle manufacturer's recommended cold inflation pressure, or the pressure specified in the 3rd column of Table 1 of this standard for the corresponding type of tire, whichever is higher;

(b) Continue to illuminate the low tire pressure warning telltale as long as the pressure in any of the vehicle's tires is equal to or less than the pressure specified in S4.2(a), and the ignition locking system is in the ''On'' (''Run'') position, whether or not the engine is running, or until manually reset in accordance with the vehicle manufacturer's instructions.

S4.3 *Low tire pressure warning telltale.*

S4.3.1 Each tire pressure monitoring system must include a low tire pressure warning telltale that:

(a) Is mounted inside the occupant compartment in front of and in clear view of the driver;

(b) Is identified by one of the symbols shown for the ''Low Tire Pressure'' Telltale in Table 1 of Standard No. 101 (49 CFR 571.101); and

(c) Is illuminated under the conditions specified in S4.2.

S4.3.2 In the case of a telltale that identifies which tire(s) is (are) underinflated, each tire in the symbol for that telltale must illuminate when the tire it represents is under-inflated to the extent specified in S4.2.

S4.3.3 (a) Except as provided in paragraph (b) of this section, each low tire pressure warning telltale must illuminate as a check of lamp function either when the ignition locking system is activated to the ''On'' (''Run'') position when the engine is not running, or when the ignition locking system is in a position between ''On'' (''Run'') and ''Start'' that is designated by the manufacturer as a check position.

(b) The low tire pressure warning telltale need not illuminate when a starter interlock is in operation.

S4.4 *TPMS malfunction.*

(a) The vehicle shall be equipped with a tire pressure monitoring system that includes a telltale that provides a warning to the driver not more than 20 minutes after the occurrence of a malfunction that affects the generation or transmission of control or response signals in the vehicle's tire pressure monitoring system. The vehicle's TPMS malfunction indicator shall meet the requirements of either S4.4(b) or S4.4(c).

(b) *Dedicated TPMS malfunction telltale.* The vehicle meets the requirements of S4.4(a) when equipped with a dedicated TPMS malfunction telltale that:

(1) Is mounted inside the occupant compartment in front of and in clear view of the driver;

(2) Is identified by the word ''TPMS'' as described under the ''Tire Pressure Monitoring System Malfunction'' Telltale in Table 1 of Standard No. 101 (49 CFR 571.101);

(3) Continues to illuminate the TPMS malfunction telltale under the conditions specified in S4.4(a) for as long as the malfunction exists, whenever the ignition locking system is in the ''On'' (''Run'') position; and

(4) (i) Except as provided in paragraph (ii), each dedicated TPMS malfunction telltale must be activated as a check of lamp function either when the ignition locking system is activated to the ''On'' (''Run'') position when the engine is not running, or when the ignition locking system is in a position between ''On'' (''Run'') and ''Start'' that is designated by the manufacturer as a check position.

(ii) The dedicated TPMS malfunction telltale need not be activated when a starter interlock is in operation.

(c) *Combination low tire pressure/TPMS malfunction telltale.* The vehicle meets the requirements of S4.4(a) when equipped with a combined Low Tire Pressure/TPMS malfunction telltale that:

(1) Meets the requirements of S4.2 and S4.3; and

(2) Flashes for a period of at least 60 seconds but no longer than 90 seconds upon detection of any condition specified in S4.4(a) after the ignition locking system is activated to the ''On'' (''Run'') position. After each period of prescribed flashing, the telltale must remain continuously illuminated as long as a malfunction exists and the ignition locking system is in the ''On'' (''Run'') position. This flashing and illumination sequence must be repeated each time the ignition locking system is placed in the ''On'' (''Run'') position until the situation causing the malfunction has been corrected. Multiple malfunctions occurring during any ignition cycle may, but are not required to, reinitiate the prescribed flashing sequence.

S4.5 *Written instructions.*

(a) Beginning on September 1, 2006, the owner's manual in each vehicle certified as complying with S4 must provide an image of the Low Tire Pressure Telltale symbol (and an image of the TPMS Malfunction Telltale warning (''TPMS''), if a dedicated telltale is utilized for this function) with the following statement in English:

Each tire, including the spare (if provided), should be checked monthly when cold and inflated to the inflation pressure recommended by the vehicle manufacturer on the vehicle placard or tire inflation pressure label. (If your vehicle has tires of a different size than the size indicated on the vehicle placard or tire inflation pressure label, you should determine the proper tire inflation pressure for those tires.)

As an added safety feature, your vehicle has been equipped with a tire pressure monitoring system (TPMS) that illuminates a low tire pressure telltale when one or more of your tires is significantly under-inflated. Accordingly, when the low tire pressure telltale illuminates, you should stop and check your tires as soon as possible, and inflate them to the proper pressure. Driving on a significantly under-inflated tire causes the tire to overheat and can lead to tire failure. Under-inflation also reduces fuel efficiency and tire tread life, and may affect the vehicle's handling and stopping ability.

Please note that the TPMS is not a substitute for proper tire maintenance, and it is the driver's responsibility to maintain correct tire pressure, even if under-inflation has not reached the level to trigger illumination of the TPMS low tire pressure telltale.

[The following paragraph is required for all vehicles certified to the standard starting on September 1, 2007 and for vehicles voluntarily equipped with a compliant TPMS MIL before that time.] Your vehicle has also been equipped with a TPMS malfunction indicator to indicate when the system is not operating properly. [For vehicles with a dedicated MIL telltale, add the following statement: The TPMS malfunction indicator is provided by a separate telltale, which displays the symbol ''TPMS'' when illuminated.] [For vehicles with a combined low tire pressure/MIL telltale, add the following statement: The TPMS malfunction indicator is combined with the low tire pressure telltale. When the system detects a malfunction, the telltale will flash for approximately one minute and then remain continuously illuminated. This sequence will continue upon subsequent vehicle start-ups as long as the malfunction exists.] When the malfunction indicator is illuminated, the system may not be able to detect or signal low tire pressure as intended. TPMS malfunctions may occur for a variety of reasons, including the installation of replacement or alternate tires or wheels on the vehicle that prevent the TPMS from functioning properly. Always check the TPMS malfunction telltale after replacing one or more tires or wheels on your vehicle to ensure that the replacement or alternate tires and wheels allow the TPMS to continue to function properly.

(b) The owner's manual may include additional information about the time for the TPMS telltale(s) to extinguish once the low tire pressure condition or the malfunction is corrected. It may also include additional information about the significance of the low tire pressure warning telltale illuminating, a description of corrective action to be undertaken, whether the tire pressure monitoring system functions with the vehicle's spare tire (if provided), and how to use a reset button, if one is provided.

(c) If a vehicle does not come with an owner's manual, the required information shall be provided in writing to the first purchaser of the vehicle.

S5 *Test conditions.*

S5.1 *Ambient temperature.* The ambient temperature is between 0 °C (32 °F) and 40 °C (104 °F).

S5.2 *Road test surface.* Compliance testing is conducted on any portion of the Southern Loop of the Treadwear Test Course defined in appendix A and Figure 2 of section 575.104 of this chapter. The road surface is dry during testing.

S5.3 *Vehicle conditions.*

S5.3.1 *Test weight.* The vehicle may be tested at any weight between its lightly loaded vehicle weight and its gross vehicle weight rating (GVWR) without exceeding any of its gross axle weight ratings.

S5.3.2 *Vehicle speed.* The vehicle's TPMS is calibrated and tested at speeds between 50 km/h (31.1 mph) and 100 km/h (62.2 mph). For vehicles equipped with cruise control, cruise control is not to be engaged during testing.

S5.3.3 *Rim position.* The vehicle rims may be positioned at any wheel position, consistent with any related instructions or limitations in the vehicle owner's manual.

S5.3.4 *Stationary location.* The vehicle's tires are shaded from direct sun when the vehicle is parked.

S5.3.5 *Brake pedal application.* Driving time shall not accumulate during service brake application.

S5.3.6 *Range of conditions or test parameters.* Whenever a range of conditions or test parameters is specified in this standard, the vehicle must meet applicable requirements when tested at any point within the range.

S5.3.7 *Tires.* The vehicle is tested with the tires installed on the vehicle at the time of initial vehicle sale, excluding the spare tire (if provided). However, the spare tire may be utilized for TPMS malfunction testing purposes.

S6 *Test procedures.*

(a) Inflate the vehicle's tires to the cold tire inflation pressure(s) provided on the vehicle placard or the tire inflation pressure label.

(b) With the vehicle stationary and the ignition locking system in the ''Lock'' or ''Off'' position, activate the ignition locking system to the ''On'' (''Run'') position or, where applicable, the appropriate position for the lamp check. The tire pressure monitoring system must perform a check of lamp function for the low tire pressure telltale as specified in paragraph S4.3.3 of this standard. If the vehicle is equipped with a separate TPMS malfunction telltale, the tire pressure monitoring system also must perform a check of lamp function as specified in paragraph S4.4(b)(4) of this standard.

(c) If applicable, set or reset the tire pressure monitoring system in accordance with the instructions in the vehicle owner's manual.

(d) *System calibration/learning phase.*

(1) Drive the vehicle for up to 15 minutes of cumulative time (not necessarily continuously) along any portion of the test course.

(2) Reverse direction on the course and drive the vehicle for an additional period of time for a total cumulative time of 20 minutes (including the time in S6(d)(1), and not necessarily continuously).

(e) Stop the vehicle and deflate any combination of one to four tires until the deflated tire(s) is (are) at 7 kPa (1 psi) below the inflation pressure at which the tire pressure monitoring system is required to illuminate the low tire pressure warning telltale.

(f) *System detection phase.*

(1) Within 5 minutes of reducing the inflation pressure in the tire(s), drive the vehicle for up to 10–15 minutes of cumulative time (not necessarily continuously) along any portion of the test course.

(2) Reverse direction on the course and drive the vehicle for an additional period of time for a total cumulative time of 20 minutes (including the time in S6(f)(1), and not necessarily continuously).

(3) The sum of the total cumulative drive time under paragraphs S6(f)(1) and (2) shall be the lesser of 20 minutes or the time at which the low tire pressure telltale illuminates.

(4) If the low tire pressure telltale did not illuminate, discontinue the test.

(g) If the low tire pressure telltale illuminated during the procedure in paragraph S6(f), deactivate the ignition locking system to the ''Off'' or ''Lock'' position. After a 5-minute period, activate the vehicle's ignition locking system to the ''On'' (''Run'') position. The telltale must illuminate and remain illuminated as long as the ignition locking system is in the ''On'' (''Run'') position.

(h) Keep the vehicle stationary for a period of up to one hour with the engine off.

(i) Inflate all of the vehicle's tires to the same inflation pressure used in paragraph S6(a). If the vehicle's tire

pressure monitoring system has a manual reset feature, reset the system in accordance with the instructions specified in the vehicle owner's manual. Determine whether the telltale has extinguished. If necessary, drive the vehicle until the telltale has been extinguished.

(j) The test may be repeated, using the test procedures in paragraphs S6(a)–(b) and S6(d)–(i), with any one, two, three, or four of the tires on the vehicle under-inflated.

(k) Simulate one TPMS malfunction by disconnecting the power source to any TPMS component, disconnecting any electrical connection between TPMS components, or installing a tire or wheel on the vehicle that is incompatible with the TPMS. When simulating a TPMS malfunction, the electrical connections for the telltale lamps are not to be disconnected.

(l) *TPMS malfunction detection.*

(1) Drive the vehicle for up to 15 minutes of cumulative time (not necessarily continuously) along any portion of the test course.

(2) Reverse direction on the course and drive the vehicle for an additional period of time for a total cumulative time of 20 minutes (including the time in S6(l)(1), and not necessarily continuously).

(3) The sum of the total cumulative drive time under paragraphs S6(l)(1) and (2) shall be the lesser of 20 minutes or the time at which the TPMS malfunction telltale illuminates.

(4) If the TPMS malfunction indicator did not illuminate in accordance with paragraph S4.4, as required, discontinue the test.

(m) If the TPMS malfunction indicator illuminated during the procedure in paragraph S6(l), deactivate the ignition locking system to the ''Off'' or ''Lock'' position. After a 5-minute period, activate the vehicle's ignition locking system to the ''On'' (''Run'') position. The TPMS malfunction indicator must again signal a malfunction and remain illuminated as long as the ignition locking system is in the ''On'' (''Run'') position.

(n) Restore the TPMS to normal operation. If necessary, drive the vehicle until the telltale has extinguished.

(o) The test may be repeated using the test procedures in paragraphs S6(k)–(n), with each such test limited to simulation of a single malfunction.

S7 *Phase-in schedule.*

S7.1 *Vehicles manufactured on or after October 5, 2005, and before September 1, 2006.* For vehicles manufactured on or after October 5, 2005, and before September 1, 2006, the number of vehicles complying with this standard (except for the provisions of S4.4 unless the manufacturer elects to also certify to those provisions) must not be less than 20 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2002, and before October 5, 2005; or

(b) The manufacturer's production on or after October 5, 2005, and before September 1, 2006.

S7.2 *Vehicles manufactured on or after September 1, 2006, and before September 1, 2007.* For vehicles manufactured on or after September 1, 2006, and before September 1, 2007, the number of vehicles complying with this standard (except for the provisions of S4.4 unless the manufacturer elects to also certify to those provisions) must not be less than 70 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2003, and before September 1, 2006; or

(b) The manufacturer's production on or after September 1, 2006, and before September 1, 2007.

S7.3 *Vehicles manufactured on or after September 1, 2007.* Except as provided in S7.7, all vehicles manufactured on or after September 1, 2007 must comply with all requirements of this standard.

S7.4 *Calculation of complying vehicles.*

(a) *Carry-Forward Credits.* For purposes of complying with S7.1, a manufacturer may count a vehicle if it is certified as complying with this standard and is manufactured on or after April 8, 2005, but before September 1, 2006.

(b) For purposes of complying with S7.2, a manufacturer may count a vehicle if it:

(1) (i) Is certified as complying with this standard and is manufactured on or after April 8, 2005, but before September 1, 2007; and

(ii) Is not counted toward compliance with S7.1; or

(2) Is manufactured on or after September 1, 2006, but before September 1, 2007.

(c) *Carry-Backward Credits.* At the vehicle manufacturer's option, for purposes of complying with S7.1, a manufacturer may count a vehicle it plans to manufacture and to certify as complying with this standard that will be produced on or after September 1, 2006 but before September 1, 2007. However, a vehicle counted toward compliance with S7.1 may not be counted toward compliance with S7.2. If the vehicle manufacturer decides to exercise the option for carry-backward credits, the manufacturer must indicate this in its report for the production period corresponding to S7.1 filed pursuant to 49 CFR 585.66. The vehicles are counted in fulfillment of the requirements of S7.1, subject to actually being produced in compliance with this standard during the specified time period and not being counted toward the requirements of S7.2.

S7.5 *Vehicles produced by more than one manufacturer.*

S7.5.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S7.1 through S7.3, a vehicle produced by more than one manufacturer must be attributed to a single manufacturer as follows, subject to S7.5.2:

(a) A vehicle that is imported must be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, must be attributed to the manufacturer that markets the vehicle.

S7.5.2 A vehicle produced by more than one manufacturer must be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S7.5.1.

S7.6 *Small volume manufacturers.* Vehicles manufactured by a manufacturer that produces fewer than 5,000 vehicles for sale in the United States during the period of September 1, 2005 to August 31, 2006, or the period from September 1, 2006 to August 31, 2007, are not subject to the corresponding requirements of S7.1, S7.2, and S7.4.

S7.7 *Final-stage manufacturers and alterers.* Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S7.1 through S7.4. Instead, vehicles that are manufactured in two or more stages or that are altered must comply with this standard beginning on September 1, 2008.

TABLES TO § 571.138

TABLE 1—LOW TIRE PRESSURE WARNING TELLTALE—MINIMUM ACTIVATION PRESSURE

Column 1—tire type	Column 2—maximum or rated inflation pressure		Column 3—minimum activation pressure	
	(kPa)	(psi)	(kPa)	(psi)
P-metric—Standard Load	240,	35,	140	20
	300, or	44, or	140	20
	350	51	140	20
P-metric—Extra Load	280 or	41 or	160	23
	340	49	160	23
Load Range C	350	51	200	29
Load Range D	450	65	240	35
Load Range E	550	80	240	35

[70 FR 18187, Apr. 8, 2005, as amended at 70 FR 53100, Sept. 7, 2005; 72 FR 38025, July 12, 2007]

§571.139 Standard No. 139; New pneumatic radial tires for light vehicles.

S1. *Scope and purpose.* This standard specifies tire dimensions, test requirements, labeling requirements, and defines tire load ratings.

S2 *Application.* This standard applies to new pneumatic radial tires for use on motor vehicles (other than motorcycles and low speed vehicles) that have a gross vehicle weight rating (GVWR) of 10,000 pounds or less and that were manufactured after 1975. This standard does not apply to special tires (ST) for trailers in highway service, tires for use on farm implements (FI) in agricultural service with intermittent highway use, tires with rim diameters of 12 inches and below, T-type temporary use spare tires with radial construction, and light truck tires with a tread depth of 18/32 inch or greater.

S3 *Definitions.*

Bead means the part of the tire that is made of steel wires, wrapped or reinforced by ply cords and that is shaped to fit the rim.

Bead separation means a breakdown of the bond between components in the bead.

Bias ply tire means a pneumatic tire in which the ply cords that extend to the beads are laid at alternate angles substantially less than 90 degrees to the centerline of the tread.

Carcass means the tire structure, except tread and sidewall rubber which, when inflated, bears the load.

Chunking means the breaking away of pieces of the tread or sidewall.

Cord means the strands forming the plies in the tire.

Cord separation means the parting of cords from adjacent rubber compounds.

Cracking means any parting within the tread, sidewall, or inner liner of the tire extending to cord material.

Extra load tire means a tire designed to operate at higher loads and higher inflation pressure than the corresponding standard tire.

Groove means the space between two adjacent tread ribs.

Innerliner means the layer(s) forming the inside surface of a tubeless tire that contains the inflating medium within the tire.

Innerliner separation means the parting of the innerliner from cord material in the carcass.

Light truck (LT) tire means a tire designated by its manufacturer as primarily intended for use on lightweight trucks or multipurpose passenger vehicles.

Load rating means the maximum load that a tire is rated to carry for a given inflation pressure.

Maximum load rating means the load rating for a tire at the maximum permissible inflation pressure for that tire.

Maximum permissible inflation pressure means the maximum cold inflation pressure to which a tire may be inflated.

Measuring rim means the rim on which a tire is fitted for physical dimension requirements.

Open splice means any parting at any junction of tread, sidewall, or innerliner that extends to cord material.

Outer diameter means the overall diameter of an inflated new tire.

Overall width means the linear distance between the exteriors of the sidewalls of an inflated tire, including elevations due to labeling, decorations, or protective bands or ribs.

Passenger car tire means a tire intended for use on passenger cars, multipurpose passenger vehicles, and trucks, that have a gross vehicle weight rating (GVWR) of 10,000 pounds or less.

Ply means a layer of rubber-coated parallel cords.

Ply separation means a parting of rubber compound between adjacent plies.

Pneumatic tire means a mechanical device made of rubber, chemicals, fabric and steel or other materials, that, when mounted on an automotive wheel, provides the traction and contains the gas or fluid that sustains the load.

Radial ply tire means a pneumatic tire in which the ply cords that extend to the beads are laid at substantially 90 degrees to the centerline of the tread.

Reinforced tire means a tire designed to operate at higher loads and at higher inflation pressures than the corresponding standard tire.

Rim means a metal support for a tire or a tire and tube assembly upon which the tire beads are seated.

Section width means the linear distance between the exteriors of the sidewalls of an inflated tire, excluding elevations due to labeling, decoration, or protective bands.

Sidewall means that portion of a tire between the tread and bead.

Sidewall separation means the parting of the rubber compound from the cord material in the sidewall.

Snow tire means a tire that attains a traction index equal to or greater than 112, compared to the ASTM F2493 standard reference test tire when using the snow traction test on the medium pack snow surface as described in ASTM F1805–20 (incorporated by reference, see §571.5), and that is marked with an Alpine Symbol specified in S5.5(i) on at least one sidewall.

Test rim means the rim on which a tire is fitted for testing, and may be any rim listed as appropriate for use with that tire.

Tread means that portion of a tire that comes into contact with the road.

Tread rib means a tread section running circumferentially around a tire.

Tread separation means pulling away of the tread from the tire carcass.

Treadwear indicators (TWI) means the projections within the principal grooves designed to give a visual indication of the degrees of wear of the tread.

Wheel-holding fixture means the fixture used to hold the wheel and tire assembly securely during testing.

S4. *Tire and rim matching information.*

S4.1. Each manufacturer of tires must ensure that a listing of the rims that may be used with each tire that it produces is provided to the public in accordance with S4.1.1 and S4.1.2.

S4.1.1 Each rim listing for a tire must include dimensional specifications and a diagram of the rim and must be in one of the following forms:

(a) Listed by manufacturer name or brand name in a document furnished to dealers of the manufacturer's tires, to any person upon request, and in duplicate to the Docket Section (No. NHTSA–2009–0117), National Highway Traffic Safety Administration, West Building, 1200 New Jersey Ave. SE, Washington, DC 20590; or

(b) Contained in publications, current at the date of manufacture of the tire or any later date, of at least one of the following organizations:

(1) The Tire and Rim Association.

(2) The European Tyre and Rim Technical Organization.

(3) Japan Automobile Tire Manufacturers' Association, Inc.

(4) Tyre & Rim Association of Australia.

(5) Associacao Latino Americana de Pneus e Aros (Brazil).

(6) South African Bureau of Standards.

S4.1.2 A listing compiled in accordance with paragraph (a) of S4.1.1 need not include dimensional specifications or a diagram of a rim whose dimensional specifications and diagram are contained in a listing published in accordance with paragraph (b) of S4.1.1.

S4.2. Information contained in a publication specified in S4.1.1(b) that lists general categories of tires and rims by size designation, type of construction, and/or intended use, is considered to be manufacturer's information required by S4.1 for the listed tires, unless the publication itself or specific information provided according to S4.1(a) indicates otherwise.

S5. General requirements

S5.1. *Size and construction.* Each tire shall fit each rim specified for its size designation in accordance with S4.1.

S5.2. *Performance requirements.* Each tire shall conform to each of the following:

(a) It shall meet the requirements specified in S6 for its tire size designation, type, and maximum permissible inflation pressure.

(b) It shall meet each of the applicable requirements set forth in paragraphs (c) and (d) of this S5.2, when mounted on a model rim assembly corresponding to any rim designated by the tire manufacturer for use with the tire in accordance with S4.

(c) Its maximum permissible inflation pressure shall be 240, 280, 300, 340, or 350 kPa.

(d) Its load rating shall be that specified either in a submission made by an individual manufacturer, pursuant to

S4, or in one of the publications described in S4 for its size designation, type and each appropriate inflation pressure. If the maximum load rating for a particular tire size is shown in more than one of the publications described in S4, each tire of that size designation shall have a maximum load rating that is not less than the published maximum load rating, or if there are differing maximum load ratings for the same tire size designation, not less then the lowest published maximum load rating.

S5.3. *Test sample.* For the tests specified in S6, use:

(a) One tire for high speed;

(b) Another tire for endurance and low inflation pressure performance; and

(c) A third tire for physical dimensions, resistance to bead unseating, and strength, in sequence.

S5.4. *Treadwear indicators.* Except in the case of tires with a 12-inch or smaller rim diameter, each tire shall have not less than six treadwear indicators spaced approximately equally around the circumference of the tire that enable a person inspecting the tire to determine visually whether the tire has worn to a tread depth of one sixteenth of an inch. Tires with 12-inch or smaller rim diameter shall have not less than three such treadwear indicators.

S5.5 *Tire markings.* Except as specified in paragraphs (a) through (i) of S5.5, each tire must be marked on each sidewall with the information specified in S5.5(a) through (d) and on one sidewall with the information specified in S5.5(e) through (i) according to the phase-in schedule specified in S7 of this standard. The markings must be placed between the maximum section width and the bead on at least one sidewall, unless the maximum section width of the tire is located in an area that is not more than one-fourth of the distance from the bead to the shoulder of the tire. If the maximum section width falls within that area, those markings must appear between the bead and a point one-half the distance from the bead to the shoulder of the tire, on at least one sidewall. The markings must be in letters and numerals not less than 0.078 inches high and raised above or sunk below the tire surface not less than 0.015 inches.

(a) The symbol DOT, which constitutes a certification that the tire conforms to applicable Federal motor vehicle safety standards;

(b) The tire size designation as listed in the documents and publications specified in S4.1.1 of this standard;

(c) The maximum permissible inflation pressure, subject to the limitations of S5.5.4 through S5.5.6 of this standard;

(d) The maximum load rating and for LT tires, the letter designating the tire load range;

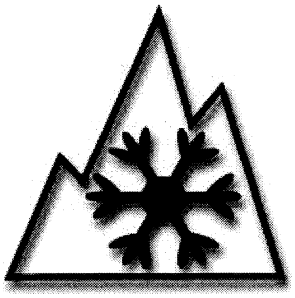
(e) The generic name of each cord material used in the plies (both sidewall and tread area) of the tire;

(f) The actual number of plies in the sidewall, and the actual number of plies in the tread area, if different;

(g) The term ''tubeless'' or ''tube type,'' as applicable;

(h) The word ''radial,'' if the tire is a radial ply tire; and

(i) *Alpine Symbol.* A tire meeting the definition of a snow tire as defined in paragraph S3 may, at the option of the manufacturer, show the pictograph of a mountain with a snowflake as shown below. If the manufacturer chooses to mark the snow tire with the alpine symbol, the mountain profile must have a minimum base of 15 mm and a minimum height of 15 mm, and must contain three peaks with the middle peak being the tallest. Inside the mountain, there must be a six-sided snowflake having a minimum height of one-half the tallest peak.



S5.5.1 *Tire identification number.*

(a) *Tires manufactured before September 1, 2009.* Each tire must be labeled with the tire identification number required by 49 CFR part 574 on a sidewall

of the tire. Except for retreaded tires, either the tire identification number or a partial tire identification number, containing all characters in the tire identification number, except for the date code and, at the discretion of the manufacturer, any optional code, must be labeled on the other sidewall of the tire.

(b) *Tires manufactured on or after September 1, 2009.* Each tire must be labeled with the tire identification number required by 49 CFR part 574 on the intended outboard sidewall of the tire. Except for retreaded tires, either the tire identification number or a partial tire identification number, containing all characters in the tire identification number, except for the date code and, at the discretion of the manufacturer, any optional code, must be labeled on the other sidewall of the tire. Except for retreaded tires, if a tire does not have an intended outboard sidewall, the tire must be labeled with the tire identification number required by 49 CFR part 574 on one sidewall and with either the tire identification number or a partial tire identification number, containing all characters in the tire identification number except for the date code and, at the discretion of the manufacturer, any optional code, on the other sidewall.

S5.5.2 [Reserved]

S5.5.3 Each tire must be labeled with the name of the manufacturer, or brand name and number assigned to the manufacturer in the manner specified in 49 CFR part 574.

S5.5.4 For passenger car tires, if the maximum inflation pressure of a tire is 240, 280, 300, 340, or 350 kPa, then:

(a) Each marking of that inflation pressure pursuant to S5.5(c) must be followed in parenthesis by the equivalent psi, rounded to the next higher whole number; and

(b) Each marking of the tire's maximum load rating pursuant to S5.5(d) in kilograms must be followed in parenthesis by the equivalent load rating in pounds, rounded to the nearest whole number.

S5.5.5 If the maximum inflation pressure of a tire is 420 kPa (60 psi), the tire must have permanently molded into or onto both sidewalls, in letters and numerals not less than ½ inch high, the words ''Inflate to 60 psi'' or ''Inflate to 420 kPa (60 psi).'' On both sidewalls, the words must be positioned in an area between the tire shoulder and the bead of the tire. However, the words must be also positioned on the tire so that they are not obstructed by the flange of any rim designated for use with that tire in this standard or in Standard No. 110 (§ 571.110 of this part).

S5.5.6 For LT tires, the maximum permissible inflation pressure shown must be the inflation pressure that corresponds to the maximum load of the tire for the tire size as specified in one of the publications described in S4.1.1.(b) of § 571.139. At the manufacturer's option, the shown inflation pressure may be as much as 10 psi (69 kPa) greater than the inflation pressure corresponding to the specified maximum load.

S6. Test procedures, conditions and performance requirements. Each tire shall meet all of the applicable requirements of this section when tested according to the conditions and procedures set forth in S5 and S6.1 through S6.7.

S6.1. Tire dimensions

S6.1.1 Test conditions and procedures.

S6.1.1.1 Tire Preparation.

S6.1.1.1.1 Mount the tire on the measuring rim specified by the tire manufacturer or in one of the publications listed in S4.1.1

S6.1.1.1.2 For passenger car tires, inflate to the pressure specified in the following table:

Inflation pressure (kPa)	
Standard	Reinforced
180	220

S6.1.1.1.3 In the case of a LT tire, inflate it to the pressure at maximum load as labeled on sidewall.

S6.1.1.1.4 Condition the assembly at an ambient room temperature of 20 °C to 30 °C for not less than 24 hours.

S6.1.1.1.5 Readjust the tire pressure to that specified in S6.1.1.1.2.

S6.1.1.2 *Test procedure.*

S6.1.1.2.1 Measure the section width and overall width by caliper at six points approximately equally spaced around the circumference of the tire, avoiding measurement of the additional thickness of the special protective ribs or bands. The average of the

measurements so obtained are taken as the section width and overall width, respectively.

S6.1.1.2.2 Determine the outer diameter by measuring the maximum circumference of the tire and dividing the figure so obtained by Pi (3.14).

S6.1.2 *Performance Requirements.* The actual section width and overall width for each tire measured in accordance with S6.1.1.2 shall not exceed the section width specified in a submission made by an individual manufacturer, pursuant to S4.1.1(a) or in one of the publications described in S4.1.1(b) for its size designation and type by more than:

(a) (For tires with a maximum permissible inflation pressure of 32, 36, or 40 psi) 7 percent, or

(b) (For tires with a maximum permissible inflation pressure of 240, 280, 300, 340 or 350 kPa) 7 percent or 10 mm (0.4 inches), whichever is larger.

S6.2 High Speed Performance

S6.2.1 Test conditions and procedures.

S6.2.1.1 Preparation of tire.

S6.2.1.1.1 Mount the tire on a test rim and inflate it to the pressure specified for the tire in the following table:

Tire application	Test pressure (kPa)
Passenger car tires:	
Standard load	220
Extra load	260
Light truck tires with a nominal cross section ≤295 mm (11.5 inches):	
Load Range C	320
Load Range D	410
Load Range E	500
Light truck tires with a nominal cross section >295 mm (11.5 inches)	
Load Range C	230
Load Range D	320
Load Range E	410

S6.2.1.1.2 Condition the assembly at 32 to 38 °C for not less than 3 hours.

S6.2.1.1.3 Before or after mounting the assembly on a test axle, readjust the tire pressure to that specified in S6.2.1.1.1.

S6.2.1.2 Test procedure.

S6.2.1.2.1 Press the assembly against the outer face of a test drum with a diameter of 1.70 m ±1%.

S6.2.1.2.2 Apply to the test axle a load equal to 85% of the tire's maximum load carrying capacity.

S6.2.1.2.3 Break-in the tire by running it for 2 hours at 80 km/h.

S6.2.1.2.4 Allow tire to cool to 38 °C and readjust inflation pressure to applicable pressure in 6.2.1.1.1 immediately before the test.

S6.2.1.2.5 Throughout the test, the inflation pressure is not corrected and the test load is maintained at the value applied in S6.2.1.2.2.

S6.2.1.2.6 During the test, the ambient temperature, measured at a distance of not less than 150 mm and not more than 1 m from the tire, is maintained at not less than 32 °C or more than 38 °C.

S6.2.1.2.7 The test is conducted, continuously and uninterrupted, for ninety minutes through three thirty-minute consecutive test stages at the following speeds: 140, 150, and 160 km/h.

S6.2.1.2.8 Allow the tire to cool for between 15 minutes and 25 minutes. Measure its inflation pressure. Then, deflate the tire, remove it from the test rim, and inspect it for the conditions specified in S6.2.2(a).

S6.2.2 Performance requirements. When the tire is tested in accordance with S6.2.1:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, innerliner, belt or bead separation, chunking, open splices, cracking, or broken cords.

(b) The tire pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in S6.2.1.1.1.

S6.3 Tire Endurance

S6.3.1 Test conditions and procedures.

S6.3.1.1 Preparation of Tire.

S6.3.1.1.1 Mount the tire on a test rim and inflate it to the pressure specified for the tire in the following table:

Tire application	Test pressure (kPa)
Passenger car tires:	
Standard load	180
Extra load	220
Light truck tires with a nominal cross section ≤295 mm (11.5 inches)	
Load Range C	260
Load Range D	340
Load Range E	410
Light truck tires with a nominal cross section >295 mm (11.5 inches)	
Load Range C	190
Load Range D	260
Load Range E	340

S6.3.1.1.2 Condition the assembly at 32 to 38 °C for not less than 3 hours.

S6.3.1.1.3 Readjust the pressure to the value specified in S6.3.1.1.1 immediately before testing.

S6.3.1.2 Test Procedure.

S6.3.1.2.1 Mount the assembly on a test axle and press it against the outer face of a smooth wheel having a diameter of 1.70 m ±1%.

S6.3.1.2.2 During the test, the ambient temperature, at a distance of not less than 150 mm and not more than 1 m from the tire, is maintained at not less than 32 °C or more than 38 °C.

S6.3.1.2.3 Conduct the test, without interruptions, at the test speed of not less than 120 km/h with loads and test periods not less than those shown in the following table. For snow tires, conduct the test at not less than 110 km/h.

Test period	Duration (hours)	Load as a percentage of tire maximum load rating
1	4	85
2	6	90
3	24	100

S6.3.1.2.4 Throughout the test, the inflation pressure is not corrected and the test loads are maintained at the value corresponding to each test period, as shown in the table in S6.3.1.2.3.

S6.3.1.2.5 Allow the tire to cool for between 15 minutes and 25 minutes after running the tire for the time specified in the table in S6.3.1.2.3, measure its inflation pressure. Inspect the tire externally on the test rim for the conditions specified in S6.3.2(a).

S6.3.2 Performance requirements. When the tire is tested in accordance with S6.3.1:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, belt or bead separation, chunking, open splices, cracking or broken cords.

(b) The tire pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in S6.3.1.1.1.

S6.4 Low Inflation Pressure Performance

S6.4.1 Test conditions and procedures.

S6.4.1.1 Preparation of tire.

S6.4.1.1.1 This test is conducted following completion of the tire endurance test using the same tire and rim assembly tested in accordance with S6.3 with the tire deflated to the following appropriate pressure:

Tire application	Test pressure (kPa)
Passenger car tires.	
Standard load	140
Extra load	160
Light truck tires with a nominal cross section ≤295 mm (11.5 inches)	
Load Range C	200
Load Range D	260
Load Range E	320
Light truck tires with a nominal cross section >295 mm (11.5 inches)	
Load Range C	150
Load Range D	200
Load Range E	260

S6.4.1.1.2 After the tire is deflated to the appropriate test pressure in S6.4.1.1.1 at the completion of the endurance test, condition the assembly at 32 to 38 °C for not less than 2 hours.

S6.4.1.1.3 Before or after mounting the assembly on a test axle, readjust the tire pressure to that specified in S6.4.1.1.1.

S6.4.1.2 Test procedure.

S6.4.1.2.1 The test is conducted for ninety minutes at the end of the test specified in S6.3, continuous and uninterrupted, at a speed of 120 km/h (75 mph). For snow tires, conduct the test at not less than 110 km/h.

S6.4.1.2.2 Press the assembly against the outer face of a test drum with a diameter of 1.70 m + 1%.

S6.4.1.2.3 Apply to the test axle a load equal to 100% of the tire's maximum load carrying capacity.

S6.4.1.2.4 Throughout the test, the inflation pressure is not corrected and the test load is maintained at the initial level.

S6.4.1.2.5 During the test, the ambient temperature, at a distance of not less than 150 mm and not more than 1 m from the tire, is maintained at not less than 32 °C or more than 38 °C.

S6.4.1.2.6 Allow the tire to cool for between 15 minutes and 25 minutes. Measure its inflation pressure. Then, deflate the tire, remove it from the test rim, and inspect it for the conditions specified in S6.4.2(a).

S6.4.2 Performance requirements. When the tire is tested in accordance with S6.4.1:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, innerliner,

belt or bead separation, chunking, open splices, cracking, or broken cords, and

(b) The tire pressure, when measured at any time between 15 minutes and 25 minutes after the end of the test, shall not be less than 95% of the initial pressure specified in S6.4.1.1.1.

S6.5 Tire strength.

S6.5.1 *Tire strength for passenger car tires.* Each tire shall comply with the requirements of S5.3 of §571.109.

S6.5.2 Tire strength for LT tires. Each tire shall comply with the requirements of S7.3 of §571.119.

S6.6 Tubeless tire bead unseating resistance. Each tire shall comply with the requirements of S5.2 of §571.109. For light truck tires, the maximum permissible inflation pressure to be used for the bead unseating test is as follows:

Load Range C	260 kPa.
Load Range D	340 kPa.
Load Range E	410 kPa.

For light truck tires with a nominal cross section greater than 295 mm (11.5 inches), the maximum permissible inflation pressure to be used for the bead unseating test is as follows:

Load Range C	190 kPa.
Load Range D	260 kPa.
Load Range E	340 kPa.

S7. *Phase-in schedule for tire markings.*

S7.1 *Tires manufactured on or after September 1, 2005 and before September 1, 2006.* For tires manufactured on or after September 1, 2005 and before September 1, 2006, the number of tires complying with S4, S5.5, S5.5.1, S5.5.2, S5.5.3, S5.5.4, S5.5.5, and S5.5.6 of this standard must be equal to not less than 40% of the manufacturer's production during that period.

S7.2 *Tires manufactured on or after September 1, 2006 and before September 1, 2007.* For tires manufactured on or after September 1, 2006 and before September 1, 2007, the number of tires complying with S4, S5.5, S5.5.1, S5.5.2, S5.5.3, S5.5.4, S5.5.5, and S5.5.6 of this standard must be equal to not less than 70% of the manufacturer's production during that period.

S7.3 *Tires manufactured on or after September 1, 2007.* Each tire must comply with S4, S5.5, S5.5.1, S5.5.2, S5.5.3, S5.5.4, S5.5.5, and S5.5.6 of this standard.

[67 FR 69627, Nov. 18, 2002, as amended at 68 FR 38150, June 26, 2003; 69 FR 31319, June 3, 2004; 71 FR 886, Jan. 6, 2006; 72 FR 49211, Aug. 28, 2007; 73 FR 72358, Nov. 28, 2008; 77 FR 760, Jan. 6, 2012; 86 FR 48545, Aug. 31, 2021; 87 FR 34810, June 8, 2022]

§571.141 Standard No. 141; Minimum Sound Requirements for Hybrid and Electric Vehicles.

S1. *Scope.* This standard establishes performance requirements for pedestrian alert sounds for motor vehicles.

S2. *Purpose.* The purpose of this standard is to reduce the number of injuries that result from electric and hybrid vehicle crashes with pedestrians by providing a sound level and sound characteristics necessary for these vehicles to be detected and recognized by pedestrians.

S3. *Application.* This standard applies to—

(a) Electric vehicles with a gross vehicle weight rating (GVWR) of 4,536 Kg or less that are passenger cars, multipurpose passenger vehicles, trucks, or buses;

(b) Hybrid vehicles with a gross vehicle weight rating (GVWR) of 4,536 Kg or less that are passenger cars, multi-purpose passenger vehicles, trucks, or buses; and

(c) Electric vehicles and hybrid vehicles that are low speed vehicles.

S4. Definitions. Band or *one-third octave band* means one of thirteen one-third octave bands having nominal center frequencies ranging from 315 to 5000Hz. These are Bands 25 through 37 as defined in Table A1, Mid-band Frequencies for One-Third-Octave-Band and Octave-Band Filters in the Audio Range, of ANSI S1.11–2004: ''Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters'' (incorporated by reference, see §571.5).

Band sum means the combination of Sound Pressure Levels (SPLs) from selected bands that produce an SPL representing the sound in all of these bands. Band sum is calculated with the following equation:

$$Band\ Sum = 10\ log_{10} \sum_{i=1}^{2} 10^{(SPL_i/10)}$$

Where:
SPL_i is the sound pressure level in each selected band.

Electric vehicle means a motor vehicle with an electric motor as its sole means of propulsion.

Front plane of the vehicle means a vertical plane tangent to the leading edge of the vehicle during forward operation.

Hybrid vehicle means a motor vehicle which has more than one means of propulsion for which the vehicle's propulsion system can propel the vehicle in the normal travel mode in at least one forward drive gear or reverse without the internal combustion engine operating.

Rear plane means a vertical plane tangent to the leading edge of the rear of the vehicle during operation in reverse.

Trim level is defined to mean a subset of vehicles within the same model designation with the same body type and which are alike in their general level of standard equipment, such as a ''base'' trim level of a vehicle model. Vehicles with only minor trim differences that are unlikely to affect vehicle-emitted sound are not considered different for the purposes of this safety standard.

S5. *Requirements.* Subject to the phase-in set forth in S9 of this standard, each hybrid and electric vehicle must meet the requirements specified in either S5.1 or S5.2. subject to the requirements in S5.3. Each vehicle must also meet the requirements in S5.4 and S5.5.

S5.1 *Performance requirements for four-band alert sounds.*

S5.1.1 *Stationary.* When stationary the vehicle must satisfy S5.1.1.1 and S5.1.1.2 whenever the vehicle's propulsion system is activated and:

(i) In the case of a vehicle with an automatic transmission, the vehicle's gear selector is in Neutral or any gear position other than Park that provides forward vehicle propulsion;

(iii) in the case of a vehicle with a manual transmission, the vehicle's parking brake is released and the gear selector is not in Reverse.

S5.1.1.1 For *detection*, the vehicle must emit a sound having at least the A-weighted sound pressure level according to Table 1 in each of four non-adjacent bands spanning no fewer than 9 of the 13 bands from 315 to 5000 Hz.

S5.1.1.2 For *directivity*, the vehicle must emit a sound measured at the microphone on the line CC' having at least the A-weighted sound pressure level according to Table 1 in each of four non-adjacent bands spanning no fewer than 9 of the 13 bands from 315 to 5000Hz.

TABLE 1—ONE-THIRD OCTAVE BAND MIN. SPL REQUIREMENTS FOR SOUND WHEN STATIONARY AND CONSTANT SPEEDS LESS THAN 10KM/H

One-third octave band center frequency, Hz	Min SPL, A-weighted dB
315	39
400	39
500	40
630	40
800	41
1000	41
1250	42
1600	39
2000	39
2500	37
3150	34
4000	32
5000	31

S5.1.2 *Reverse.* For vehicles capable of rearward self-propulsion, whenever the vehicle's gear selector is in the Reverse position, the vehicle must emit a sound having at least the A-weighted sound pressure level according to Table 2 in each of four non-adjacent bands spanning no fewer than 9 of the 13 bands from 315 to 5000Hz.

TABLE 2—ONE-THIRD OCTAVE BAND MIN. SPL REQUIREMENTS FOR SOUND WHILE IN REVERSE

One-third octave band center frequency, Hz	Min SPL, A-weighted dB
315	42
400	41

TABLE 2—ONE-THIRD OCTAVE BAND MIN. SPL REQUIREMENTS FOR SOUND WHILE IN REVERSE—Continued

One-third octave band center frequency, Hz	Min SPL, A-weighted dB
500	43
630	43
800	44
1000	44
1250	45
1600	41
2000	42
2500	40
3150	37
4000	35
5000	33

S5.1.3 *Constant pass-by speeds greater than 0 km/h but less than 20 km/h.* When at a constant speed greater than 0 km/h but less than 20 km/h the vehicle must emit a sound having at least the A-weighted sound pressure level according to Table 1 or Table 3 as applicable based upon vehicle test speed in each of four non-adjacent bands spanning no fewer than 9 of the 13 bands from 315 to 5000 Hz.

TABLE 3—ONE-THIRD OCTAVE BAND MIN. SPL REQUIREMENTS FOR CONSTANT PASS-BY SPEEDS GREATER THAN OR EQUAL TO 10 KM/H BUT LESS THAN 20 KM/H

One-third octave band center frequency, Hz	Min SPL, A-weighted dB
315	45
400	44
500	46
630	46
800	47
1000	47
1250	48
1600	44
2000	45
2500	43
3150	40
4000	38
5000	36

S5.1.4 *Constant pass-by speeds greater than or equal to 20km/h but less than 30 km/h.* When at a constant speed equal to or greater than 20 km/h but less than 30 km/h the vehicle must emit a sound having at least the A-weighted sound pressure level according to Table 4 in each of four non-adjacent bands spanning no fewer than 9 of the 13 bands from 315 to 5000 Hz.

TABLE 4—ONE-THIRD OCTAVE BAND MIN. SPL REQUIREMENTS FOR CONSTANT PASS-BY SPEEDS GREATER THAN OR EQUAL TO 20 KM/H BUT LESS THAN 30 KM/H

One-third octave band center frequency, Hz	Min SPL, A-weighted dB
315	52
400	51
500	52
630	53
800	53
1000	54
1250	54
1600	51
2000	51
2500	50
3150	47
4000	45
5000	43

S5.1.5 *Constant 30km/h pass-by.* When at a constant speed of 30–32 km/h the vehicle must emit a sound having at least the A-weighted sound pressure level according to Table 5 in each of four non-adjacent bands spanning no fewer than 9 of the 13 bands from 315 to 5000 Hz.

TABLE 5—ONE-THIRD OCTAVE BAND MIN. SPL REQUIREMENTS FOR 30–32 KM/H PASS-BY

One-third octave band center frequency, Hz	Min SPL, A-weighted dB
315	56
400	55
500	57
630	57
800	58
1000	58
1250	59
1600	55
2000	55
2500	54
3150	51
4000	49
5000	47

S5.2 *Performance requirements for two-band alert sounds.* When operating under the vehicle speed conditions specified in Table 6, the vehicle must emit sound having two non-adjacent one-third octave bands from 315 to 3150 Hz each having at least the A-weighted sound pressure level according to the minimum SPL requirements in Table 6 and spanning no fewer than three one-third octave bands from 315 to 3150 Hz. One of the two bands meeting the minimum requirements in Table 6 shall be the band that has the highest SPL of the 315 to 800 Hz bands and the second band shall be the band meeting the minimum requirements in Table 6 that

has the highest SPL of the 1000 to 3150 Hz bands. The two bands used to meet the two-band minimum requirements must also meet the band sum requirements as specified in Table 6.

TABLE 6—ONE-THIRD OCTAVE BAND MINIMUM REQUIREMENTS FOR TWO-BAND ALERT

Vehicle speed	A-weighted SPL, dB(A)	
	Minimum in each band	Band sum
Reverse	40	48
Stationary and up to but not including 10 km/h	40	44
10 km/h up to but not including 20 km/h	42	51
20 km/h up to but not including 30 km/h	47	57
30 km/h	52	62

S5.2.1 When tested according to the test procedure in S7.1 the vehicle must emit a sound measured at the microphone on the line CC' having at least two non-adjacent octave bands from 315 to 3150 Hz each having at least the A-weighted sound pressure level, indicated in the ''Minimum in Each Band'' column in Table 6 for the ''Stationary up to but not including 10 km/h'' condition. The two bands used to meet the two-band minimum requirements must also meet the Band Sum as specified in Table 6.

S5.3 If a hybrid vehicle to which this standard applies is evaluated for compliance with requirements in S5.1.1 through S5.1.5 or S5.2 (Stationary, Reverse, Pass-by at 10 km/h, 20 km/h, and 30 km/h, respectively), and during testing to any one of those requirements the vehicle is measured for ten consecutive times without recording a valid measurement, or for a total of 20 times without recording four valid measurements because the vehicle's ICE remains active for the entire duration of a measurement or the vehicle's ICE activates intermittently during every measurement, the vehicle is exempted from meeting the specific requirement that was under evaluation at the time the ICE interfered in the prescribed manner.

S5.4 *Relative volume change to signify acceleration and deceleration.* The sound produced by the vehicle in accordance with paragraph S5 shall change in volume, as calculated in S7.6, from one critical operating condition to the next in accordance with the requirements in Table 7.

TABLE 7—MINIMUM RELATIVE VOLUME CHANGE REQUIREMENTS

Critical operating speed intervals	Minimum relative volume change, dB
Between:	
Stationary and 10 km/h	3
10 km/h and 20 km/h	3
20 km/h and 30 km/h	3

S5.5 *Sameness requirement*

S5.5.1 Any two vehicles of the same make, model, model year, body type, and trim level (as those terms are defined in 49 CFR 565.12 or in section S4 of this safety standard) to which this safety standard applies shall be designed to have the same pedestrian alert sound when operating under the same test conditions and at the same speed including any test conditions and speeds for which an alert sound is required in Section S5 of this safety standard.

S5.5.2 For the purposes of this requirement, the pedestrian alert sound of vehicles which meet the applicable requirements in S5.1 through S5.4 of this standard are deemed to be the same if the digital source of the sound, if any, is the same and if the algorithms that either generate the sound directly or process the digital source to generate the sound are the same.

S6. *Test Conditions.*

S6.1 *Weather conditions.* The ambient conditions specified by this section will be met at all times during the tests described in S7. Conditions will be measured with the accuracy required in S6.3.3 at the microphone height specified in S6.4 ±0.02 m.

S6.1.1 The ambient temperature will be between 5 °C (41 °F) and 40 °C (104 °F).

S6.1.2 The maximum wind speed at the microphone height is no greater than 5 m/s (11 mph), including gusts.

S6.1.3 No precipitation and the test surface is dry.

S6.1.4 *Background noise level.* The background noise level will be measured and reported as specified in S6.7, *Ambient correction.*

S6.2 *Test surface.* Test surface will meet the requirements of ISO 10844:1994, ISO 10844:2011, or ISO 10844:2014 (incorporated by reference, see §571.5).

S6.3 *Instrumentation.*

S6.3.1 *Acoustical measurement.* Instruments for acoustical measurement will meet the requirements of S5.1 of SAE J2889–1 (incorporated by reference, see §571.5).

S6.3.2 *Vehicle speed measurement.* Instruments used to measure vehicle speed during the constant speed pass-by tests in S7 of this standard will be capable of either continuous measurement of speed within ±0.5 km/h over the entire measurement zone specified in S6.4 or independent measurements of speed within ±0.2 km/h at the beginning and end of the measurement zone specified in S6.4.

S6.3.3 *Meteorological instrumentation.* Instruments used to measure ambient conditions at the test site will meet the requirements of S5.3 of SAE J2889–1 (incorporated by reference, see §571.5).

S6.4 *Test site.* The test site will be established per the requirements of 6.1 of SAE J2889–1 (incorporated by reference, see §571.5), including Figure 1, ''Test Site Dimensions'' with the definitions of the abbreviations in Figure 1 as given in Table 1of SAE J2889–1 (incorporated by reference, see §571.5). Microphone positions will meet the requirements of 7.1.1 of SAE J2889–1 (incorporated by reference, see §571.5).

S6.5 *Test set up for directivity measurement* will be as per S6.4 with the addition of one microphone meeting the requirements of S6.3.1 placed on the line CC', 2m forward of the line PP' at a height of 1.2m above ground level.

S6.6 *Vehicle condition*

(a) The vehicle's doors are shut and locked and windows are shut.

(b) All accessory equipment (air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) that can be shut down, will be off. Propulsion battery cooling fans and pumps and other components of the vehicle's propulsion battery thermal management system are not considered accessory equipment. During night time testing test vehicle headlights may be activated.

(c) Vehicle's electric propulsion batteries, if any, are charged according to the requirements of S7.1.2.2 of SAE J2889–1 (incorporated by reference, see §571.5). If propulsion batteries must be recharged during testing to ensure internal combustion engine does not activate, manufacturer instructions will be followed.

(d) Vehicle test weight, including the driver and instrumentation, will be evenly distributed between the left and right side of the vehicle and will not exceed the vehicle's GVWR or GAWR:

(1) For passenger cars, and MPVs, trucks, and buses with a GVWR of 4,536 kg (10,000 pounds) or less, the vehicle test weight is the unloaded vehicle weight plus 180 kg (396 pounds);

(2) For LSVs, the test weight is the unloaded vehicle weight plus 78 kg (170 pounds).

(e) Tires will be free of all debris and each tire's cold tire inflation pressure set to:

(1) For passenger cars, and MPVs, trucks, and buses with a GVWR of 4,536 kg (10,000 pounds) or less, the inflation pressure specified on the vehicle placard in FMVSS No. 110;

(2) For LSVs, the inflation pressure recommended by the manufacturer for GVWR; if none is specified, the maximum inflation pressure listed on the sidewall of the tires.

(f) Tires are conditioned by driving the test vehicle around a circle 30 meters (100 feet) in diameter at a speed that produces a lateral acceleration of 0.5 to 0.6 g for three clockwise laps followed by three counterclockwise laps;

S6.7 *Ambient correction.*

S6.7.1 Measure the ambient noise for at least 30 seconds immediately before and after each series of vehicle tests. A series is a test condition, *i.e.* stationary, reverse, 10 km/h pass-by test, 20 km/h pass-by test, or 30 km/h pass-by test. Ambient noise data files will be collected from each microphone required by the test procedures in S7.

S6.7.2 For each microphone, determine the minimum A-weighted overall ambient SPL during the 60 seconds (or more) of recorded ambient noise consisting of at least 30 seconds recorded immediately before and at least 30 seconds immediately after each test series.

S6.7.3 For each microphone, compute an ambient level for each of the 13 one-third octave bands using the time that is associated with the minimum A-weighted overall ambient identified in S6.7.2 of this section.

S6.7.4 To correct overall SPL values for ambient noise, calculate the difference, for each microphone, between the measured overall SPL values for a test vehicle obtained in sections S7.1.4(b) and S7.3.4(b) and the minimum overall ambient SPL values determined in S6.7.2, above. Using Table 8, determine a correction factor for each microphone. Subtract the correction factor from the overall SPL value measured under sections S7.1.4(b) and S7.3.4(b) to calculate the corrected overall SPL value. Any test for which the minimum overall SPL of the ambient is within 3 dB of the uncorrected overall SPL of the vehicle is invalid and not analyzed further.

S6.7.5 To correct one-third octave band sound levels for ambient noise, calculate the difference, for each microphone, between the uncorrected level for a one-third octave band (obtained in sections S7.1.5(b), S7.1.6(b) and S7.3.5(b)) and the minimum ambient level in the same one-third octave band as determined in S6.7.3. Use Table 9 to determine if a correction is required for each microphone and one-third octave band. If a correction is required, subtract the appropriate correction factor in Table 9 from the uncorrected one-third octave band sound level to calculate the corrected level for each one-third octave band. If the level of any ambient one-third octave band is within 3 dB of the corresponding uncorrected one-third octave band level, then that one-third octave band is invalid and not analyzed further.

TABLE 8—OVERALL SPL CORRECTIONS FOR AMBIENT NOISE

Difference between vehicle measurement and ambient noise level	Correction
Greater than 10 dB	0 dB.
Greater than 8 dB but less than or equal to 10 dB	0.5 dB.
Greater than 6 dB but less than or equal to 8 dB	1.0 dB.
Greater than 4.5 dB but less than or equal to 6 dB	1.5 dB.
Greater than 3 dB but less than or equal to 4.5 dB	2.5 dB.
Less than or equal to 3 dB	Invalid test run.

TABLE 9—1/3 OCTAVE BAND CORRECTIONS FOR AMBIENT NOISE

Difference between vehicle 1/3 octave band sound pressure level and ambient noise level	Correction
Greater than 6 dB	0 dB.
Greater than 4.5 dB but less than or equal to 6 dB	1.5 dB.
Greater than 3 dB but less than or equal to 4.5 dB	2.5 dB.
Less than or equal to 3 dB	Specific 1/3 octave band is not useable.

S7. Test Procedure.

S7.1 Stationary vehicle in forward gear.

S7.1.1 Execute stationary tests and collect acoustic sound files.

(a) Position the vehicle with the front plane at the line PP', the vehicle centerline on the line CC' and the starting system deactivated. For vehicle equipped with a Park position, place the vehicle's gear selector in ''Park'' and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in ''Neutral'' and engage the parking brake. Activate the starting system to energize the vehicle's propulsion system.

(b) For vehicles equipped with a Park position for the gear selector, after activating the starting system to energize the vehicle's propulsion system, apply and maintain a full application of the service brake, disengage the vehicle parking brake and then place the vehicle's gear selector in ''Drive,'' or any forward gear. For vehicles not equipped with a Park position for the gear selector, after activating the

starting system to energize the vehicle's propulsion system, apply and maintain a full application of the service brake, disengage the vehicle parking brake, disengage the manual clutch (fully depress and hold the clutch pedal), and place the vehicle's gear selector in any forward gear.

(c) Execute multiple tests to acquire at least four valid tests within 2 dBA overall SPL in accordance with S7.1.2 and S7.1.3. For each test, measure the sound emitted by the stationary test vehicle for a duration of 10 seconds.

(d) During each test a left (driver's side), a right (passenger side), and a front-center acoustic file will be recorded.

S7.1.2. Eliminate invalid tests.

(a) Determine validity of sound files collected during S7.1.1 tests. Measurements that contain any distinct, transient, loud sounds (*e.g.*, chirping birds, overhead planes, trains, car doors being slammed, etc.) are considered invalid. Measurements that contain sounds emitted by any vehicle system that is automatically activated and constantly engaged during the entire 10 second performance test are considered valid. Measurements that contain sound emitted by any vehicle system that is automatically activated and intermittently engaged at any time during the stationary performance test, are considered invalid. Additionally, when testing a hybrid vehicle with an internal combustion engine, measurements that include sound emitted by the ICE either intermittently or continuously are considered invalid. A valid test requires a valid left side, a valid right side, and a valid front-center acoustic sound file.

(b) Sequentially number all tests which are deemed valid based upon the chronological order in which they were conducted. Acoustic files will be identified with a test sequence number and their association with the left side, right side, or front center microphone.

S7.1.3 Identify first four valid tests within 2dBA.

(a) For each valid test sound file identified in S7.1.2, determine a maximum overall SPL value, in decibels. Each SPL value will be reported to the nearest tenth of a decibel.

(b) Compare the first four left-side SPL values from S7.1.3(a) of this paragraph, and determine the range by taking the difference between the largest and smallest of the four values. In the same manner, determine the range of SPL values for the first four right-side and the first four front-center sound files. If the range for the left side, right side, and front-center are all less than or equal to 2.0 dB, then the twelve sound files associated with the first four valid tests will be used for the one-third octave band evaluations in S7.1.5. and S7.1.6. If the range of the SPL values for the left side are not within 2 dBA, or for the right side are not within 2 dBA, or for the front-center of the vehicle are not within 2 dBA, an iterative process will be used to consider sound files from additional sequential tests until the range for all three microphone locations are within 2 dBA for the same sequence number recordings for all three locations.

S7.1.4 Compare the average overall SPL for the left and right side of the test vehicle to determine which is lower.

(a) Document the maximum overall SPL values in each of the eight acoustic data files (four left side files and four right side files) identified in S7.1.3.

(b) Correct each of the eight SPL values from S7.1.4(a) according to S6.7 using the ambient sound level recorded during the test. The results will be reported to the nearest tenth of a decibel.

(c) Calculate a left-side average and a right-side average from the ambient-corrected overall SPL values from S71.4(b), and determine the lower of the two sides. The result will be reported to the nearest tenth of a decibel.

(d) If the left-side value from S7.1.4(c) is the lower one, then the left side acoustic data will be further evaluated for compliance at the one-third octave band levels in accordance with S7.1.5. If the left-side value from S7.1.4(c) is not the lower one, the right-side acoustic data will be further evaluated for compliance at the one-third octave band level in accordance with S7.1.5.

S7.1.5 Select one-third octave bands to be used for evaluating compliance with detection requirements for a stationary vehicle.

(a) For each of the four left-side or right-side acoustic files, which ever was selected in S7.1.4, determine the sound pressure level in each one-third octave band from 315 Hz up to and including 5000 Hz.

(b) Correct the one-third octave band levels in all four sound files to adjust for the ambient sound level recorded during the test according to paragraph S6.7.

(c) For each one-third octave band, average the corrected levels from the four sound files. The results will be reported to the nearest tenth of a decibel.

(d) For alerts designed to meet the four-band requirements of S5.1 of this standard:

(i) Select any four one-third octave bands that are non-adjacent to each other and that span a range of at least nine one-third octave bands in the range of 315 Hz up to and including 5000 Hz to evaluate according to paragraph S7.1.5(d)(ii). This step will be repeated until compliance is established or it is determined that no combination meeting this selection criterion can satisfy paragraph S7.1.5(d)(ii).

(ii) Compare the average corrected sound pressure level from S7.1.5(c) in each of the four one-third octave bands selected in paragraph S7.1.5(d)(i) to the required minimum level of the corresponding one-third octave band specified in paragraph S5.1.1, Table 1, to determine compliance.

(e) For alerts designed to meet the two-band requirements of S5.2 of this standard:

(i) Select the two one-third octave bands, one below 1000 Hz and one at or above 1000 Hz, having the largest A-weighted SPL values within the range of 315 Hz up to 3150 Hz and that are non-adjacent to each other to evaluate according to S7.1.5(e)(ii), below. In the event that the pair of bands with the largest SPL values are the 800 Hz and 1000 Hz bands, then select both of the following pairs to evaluate according S7.1.5(e)(ii): The 800 Hz band along with the band having the second-largest A-weighted SPL value from the 1000 Hz and above bands; and, the 1000 Hz band along with the band having the second-largest A-weighted SPL value from the 800 Hz and below bands. At least one of the band pairs selected as specified in this paragraph shall meet the minimum requirements when evaluated according to S7.1.5(e)(ii).

(ii) Compare the average corrected sound pressure level from S7.1.5(c) in each of the two one-third octave bands selected in paragraph S7.1.5(e)(i) to the required minimum level of the corresponding one-third octave band specified in paragraph S5.2, Table 6. Also, compare the band sum of the two bands to the required minimum band sum in Table 6.

S7.1.6 Select one-third octave bands to be used for evaluating compliance with directivity requirements for a stationary vehicle.

(a) Determine the one-third octave band levels associated with the four front center sound files selected in S7.1.3.

(b) The identified one-third octave band levels in each of the four sound files will be corrected for the measured ambient levels as specified in paragraph S6.7.

(c) The four corrected sound pressure level values calculated from each of the four sound files in each one-third octave band will be averaged together to get the average corrected sound pressure level in each one-third octave band.

(d) For alerts designed to meet the four-band requirements of S5.1 of this standard:

(i) Select any four one-third octave bands that are non-adjacent to each other and that span a range of at least nine one-third octave bands in the range of 315 Hz up to and including 5000 Hz to evaluate according to paragraph S7.1.6(d)(ii). This step will be repeated until compliance is established or it is determined that no combination meeting this selection criterion can satisfy paragraph S7.1.6(d)(ii).

(ii) Compare the average corrected sound pressure level from S7.1.6(c) in each of the four one-third octave bands selected in paragraph S7.1.6(d)(i) to the required minimum level of the corresponding one-third octave band specified in paragraph S5.1.1, Table 1, to determine compliance.

(e) For alerts designed to meet the two-band requirements of S5.2 of this standard:

(i) Select the two one-third octave bands, one below 1000 Hz and one at or above 1000 Hz, having the largest A-weighted SPL values within the range of 315 Hz up to 3150 Hz and that are non-adjacent to each other to evaluate according to S7.1.6(e)(ii), below. In the event that the pair of bands with the largest SPL values are the 800 Hz and 1000 Hz bands, then select both of the following pairs to evaluate according S7.1.6(e)(ii): The 800 Hz band along with the band having the second-largest A-weighted SPL value from the 1000 Hz and above bands; and, the 1000 Hz band along with the band having the second-largest A-weighted SPL value from the 800 Hz and below bands. At least one of the band pairs selected as specified in this paragraph shall meet the minimum requirements when evaluated according to S7.1.6(e)(ii), below.

(ii) Compare the average corrected sound pressure level from S7.1.6(c) in each of the two one-third octave bands selected in paragraph S7.1.6(e)(i) to the required minimum level of the corresponding one-third octave band specified in paragraph S5.2, Table 6. Also, compare the band sum of the two bands to the required minimum band sum in Table 6.

S7.2 *Stationary vehicle in reverse gear.* Test the vehicle per S7.1.1 through S7.1.5 except that the rear plane of the vehicle is placed on the PP' line, no center microphone is used, and the vehicle's transmission gear selector is placed in the 'Reverse' position. The minimum sound level requirements for the Reverse test condition are contained in S5.1.2, Table 2, for four-band compliance and in S5.2, Table 6, for two-band compliance.

S7.3 *Constant speed pass-by tests at speeds greater than 0 km/h but less than 20 km/h.*

S7.3.1 Execute pass-by tests at 11km/h (±1 km/h) and collect acoustic sound files.

(a) For each test, measure the sound emitted by the test vehicle while at a constant speed of 11km/h (± 1km/h) throughout the measurement zone specified in S6.4 between lines AA' and PP'. Execute multiple test runs at 11km/h (±1km/h) to acquire at least four valid tests within 2dBA in accordance with S7.3.2 and S7.3.3.

(b) During each test, record a left (driver's side) and a right (passenger side) acoustic sound file.

S7.3.2 Eliminate invalid tests and acoustic sound files

(a) Determine validity of sound files collected during S7.3.1 tests. Measurements that contain any distinct, transient, background sounds (*e.g.*, chirping birds, overhead planes, car doors being slammed, etc.) are considered invalid. Measurements that contain sounds emitted by any vehicle system that is automatically activated and constantly engaged during the entire performance test are considered valid. Measurements that contain sound emitted by any vehicle system that is automatically activated, and intermittently engaged at any time during the performance test, are considered invalid. Additionally, when testing a hybrid vehicle with an internal combustion engine that runs intermittently during a specific test, measurements that contain sound emitted by the ICE are considered invalid. A valid test requires both a valid left side and a valid right side acoustic sound file.

(b) Tests which are deemed valid will be numbered sequentially based upon the chronological order in which they were collected. Sound files will retain their test sequence number and their association with the left side or right side microphone.

S7.3.3 Identify ''first four valid tests within 2 dBA''.

(a) For each valid test sound file identified in S7.3.2, determine a maximum overall SPL value, in decibels. The SPL value will be reported to the nearest tenth of a decibel.

(b) Compare the first four left side maximum overall SPL values. Of the four SPL values calculate the difference between the largest and smallest maximum SPL values. The same process will be used to determine the difference between the largest and smallest maximum SPL values for the first four right side maximum SPL values. If the difference values on the left and right sides of the test vehicle are both less than or equal to 2.0 dB, then the eight sound files associated with the first four valid tests will be used for the final one-third octave band evaluation in accordance with S7.3.4.

and S7.3.5. If the first four test sound files on each side of the vehicle are not within 2 dBA, an iterative process will be used to consider sound files from additional sequential tests until the range for both microphone locations are within 2 dBA for the same sequence number recordings for both locations.

S7.3.4 Determine average overall SPL value on each side (left and right) of test vehicle.

(a) Document the maximum overall SPL value in decibels for each of the eight acoustic sound data files (four left-side files and four right-side files) identified in S7.3.3.

(b) Each of the eight acoustic sound data file maximum overall SPL values will be corrected for the recorded ambient conditions as specified in paragraph S6.7. The test results will be reported to the nearest tenth of a decibel.

(c) Calculate the average of the four overall ambient-corrected SPL values on each side of the vehicle to derive one corrected maximum overall SPL value for each side of the vehicle. The result will be reported to the nearest tenth of a decibel.

(d) The side of the vehicle with the lowest average corrected maximum overall SPL value will be the side of the vehicle that is further evaluated for compliance at the one-third octave band levels in accordance with S7.3.5.

S7.3.5 Select one-third octave bands to be used for evaluating compliance with the constant speed pass-by requirements.

(a) The side of the vehicle selected in S7.3.4 will have four associated individual acoustic sound data files. Each sound file shall be broken down into its one-third octave band levels.

(b) The identified octave band levels in each of the four sound files will be corrected for the measured ambient levels as specified in paragraph S6.7.

(c) The four corrected sound pressure level values calculated from each of the four sound files in each one-third octave band will be averaged together to get the average corrected sound pressure level in each one-third octave band.

(d) For alerts designed to meet the four-band requirements of S5.1 of this standard:

(i) Select any four one-third octave bands that are non-adjacent to each other and that span a range of at least nine one-third octave bands in the range of 315 Hz up to and including 5000 Hz to evaluate according to paragraph S7.3.5(d)(ii). This step will be repeated until compliance is established or it is determined that no combination meeting this selection criterion can satisfy paragraph S7.3.5(d)(ii).

(ii) Compare the average corrected sound pressure level from S7.3.5(c) in each of the four one-third octave bands selected in paragraph S7.3.5(d)(i) to the required minimum level of the corresponding one-third octave band specified in paragraph S5.1.3, Table 3, to determine compliance.

(e) For alerts designed to meet the two-band requirements of S5.2 of this standard:

(i) Select the two one-third octave bands, one below 1000 Hz and one at or above 1000 Hz, having the largest A-weighted SPL values within the range of 315 Hz up to 3150 Hz and that are non-adjacent to each other to evaluate according to S7.3.5(e)(ii), below. In the event that the pair of bands with the largest SPL values are the 800 Hz and 1000 Hz bands, then select both of the following pairs to evaluate according S7.3.5(e)(ii): The 800 Hz band along with the band having the second-largest A-weighted SPL value from the 1000 Hz and above bands; and, the 1000 Hz band along with the band having the second-largest A-weighted SPL value from the 800 Hz and below bands. At least one of the band pairs selected as specified in this paragraph shall meet the minimum requirements when evaluated according to S7.3.5(e)(ii), below.

(ii) Compare the average corrected sound pressure level from S7.3.5(c) in each of the two one-third octave bands selected in paragraph S7.3.5(e)(i) to the required minimum level of the corresponding one-third octave band specified in paragraph S5.2, Table 6. Also, compare the band sum of the two bands to the required minimum band sum in Table 6.

S7.3.6 The procedures in S7.3.1 through S7.3.5 may be repeated for any pass-by test speed greater than 0 km/h and less than 20 km/h. For test speeds greater than 0 km/h and less than 10

km/h, the minimum sound level requirements are contained in S5.1.1, Table 1, for four-band compliance and in S5.2, Table 6, for two-band compliance. For test speeds greater than or equal to 10 km/h and less than 20 km/h, the minimum sound level requirements are contained in S5.1.3, Table 3, for 4-band compliance and in S5.2, Table 6, for 2-band compliance.

S7.4 *Pass-by tests at speeds greater than or equal to 20 km/h and less than 30 km/h.* Repeat the procedures of S7.3 at 21 km/h ± 1 km/h. The procedures in S7.3 also may be repeated for any pass-by test speed greater than 20 km/h and less than 30 km/h. For this range of test speeds, the minimum sound level requirements are contained in S5.1.4, Table 4, for four-band compliance and in S5.2, Table 6, for two-band compliance.

S7.5 *Pass-by tests at 30 km/h.* Repeat the procedures of S7.3 at 31 km/h ± 1 km/h. For this test speed, the minimum sound level requirements are contained in S5.1.5, Table 5, for four-band compliance and in S5.2, Table 6, for two-band compliance.

S7.6 *Relative volume change.* The valid test run data selected for each critical operating scenario in S7.1 (S7.1.5(c)), S7.3 (S7.3.5(c)), S7.4 and S7.5 will be used to derive relative volume change as required in S5.4 as follows:

S7.6.1 Calculate the average sound pressure level for each of the 13 one-third octave bands (315 Hz to 5000 Hz) using the four valid test runs identified for each critical operating scenario from S7.1.3 and S7.3.3 (stationary, 10 km/h (11±1km/h), 20 km/h (21±1km/h), and 30 km/h (31±1km/h)).

S7.6.2 For each critical operating scenario, normalize the levels of the 13 one-third octave bands by subtracting the corresponding minimum SPL values specified in Table 1 for the stationary operating condition from each of the one-third octave band averages calculated in S7.6.1.

S7.6.3 Calculate the NORMALIZED BAND SUM for each critical operating scenario (stationary, 10 km/h (11±1km/h), 20 km/h (21±1km/h), and 30 km/h (31±1km/h)) as follows:

$$NORMALIZEDBANDSUM = 10 * \log_{10}\left(\sum_{13}^{i=1} 10^{\frac{Normalized\ Band\ Level_i}{10}}\right)$$

Where:

i represents the 13 one-third octave bands and $Normalized\ Band\ Level_i$ is the normalized one-third octave band value derived in S7.6.2.

S7.6.4 Calculate the relative volume change between critical operating scenarios (stationary to 10km/h; 10km/h to 20 km/h; 20km/h to 30 km/h) by subtracting the NORMALIZED BAND SUM of the lower speed operating scenario from the NORMALIZED BAND SUM of the next higher speed operating scenario. *For example, the relative volume change between 10 km/h (11±1km/h) and 20 km/h (21±1km/h) would be the* NORMALIZED BAND SUM *level at 21±1km/h minus the* NORMALIZED BAND SUM *level at 11±1km/h.*

S8 *Prohibition on altering the sound of a vehicle subject to this standard.* No entity subject to the authority of the National Highway Traffic Safety Administration may:

(a) Disable, alter, replace, or modify any element of a vehicle installed as original equipment for purposes of complying with this Standard, except in connection with a repair of a vehicle malfunction or to remedy a defect or non-compliance; or

(b) Provide any person with any mechanism, equipment, process, or device intended to disable, alter, replace, or modify the sound emitting capability of a vehicle subject to this standard, except in connection with a repair of vehicle malfunction or to remedy a defect or non-compliance.

S9 *Phase-in schedule.*

S9.1 *Hybrid and Electric Vehicles manufactured on or after March 1, 2020, and before February 28, 2021.* For hybrid and electric vehicles to which this standard

applies manufactured on and after March 1, 2020, and before March 1, 2021, except vehicles produced by small volume manufacturers, the quantity of hybrid and electric vehicles complying with this safety standard shall be not less than 50 percent of one or both of the following:

(a) A manufacturer's average annual production of hybrid and electric vehicles on and after September 1, 2016, and before September 1, 2019;

(b) A manufacturer's total production of hybrid and electric vehicles on and after March 1, 2020, and before March 1, 2021.

S9.2 *Hybrid and Electric Vehicles manufactured on or after March 1, 2021.* All hybrid and electric vehicles to which this standard applies manufactured on or after March 1, 2021, shall comply with this safety standard.

[81 FR 90514, Dec. 14, 2016, as amended at 83 FR 8196, Feb. 26, 2018; 85 FR 54280, Sept. 1, 2020; 87 FR 41625, July 13, 2022]

§ 571.201 Standard No. 201; Occupant protection in interior impact.

S1. *Purpose and scope.* This standard specifies requirements to afford impact protection for occupants.

S2. *Application.* This standard applies to passenger cars and to multipurpose passenger vehicles, trucks designed to carry at least one person, and buses with a GVWR of 4,536 kilograms or less, except that the requirements of S6 do not apply to buses with a GVWR of more than 3,860 kilograms.

S3. *Definitions.*

A-pillar means any pillar that is entirely forward of a transverse vertical plane passing through the seating reference point of the driver's designated seating position or, if there is no driver's designated seating position, any pillar that is entirely forward of a transverse vertical plane passing through the seating reference point of the rearmost designated seating position in the front row of seats.

Ambulance means a motor vehicle designed exclusively for the purpose of emergency medical care, as evidenced by the presence of a passenger compartment to accommodate emergency medical personnel, one or more patients on litters or cots, and equipment and supplies for emergency care at a location or during transport.

B-pillar means the forwardmost pillar on each side of the vehicle that is, in whole or in part, rearward of a transverse vertical plane passing through the seating reference point of the driver's designated seating position or, if there is no driver's designated seating position, the forwardmost pillar on each side of the vehicle that is, in whole or in part, rearward of a transverse vertical plane passing through the seating reference point of the rearmost designated seating position in the front row of seats, unless:

(1) There is only one pillar rearward of that plane and it is also a rearmost pillar; or

(2) There is a door frame rearward of the A-pillar and forward of any other pillar or rearmost pillar.

Brace means a fixed diagonal structural member in an open body vehicle that is used to brace the roll-bar and that connects the roll-bar to the main body of the vehicle structure.

Convertible means a vehicle whose A-pillars are not joined with the B-pillars (or rearmost pillars) by a fixed, rigid structural member.

Convertible roof frame means the frame of a convertible roof.

Convertible roof linkage mechanism means any anchorage, fastener, or device necessary to deploy a convertible roof frame.

Daylight opening means, for openings on the side of the vehicle, other than a door opening, the locus of all points where a horizontal line, perpendicular to the vehicle longitudinal centerline, is tangent to the periphery of the opening. For openings on the front and rear of the vehicle, other than a door opening, *daylight opening* means the locus of all points where a horizontal line, parallel to the vehicle longitudinal centerline, is tangent to the periphery of the opening. If the horizontal line is tangent to the periphery at more than one point at any location, the most inboard point is used to determine the daylight opening.

Door frame means the rearmost perimeter structure, including trim but excluding glass, of the forward door and the forwardmost perimeter structure, including trim but excluding

glass, of the rear door of a pair of adjacent side doors that:

(1) Have opposing hinges;

(2) Latch together without engaging or contacting an intervening pillar;

(3) Are forward of any pillar other than the A-pillar on the same side of the vehicle; and

(4) Are rearward of the A-pillar.

Door opening means, for door openings on the side of the vehicle, the locus of all points where a horizontal line, perpendicular to the vehicle longitudinal centerline, is tangent to the periphery of the side door opening. For door openings on the back end of the vehicle, *door opening* means the locus of all points where a horizontal line, parallel to the vehicle longitudinal centerline, is tangent to the periphery of the back door opening. If the horizontal line is tangent to the periphery at more than one point at any location, the most inboard point is the door opening.

Dynamically deployed upper interior head protection system means a protective device or devices which are integrated into a vehicle and which, when activated by an impact, provide, through means requiring no action from occupants, protection against head impacts with upper interior structures and components of the vehicle in crashes.

Forehead impact zone means the part of the free motion headform surface area that is determined in accordance with the procedure set forth in S8.10.

Free motion headform means a test device which conforms to the specifications of part 572, subpart L of this chapter.

Interior rear quarter panel means a vehicle interior component located between the rear edge of the side door frame, the front edge of the rearmost seat back, and the daylight opening.

Mid-sagittal plane of a dummy means a longitudinal vertical plane passing through the seating reference point of a designated seating position.

Other door frame means the rearmost perimeter structure, including trim but excluding glass, of the forward door and the forwardmost perimeter structure, including trim but excluding glass, of the rear door of a pair of adjacent side doors that:

(1) Have opposing hinges;

(2) Latch together without engaging or contacting an intervening pillar; and

(3) Are rearward of the B-pillar.

Other pillar means any pillar which is not an A-pillar, a B-pillar, or a rearmost pillar.

Pillar means any structure, excluding glazing and the vertical portion of door window frames, but including accompanying moldings, attached components such as safety belt anchorages and coat hooks, which:

(1) If there is a driver's designated seating position, supports either a roof or any other structure (such as a roll-bar) that is above the driver's head, or if there is no driver's designated seating position, supports either a roof or any other structure (such as a roll-bar) that is above the occupant in the rearmost designated seating position in the front row of seats, or

(2) Is located along the side edge of a window.

Roll-bar means a fixed overhead structural member, including its vertical support structure, that extends from the left to the right side of the passenger compartment of any open body vehicles and convertibles. It does not include a header.

Seat belt anchorage means any component involved in transferring seat belt loads to the vehicle structure, including, but not limited to, the attachment hardware, but excluding webbing or straps, seat frames, seat pedestals, and the vehicle structure itself, whose failure causes separation of the belt from the vehicle structure.

Seat belt mounting structure means:

(a) A vehicle body or frame component, including trim, that incorporates an upper seat belt anchorage conforming to the requirements of S4.2.1 and S4.3.2 of 49 CFR 571.210, that is located rearward of the rearmost outboard designated seating position, and that extends above a horizontal plane 660 mm above the seating reference point (SgRP) of that seating position; and

(b) A vehicle body or frame component, including trim, that incorporates an upper seat belt anchorage conforming to the requirements of S4.2.1

and S4.3.2 of 49 CFR 571.210, that is located forward of the rearmost outboard designated seating position, and that extends above a horizontal plane 460 mm above the SgRP of that seating position located rearward of the anchorage.

(c) The seat belt mounting structure is not a pillar, roll bar, brace or stiffener, side rail, seat, interior rear quarter panel, or part of the roof.

Sliding door track means a track structure along the upper edge of a side door opening that secures the door in the closed position and guides the door when moving to and from the open position.

Stiffener means a fixed overhead structural member that connects one roll-bar to another roll-bar or to a header of any open body vehicle or convertible.

Upper roof means the area of the vehicle interior that is determined in accordance with the procedure set forth in S8.15.

Windshield trim means molding of any material between the windshield glazing and the exterior roof surface, including material that covers a part of either the windshield glazing or exterior roof surface.

S4 *Requirements*

S4.1 Except as provided in S4.2, each vehicle shall comply with either:

(a) The requirements specified in S5, or,

(b) The requirements specified in S5 and S6.

S4.2 Vehicles manufactured on or after September 1, 1998 shall comply with the requirements of S5 and S6.

S5 *Requirements for instrument panels, seat backs, interior compartment doors, sun visors, and armrests.* Each vehicle shall comply with the requirements specified in S5.1 through S5.5.2.

S5.1 *Instrument panels.* Except as provided in S5.1.1, when that area of the instrument panel that is within the head impact area is impacted in accordance with S5.1.2 by a 6.8 kilogram, 165 mm diameter head form at—

(a) A relative velocity of 24 kilometers per hour for all vehicles except those specified in paragraph (b) of this section,

(b) A relative velocity of 19 kilometers per hour for vehicles that meet the occupant crash protection requirements of S5.1 of 49 CFR 571.208 by means of inflatable restraint systems and meet the requirements of S4.1.5.1(a)(3) by means of a Type 2 seat belt assembly at any front passenger designated seating position, the deceleration of the head form shall not exceed 80 g continuously for more than 3 milliseconds.

S5.1.1 The requirements of S5.1 do not apply to:

(a) Console assemblies;

(b) Areas less than 125 mm inboard from the juncture of the instrument panel attachment to the body side inner structure;

(c) Areas closer to the windshield juncture than those statically contactable by the head form with the windshield in place;

(d) If the steering control is present, areas outboard of any point of tangency on the instrument panel of a 165 mm diameter head form tangent to and inboard of a vertical longitudinal plane tangent to the inboard edge of the steering control; or

(e) Areas below any point at which a vertical line is tangent to the rearmost surface of the panel.

S5.1.2 *Demonstration procedures.* Tests shall be performed as described in SAE Recommended Practice J921 (1965) (incorporated by reference, see § 571.5), using the specified instrumentation or instrumentation that meets the performance requirements specified in SAE Recommended Practice J977 (1966) (incorporated by reference, see § 571.5), except that:

(a) The origin of the line tangent to the instrument panel surface shall be a point on a transverse horizontal line through a point 125 mm horizontally forward of the seating reference point of any front outboard passenger designated seating position, displaced vertically an amount equal to the rise which results from a 125 mm forward adjustment of the seat or 19 mm; and

(b) Direction of impact shall be either:

(1) In a vertical plane parallel to the vehicle longitudinal axis; or

(2) In a plane normal to the surface at the point of contact.

S5.2 *Seat Backs.* Except as provided in S5.2.1, when that area of the seat

back that is within the head impact area is impacted in accordance with S5.2.2 by a 6.8 kilogram, 165 mm diameter head form at a relative velocity of 24 kilometers per hour, the deceleration of the head form shall not exceed 80g continuously for more than 3 milliseconds.

S5.2.1 The requirements of S5.2 do not apply to seats installed in school buses which comply with the requirements of Standard No. 222, *School Bus Passenger Seating and Occupant Protection* (49 CFR 571.222) or to rearmost side-facing, back-to-back, folding auxiliary jump, and temporary seats.

S5.2.2 *Demonstration procedures.* Tests shall be performed as described in SAE Recommended Practice J921 (1965) (incorporated by reference, see §571.5), using the specified instrumentation or instrumentation that meets the performance requirements specified in SAE Recommended Practice J977 (1966) (incorporated by reference, see §571.5), except that:

(a) The origin of the line tangent to the uppermost seat back frame component shall be a point on a transverse horizontal line through the seating reference point of the right rear designated seating position, with adjustable forward seats in their rearmost design driving position and reclinable forward seat backs in their nominal design driving position;

(b) Direction of impact shall be either:

(1) In a vertical plane parallel to the vehicle longitudinal axis; or

(2) In a plane normal to the surface at the point of contact.

(c) For seats without head restraints installed, tests shall be performed for each individual split or bucket seat back at points within 100 mm left and right of its centerline, and for each bench seat back between points 100 mm outboard of the centerline of each outboard designated seating position;

(d) For seats having head restraints installed, each test shall be conducted with the head restraints in place at its lowest adjusted position, at a point on the head restraint centerline; and

(e) For a seat that is installed in more than one body style, tests conducted at the fore and aft extremes identified by application of subparagraph (a) shall be deemed to have demonstrated all intermediate conditions.

S5.3 *Interior compartment doors.* Each interior compartment door assembly located in an instrument panel, console assembly, seat back, or side panel adjacent to a designated seating position shall remain closed when tested in accordance with either S5.3.1(a) and S5.3.1(b) or S5.3.1(a) and S5.3.1(c). Additionally, any interior compartment door located in an instrument panel or seat back shall remain closed when the instrument panel or seat back is tested in accordance with S5.1 and S5.2. All interior compartment door assemblies with a locking device must be tested with the locking device in an unlocked position.

S5.3.1 *Demonstration procedures.*

(a) Subject the interior compartment door latch system to an inertia load of 10g in a horizontal transverse direction and an inertia load of 10g in a vertical direction in accordance with the procedure described in section 5 of SAE Recommended Practice J839b (1965) (incorporated by reference, see §571.5), or an approved equivalent.

(b) Impact the vehicle perpendicularly into a fixed collision barrier at a forward longitudinal velocity of 48 kilometers per hour.

(c) Subject the interior compartment door latch system to a horizontal inertia load of 30g in a longitudinal direction in accordance with the procedure described in section 5 of SAE Recommended Practice J839b (1965) (incorporated by reference, see §571.5), or an approved equivalent.

S5.4 *Sun visors.*

S5.4.1 A sun visor that is constructed of or covered with energy-absorbing material shall be provided for each front outboard designated seating position.

S5.4.2 Each sun visor mounting shall present no rigid material edge radius of less than 3.2 mm that is statically contactable by a spherical 165 mm diameter head form.

S5.5 *Armrests.*

S5.5.1 *General.* Each installed armrest shall conform to at least one of the following:

(a) It shall be constructed with energy-absorbing material and shall deflect or collapse laterally at least 50

mm without permitting contact with any underlying rigid material.

(b) It shall be constructed with energy-absorbing material that deflects or collapses to within 32 mm of a rigid test panel surface without permitting contact with any rigid material. Any rigid material between 13 and 32 mm from the panel surface shall have a minimum vertical height of not less than 25 mm.

(c) Along not less than 50 continuous mm of its length, the armrest shall, when measured vertically in side elevation, provide at least 50 mm of coverage within the pelvic impact area.

S5.5.2 *Folding armrests.* Each armrest that folds into the seat back or between two seat backs shall either:

(a) Meet the requirements of S5.5.1; or

(b) Be constructed of or covered with energy-absorbing material.

S6 *Requirements for upper interior components.*

S6.1 *Vehicles manufactured on or after September 1, 1998.* Except as provided in S6.3 and S6.1.4, for vehicles manufactured on or after September 1, 1998 and before September 1, 2002, a percentage of the manufacturer's production, as specified in S6.1.1, S6.1.2, or S6.1.3 shall conform, at the manufacturer's option, to either S6.1(a) or S6.1(b). For vehicles manufactured by final stage manufacturers on or after September 1, 1998 and before September 1, 2006, a percentage of the manufacturer's production as specified in S6.1.4 shall, except as provided in S6.3, conform, to either S6.1(a) or S6.1(b). The manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle.

(a) When tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). The requirements do not apply to any target that cannot be located using the procedures of S10.

(b) When equipped with a dynamically deployed upper interior head protection system and tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 as follows:

(1) Targets that are not located over any point inside the area measured along the contour of the vehicle surface within 50 mm (2.0 inch) of the periphery of the stowed system projected perpendicularly onto the vehicle interior surface, including mounting and inflation components but exclusive of any cover or covers, shall be impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). The requirements do not apply to any targets that can not be located by using the procedures of S10.

(2) Targets that are over any point inside the area measured along the contour of the vehicle interior within 50 mm (2.0 inch) of the periphery of the stowed system projected perpendicularly onto the vehicle interior surface, including mounting and inflation components but exclusive of any cover or covers, when the dynamically deployed upper interior head protection system is not deployed, shall be impacted by the free motion headform specified in S8.9 at any speed up to and including 19 km/h (12 mph) with the system undeployed. The requirements do not apply to any target that can not be located using the procedures of S10.

(3) Each vehicle shall, when equipped with a dummy test device specified in Part 572, subpart M, and tested as specified in S8.16 through S8.28, comply with the requirements specified in S7 when crashed into a fixed, rigid pole of 254 mm in diameter, at any velocity between 24 kilometers per hour (15 mph) and 29 kilometers per hour (18 mph).

S6.1.1 *Phase-in Schedule #1*

S6.1.1.1 *Vehicles manufactured on or after September 1, 1998 and before September 1, 1999.* Subject to S6.1.5(a), for vehicles manufactured by a manufacturer on or after September 1, 1998 and before September 1, 1999, the amount of vehicles complying with S7 shall be not less than 10 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1996 and before September 1, 1999, or

(b) The manufacturer's production on or after September 1, 1998 and before September 1, 1999.

S6.1.1.2 *Vehicles manufactured on or after September 1, 1999 and before September 1, 2000.* Subject to S6.1.5(b), for vehicles manufactured by a manufacturer on or after September 1, 1999 and before September 1, 2000, the amount of vehicles complying with S7 shall be not less than 25 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1997 and before September 1, 2000, or

(b) The manufacturer's production on or after September 1, 1999 and before September 1, 2000.

S6.1.1.3 *Vehicles manufactured on or after September 1, 2000 and before September 1, 2001.* Subject to S6.1.5(c), for vehicles manufactured by a manufacturer on or after September 1, 2000 and before September 1, 2001, the amount of vehicles complying with S7 shall be not less than 40 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1998 and before September 1, 2001, or

(b) The manufacturer's production on or after September 1, 2000 and before September 1, 2001.

S6.1.1.4 *Vehicles manufactured on or after September 1, 2001 and before September 1, 2002.* Subject to S6.1.5(d), for vehicles manufactured by a manufacturer on or after September 1, 2001 and before September 1, 2002, the amount of vehicles complying with S7 shall be not less than 70 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1999 and before September 1, 2002, or

(b) The manufacturer's production on or after September 1, 2001 and before September 1, 2002.

S6.1.2 *Phase-in Schedule #2*

S6.1.2.1 *Vehicles manufactured on or after September 1, 1998 and before September 1, 1999.* Subject to S6.1.5(a), for vehicles manufactured by a manufacturer on or after September 1, 1998 and before September 1, 1999, the amount of vehicles complying with S7 shall be not less than seven percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1996 and before September 1, 1999, or

(b) The manufacturer's production on or after September 1, 1998 and before September 1, 1999.

S6.1.2.2 *Vehicles manufactured on or after September 1, 1999 and before September 1, 2000.* Subject to S6.1.5(b), for vehicles manufactured by a manufacturer on or after September 1, 1999 and before September 1, 2000, the amount of vehicles complying with S7 shall be not less than 31 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1997 and before September 1, 2000, or

(b) The manufacturer's production on or after September 1, 1999 and before September 1, 2000.

S6.1.2.3 *Vehicles manufactured on or after September 1, 2000 and before September 1, 2001.* Subject to S6.1.5(c), for vehicles manufactured by a manufacturer on or after September 1, 2000 and before September 1, 2001, the amount of vehicles complying with S7 shall be not less than 40 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1998 and before September 1, 2001, or

(b) The manufacturer's production on or after September 1, 2000 and before September 1, 2001.

S6.1.2.4 *Vehicles manufactured on or after September 1, 2001 and before September 1, 2002.* Subject to S6.1.5(d), for vehicles manufactured by a manufacturer on or after September 1, 2001 and before September 1, 2002, the amount of vehicles complying with S7 shall be not less than 70 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 1999 and before September 1, 2002, or

(b) The manufacturer's production on or after September 1, 2001 and before September 1, 2002.

S6.1.3 *Phase-in Schedule #3*

S6.1.3.1 Vehicles manufactured on or after September 1, 1998 and before September 1, 1999 are not required to comply with the requirements specified in S7.

S6.1.3.2 Vehicles manufactured on or after September 1, 1999 shall comply with the requirements specified in S7.

S6.1.4 *Phase-in Schedule #4* A final stage manufacturer or alterer may, at

its option, comply with the requirements set forth in S6.1.4.1 and S6.1.4.2.

S6.1.4.1 Vehicles manufactured on or after September 1, 1998 and before September 1, 2009 are not required to comply with the requirements specified in S7.

S6.1.4.2 Vehicles manufactured on or after September 1, 2009 shall comply with the requirements specified in S7.

S6.1.5 *Calculation of complying vehicles.*

(a) For the purposes of complying with S6.1.1.1 or S6.1.2.1, a manufacturer may count a vehicle if it is manufactured on or after May 8, 1997, but before September 1, 1999.

(b) For the purposes of complying with S6.1.1.2 or S6.1.2.2, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after May 8, 1997, but before September 1, 2000, and

(2) Is not counted toward compliance with S6.1.1.1 or S6.1.2.1, as appropriate.

(c) For the purposes of complying with S6.1.1.3 or S6.1.2.3, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after May 8, 1997, but before September 1, 2001, and

(2) Is not counted toward compliance with S6.1.1.1, S6.1.1.2, S6.1.2.1, or S6.1.2.2, as appropriate.

(d) For the purposes of complying with S6.1.1.4 or S6.1.2.4, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after May 8, 1997, but before September 1, 2002, and

(2) Is not counted toward compliance with S6.1.1.1, S6.1.1.2, S6.1.1.3, S6.1.2.1, S6.1.2.2, or S6.1.2.3, as appropriate.

S6.1.6 *Vehicles produced by more than one manufacturer.*

S6.1.6.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S6.1.1 through S6.1.4, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S6.1.6.2.

(a) A vehicle which is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer which markets the vehicle.

S6.1.6.2 A vehicle produced by more than one manufacturer must be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S6.1.6.1.

S6.2 *Vehicles manufactured on or after September 1, 2002 and vehicles built in two or more stages manufactured after September 1, 2006.* Except as provided in S6.1.4 and S6.3, vehicles manufactured on or after September 1, 2002 shall, when tested under the conditions of S8, conform, at the manufacturer's option, to either S6.2(a) or S6.2(b). Vehicles manufactured by final stage manufacturers on or after September 1, 2006 shall, except as provided in S6.3, when tested under the conditions of S8, conform, at the manufacturer's option, to either S6.2(a) or S6.2(b). The manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle.

(a) When tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). The requirements do not apply to any target that cannot be located using the procedures of S10.

(b) When equipped with a dynamically deployed upper interior head protection system and tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 as follows:

(1) Targets that are not located over any point inside the area measured along the contour of the vehicle surface within 50 mm (2.0 inch) of the periphery of the stowed system projected perpendicularly onto the vehicle interior surface, including mounting and inflation components but exclusive of any cover or covers, shall be impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). The requirements do

not apply to any targets that cannot be located by using the procedures of S10.

(2) Targets that are over any point inside the area measured along the contour of the vehicle interior within 50 mm (2.0 inch) of the periphery of the stowed system projected perpendicularly onto the vehicle interior surface, including mounting and inflation components but exclusive of any cover or covers, when the dynamically deployed upper interior head protection system is not deployed, shall be impacted by the free motion headform specified in S8.9 at any speed up to and including 19 km/h (12 mph) with the system undeployed. The requirements do not apply to any target that cannot be located using the procedures of S10.

(3) Except as provided in S6.2(b)(4), each vehicle shall, when equipped with a dummy test device specified in 49 CFR part 572, subpart M, and tested as specified in S8.16 through S8.28, comply with the requirements specified in S7 when crashed into a fixed, rigid pole of 254 mm in diameter, at any velocity between 24 kilometers per hour (15 mph) and 29 kilometers per hour (18 mph).

(4) Vehicles certified as complying with the vehicle-to-pole requirements of S9 of 49 CFR 571.214, *Side Impact Protection*, need not comply with the pole test requirements specified in S6.2(b)(3) of this section.

S6.3 A vehicle need not meet the requirements of S6.1 through S6.2 for:

(a) Any target located on a convertible roof frame or a convertible roof linkage mechanism.

(b) Any target located rearward of a vertical plane 600 mm behind the seating reference point of the rearmost designated seating position. For altered vehicles and vehicles built in two or more stages, including ambulances and motor homes, any target located rearward of a vertical plane 300 mm behind the seating reference point of the driver's designated seating position or the rearmost designated seating position in the front row of seats, if there is no driver's designated seating position (tests for altered vehicles and vehicles built in two or more stages do not include, within the time period for measuring HIC(d), any free motion headform contact with components rearward of this plane). If an altered vehicle or vehicle built in two or more stages is equipped with a transverse vertical partition positioned between the seating reference point of the driver's designated seating position and a vertical plane 300 mm behind the seating reference point of the driver's designated seating position, any target located rearward of the vertical partition is excluded.

(c) Any target in a vehicle manufactured in two or more stages that is delivered to a final stage manufacturer without an occupant compartment. Note: Motor homes, ambulances, and other vehicles manufactured using a chassis cab, a cut-away van, or any other incomplete vehicle delivered to a final stage manufacturer with a furnished front compartment are not excluded under this S6.3(c).

(d) Any target in a walk-in van-type vehicles.

(e) Any target located on the seat belt mounting structures, door frames and other door frames before December 1, 2005.

S7 *Performance Criterion.* The HIC(d) shall not exceed 1000 when calculated in accordance with the following formula:

$$\mathrm{HIC} = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a\,dt \right]^{2.5} (t_2 - t_1)$$

Where the term a is the resultant head acceleration expressed as a multiple of g (the acceleration of gravity), and t1 and t2 are any two points in time during the impact which are separated by not more than a 36 millisecond time interval.

(a) For the free motion headform; HIC(d) = 0.75446 (free motion headform HIC) + 166.4.

(b) For the part 572, subpart M, anthropomorphic test dummy; HIC(d) = HIC.

S8 *Target location and test conditions.* The vehicle shall be tested and the targets specified in S10 located under the following conditions.

S8.1 *Vehicle test attitude.*

(a) The vehicle is supported off its suspension at an attitude determined in accordance with S8.1(b).

(b) Directly above each wheel opening, determine the vertical distance between a level surface and a standard

reference point on the test vehicle's body under the conditions of S8.1(b)(1) through S8.1(b)(3).

(1) The vehicle is loaded to its unloaded vehicle weight, plus its rated cargo and luggage capacity or 136 kg, whichever is less, secured in the luggage area. The load placed in the cargo area is centered over the longitudinal centerline of the vehicle.

(2) The vehicle is filled to 100 percent of all fluid capacities.

(3) All tires are inflated to the manufacturer's specifications listed on the vehicle's tire placard.

S8.2 *Windows and Sunroofs.*

(a) Movable vehicle windows are placed in the fully open position.

(b) For testing, any window on the opposite side of the longitudinal centerline of the vehicle from the target to be impacted may be removed.

(c) For testing, movable sunroofs are placed in the fully open position.

S8.3 *Convertible tops.* The top, if any, of convertibles and open-body type vehicles is in the closed passenger compartment configuration.

S8.4 *Doors.*

(a) Except as provided in S8.4(b) or S8.4(c), doors, including any rear hatchback or tailgate, are fully closed and latched but not locked.

(b) During testing, any side door on the opposite side of the longitudinal centerline of the vehicle from the target to be impacted may be open or removed.

(c) During testing, any rear hatchback or tailgate may be open or removed for testing any target except targets on the rear header, rearmost pillars, or the rearmost other side rail on either side of the vehicle.

S8.5 *Sun visors.* Each sun visor shall be placed in any position where one side of the visor is in contact with the vehicle interior surface (windshield, side rail, front header, roof, etc.).

S8.6 *Steering control and seats.*

(a) During targeting, the steering control and seats may be placed in any position intended for use while the vehicle is in motion.

(b) During testing, the steering control and seats may be removed from the vehicle.

S8.7 *Seat belt anchorages.* If a target is on a seat belt anchorage, and if the seat belt anchorage is adjustable, tests are conducted with the anchorage adjusted to a point midway between the two extreme adjustment positions. If the anchorage has distinct adjustment positions, none of which is midway between the two extreme positions, tests are conducted with the anchorage adjusted to the nearest position above the midpoint of the two extreme positions.

S8.8 *Temperature and humidity.*

(a) The ambient temperature is between 19 degrees C. and 26 degrees C., at any relative humidity between 10 percent and 70 percent.

(b) Tests are not conducted unless the headform specified in S8.9 is exposed to the conditions specified in S8.8(a) for a period not less than four hours.

S8.9 *Headform.* The headform used for testing conforms to the specifications of part 572, subpart L of this chapter.

S8.10 *Forehead impact zone.* The forehead impact zone of the headform is determined according to the procedure specified in (a) through (f).

(a) Position the headform so that the baseplate of the skull is horizontal. The midsagittal plane of the headform is designated as Plane S.

(b) From the center of the threaded hole on top of the headform, draw a 69 mm line forward toward the forehead, coincident with Plane S, along the contour of the outer skin of the headform. The front end of the line is designated as Point P. From Point P, draw a 100 mm line forward toward the forehead, coincident with Plane S, along the contour of the outer skin of the headform. The front end of the line is designated as Point O.

(c) Draw a 125 mm line which is coincident with a horizontal plane along the contour of the outer skin of the forehead from left to right through Point O so that the line is bisected at Point O. The end of the line on the left side of the headform is designated as Point a and the end on the right as Point b.

(d) Draw another 125 mm line which is coincident with a vertical plane along the contour of the outer skin of the forehead through Point P so that the line is bisected at Point P. The end

of the line on the left side of the headform is designated as Point c and the end on the right as Point d.

(e) Draw a line from Point a to Point c along the contour of the outer skin of the headform using a flexible steel tape. Using the same method, draw a line from Point b to Point d.

(f) The forehead impact zone is the surface area on the FMH forehead bounded by lines a-O-b and c-P-d, and a-c and b-d.

S8.11 *Target circle.* The area of the vehicle to be impacted by the headform is marked with a solid circle 12.7 mm in diameter, centered on the targets specified in S10, using any transferable opaque coloring medium.

S8.12 *Location of head center of gravity.*

(a) *Location of head center of gravity for front outboard designated seating positions (CG-F).* For determination of head center of gravity, all directions are in reference to the seat orientation.

(1) *Location of rearmost CG-F (CG-F2).* For front outboard designated seating positions, the head center of gravity with the seat in its rearmost normal design driving or riding position (CG-F2) is located 160 mm rearward and 660 mm upward from the seating reference point.

(2) *Location of forwardmost CG-F (CG-F1).* For front outboard designated seating positions, the head center of gravity with the seat in its forwardmost adjustment position (CG-F1) is located horizontally forward of CG-F2 by the distance equal to the fore-aft distance of the seat track.

(b) *Location of head center of gravity for rear outboard designated seating positions (CG-R).* For rear outboard designated seating positions, the head center of gravity (CG-R) is located 160 mm rearward, relative to the seat orientation, and 660 mm upward from the seating reference point.

S8.13 *Impact configuration.*

S8.13.1 The headform is launched from any location inside the vehicle which meets the conditions of S8.13.4. At the time of launch, the midsagittal plane of the headform is vertical and the headform is upright.

S8.13.2 The headform travels freely through the air, along a velocity vector that is perpendicular to the headform's skull cap plate, not less than 25 mm before making any contact with the vehicle.

S8.13.3 At the time of initial contact between the headform and the vehicle interior surface, some portion of the forehead impact zone of the headform must contact some portion of the target circle.

S8.13.4 *Approach angles.* The headform launching angle is as specified in Table 1. For components for which Table 1 specifies a range of angles, the headform launching angle is within the limits determined using the procedures specified in S8.13.4.1 and S8.13.4.2, and within the range specified in Table 1, using the orthogonal reference system specified in S9.

TABLE 1—APPROACH ANGLE LIMITS (IN DEGREES)

Target component	Horizontal Angle	Vertical angle
Front Header	180	0–50
Rear Header	0 or 360	0–50
Left Side Rail	270	0–50
Right Side Rail	90	0–50
Left Sliding Door Track	270	0–50
Right Sliding Door Track	90	0–50
Left A-Pillar	195–255	−5–50
Right A-Pillar	105–165	−5–50
Left B-Pillar	195–345	−10–50
Right B-Pillar	15–165	−10–50
Left Door Frame	195–345	−10–50
Right Door Frame	15–165	−10–50
Other Left Pillars	270	−10–50
Other Right Pillars	90	−10–50
Other Left Door Frame	270	−10–50
Other Right Door Frame	90	−10–50
Left Rearmost Pillar	270–345	−10–50
Right Rearmost Pillar	15–90	−10–50
Upper Roof	Any	0–50
Overhead Rollbar	0 or 180	0–50
Brace or Stiffener	90 or 270	0–50

TABLE 1—APPROACH ANGLE LIMITS (IN DEGREES)—Continued

Target component	Horizontal Angle	Vertical angle
Left Seat Belt Mounting Structure	195–345	−10–50
Right Seat Belt Mounting Structure	15–165	−10–50
Seat Belt Anchorages	Any	0–50

S8.13.4.1 *Horizontal Approach Angles for Headform Impacts.*

(a) *Left A-Pillar Horizontal Approach Angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F1 for the left seat and the right A-pillar. The maximum horizontal approach angle for the left A-pillar equals 360 degrees minus the angle formed by that line and the X-axis of the vehicle, measured counterclockwise.

(2) Locate a line formed by the shortest horizontal distance between CG-F2 for the left seat and the left A-pillar. The minimum horizontal approach angle for the left A-pillar impact equals the angle formed by that line and the X-axis of the vehicle, measured counterclockwise.

(b) *Right A-Pillar Horizontal Approach Angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F1 for the right seat and the left A-pillar. The minimum horizontal approach angle for the right A-pillar equals 360 degrees minus the angle formed by that line and the X-axis of the vehicle, measured counterclockwise.

(2) Locate a line formed by the shortest horizontal distance between CG-F2 for the right seat and the right A-pillar. The maximum horizontal approach angle for the right A-pillar impact equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise.

(c) *Left B-Pillar Horizontal Approach Angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F2 for the left seat and the left B-pillar. The maximum horizontal approach angle for the left B-pillar equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise, or 270 degrees, whichever is greater.

(2) Locate a line formed by the shortest horizontal distance between CG-R for the left seat and the left B-pillar. The minimum horizontal approach angle for the left B-pillar equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise.

(d) *Right B-Pillar Horizontal Approach Angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F2 for the right seat and the right B-pillar. The minimum horizontal approach angle for the right B-pillar equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise, or 90 degrees, whichever is less.

(2) Locate a line formed by the shortest horizontal distance between CG-R for the right seat and the right B-pillar. The maximum horizontal approach angle for the right B-pillar equals the angle between that line and the X-axis of the vehicle measured counterclockwise.

(e) *Left door frame horizontal approach angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F2 for the left seat and the left door frame. The maximum horizontal approach angle for the left door frame equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise, or 270 degrees, whichever is greater.

(2) Locate a line formed by the shortest horizontal distance between CG-R for the left seat and the left door frame. The minimum horizontal approach angle for the left door frame equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise.

(f) *Right door frame horizontal approach angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F2 for the right seat and the right door frame. The minimum horizontal approach angle for the right door frame

equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise, or 90 degrees, whichever is less.

(2) Locate a line formed by the shortest horizontal distance between CG-R for the right seat and the right door frame. The maximum horizontal approach angle for the right door frame equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise

(g) *Left seat belt mounting structure horizontal approach angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F2 for the left seat and the left seat belt mounting structure. If the seat belt mounting structure is below a horizontal plane passing through CG-F2 for the left seat, locate the point 200 mm directly below CG-F2 and locate a line formed by the shortest horizontal distance between that point and the left seat belt mounting structure. The maximum horizontal approach angle for the left seat belt mounting structure equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise, or 270 degrees, whichever is greater.

(2) Locate a line formed by the shortest horizontal distance between CG-R for the left seat and the left seat belt mounting structure. If the seat belt mounting structure is below a horizontal plane passing through CG-R for the left seat, locate the point 200 mm directly below CG-R and locate a line formed by the shortest horizontal distance between that point and the left seat belt mounting structure. The minimum horizontal approach angle for the left seat belt mounting structure equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise. If the CG-R does not exist, or is forward of the seat belt mounting structure, the maximum horizontal approach angle is 270 degrees.

(h) *Right seat belt mounting structure horizontal approach angles.*

(1) Locate a line formed by the shortest horizontal distance between CG-F2 for the right seat and the right seat belt mounting structure. If the seat belt mounting structure is below a horizontal plane passing through CG-F2 for the right seat, locate the point 200 mm directly below that CG-F2 and locate a line formed by the shortest horizontal distance between that point and the right seat belt mounting structure. The minimum horizontal approach angle for the right seat belt mounting structure equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise, or 90 degrees, whichever is less.

(2) Locate a line formed by the shortest horizontal distance between CG-R for the right seat and the right seat belt mounting structure. If the seat belt mounting structure is below a horizontal plane passing through CG-R, locate the point 200 mm directly below CG-R and locate a line formed by the shortest horizontal distance between that point and the right seat belt mounting structure. The maximum horizontal approach angle for the right seat belt mounting structure equals the angle formed by that line and the X-axis of the vehicle measured counterclockwise. If the CG-R does not exist, or is forward of the seat belt mounting structure, the maximum horizontal approach angle is 90 degrees.

S8.13.4.2 *Vertical Approach Angles*

(a) Position the forehead impact zone in contact with the selected target at the prescribed horizontal approach angle. If a range of horizontal approach angles is prescribed, position the forehead impact zone in contact with the selected target at any horizontal approach angle within the range which may be used for testing.

(b) Keeping the forehead impact zone in contact with the target, rotate the FMH upward until the lip, chin or other part of the FMH contacts the component or other portion of the vehicle interior.

(1) Except as provided in S8.13.4.2(b)(2), keeping the forehead impact zone in contact with the target, rotate the FMH downward by 5 degrees for each target to determine the maximum vertical angle.

(2) For all pillars, except A-pillars, and all door frames and seat belt mounting structures, keeping the forehead impact zone in contact with the target, rotate the FMH downward by 10 degrees for each target to determine the maximum vertical angle.

S8.14 *Multiple impacts.*

(a) A vehicle being tested may be impacted multiple times, subject to the limitations in S8.14(b), (c), (d) and (e).

(b) As measured as provided in S8.14(d), impacts within 300 mm of each other may not occur less than 30 minutes apart.

(c) As measured as provided in S8.14(d), no impact may occur within 150 mm of any other impact.

(d) For S8.14(b) and S8.14(c), the distance between impacts is the distance between the center of the target circle specified in S8.11 for each impact, measured along the vehicle interior.

(e) No impact may occur within the ''exclusion zone'' of any pillar target specified in S10.1 through S10.4, door frame target specified in S10.14 and S10.15, upper roof target specified in S10.9, or seat belt mounting structure target specified in S10.16. The ''exclusion zone'' is determined according to the procedure in S8.14(f) through S8.14(k).

(f) Locate the point, Point X, at the center of the target circle specified in S8.11 for the tested target.

(g) Determine two spheres centered on Point X. Radii of these spheres are 150 mm and 200 mm, respectively.

(h) Locate a horizontal plane passing through Point X. Determine the intersection points, if they exist, of the small sphere surface, the horizontal plane, and the vehicle interior surface. Relative to Point X, the point on the left is Point L and the point on the right is Point R.

(i) Locate a vertical plane, Plane Z, passing through Point X and coincident (within ±5°) with the horizontal approach angle used or intended for use in testing the target centered on Point X.

(j) If either Point L or Point R does not exist, extend Line LX and/or Line RX, as appropriate, perpendicular to Plane Z beyond Point X by 150 mm. The end of the line is designated as Point L or Point R, as appropriate.

(k) Locate a vertical plane, Plane ZL, passing through Point L and parallel to Plane Z. Locate another vertical plane, Plane ZR, passing through Point R and parallel to Plane Z. The ''exclusion zone'' is the vehicle interior surface area between Plane ZL and Plane ZR below the upper boundary of the smaller sphere and above the lower boundary of the larger sphere. Points on the intersection of the vehicle interior surface and the large sphere below the target, the small sphere above the target, Plane ZL and Plane ZR are not included in the ''exclusion zone.''

S8.15 *Upper Roof.* The upper roof of a vehicle is determined according to the procedure specified in S8.15 (a) through (h).

(a) Locate the transverse vertical plane A at the forwardmost point where it contacts the interior roof (including trim) at the vehicle centerline.

(b) Locate the transverse vertical plane B at the rearmost point where it contacts the interior roof (including trim) at the vehicle centerline.

(c) Measure the horizontal distance (D1) between Plane A and Plane B.

(d) Locate the vertical longitudinal plane C at the leftmost point at which a vertical transverse plane, located 300 mm rearward of the A-pillar reference point described in S10.1(a), contacts the interior roof (including trim).

(e) Locate the vertical longitudinal plane D at the rightmost point at which a vertical transverse plane, located 300 mm rearward of the A-pillar reference point described in S10.1(a), contacts the interior roof (including trim).

(f) Measure the horizontal distance (D2) between Plane C and Plane D.

(g) Locate a point (Point M) on the interior roof surface, midway between Plane A and Plane B along the vehicle longitudinal centerline.

(h) The upper roof zone is the area of the vehicle upper interior surface bounded by the four planes described in S8.15(h)(1) and S8.15(h)(2):

(1) A transverse vertical plane E located at a distance of (.35 D1) forward of Point M and a transverse vertical plane F located at a distance of (.35 D1) rearward of Point M, measured horizontally.

(2) A longitudinal vertical plane G located at a distance of (.35 D2) to the left of Point M and a longitudinal vertical plane H located at a distance of (.35 D2) to the right of Point M, measured horizontally.

S8.16 *Test weight—vehicle to pole test.* Each vehicle shall be loaded to its unloaded vehicle weight, plus 136 kilograms (300 pounds) or its rated cargo and luggage capacity (whichever is less), secured in the luggage or load-carrying area, plus the weight of the necessary anthropomorphic test dummy. Any added test equipment shall be located away from impact areas in secure places in the vehicle.

S8.17 *Vehicle test attitude—vehicle to pole test.* Determine the distance between a level surface and a standard reference point on the test vehicle's body, directly above each wheel opening, when the vehicle is in its ''as delivered'' condition. The ''as delivered'' condition is the vehicle as received at the test site, filled to 100 percent of all fluid capacities and with all tires inflated to the manufacturer's specifications listed on the vehicle's tire placard. Determine the distance between the same level surface and the same standard reference points in the vehicle's ''fully loaded condition.'' The ''fully loaded condition'' is the test vehicle loaded in accordance with S8.16. The load placed in the cargo area shall be centered over the longitudinal centerline of the vehicle. The pretest vehicle attitude shall be the same as either the ''as delivered'' or ''fully loaded'' attitude or is between the ''as delivered'' attitude and the ''fully loaded'' attitude. If the test configuration requires that the vehicle be elevated off the ground, the pretest vehicle attitude must be maintained.

S8.18 *Adjustable seats—vehicle to pole test.* Initially, adjustable seats shall be adjusted as specified in S8.3.2.1 of Standard 214 (49 CFR 571.214).

S8.19 *Adjustable seat back placement—vehicle to pole test.* Initially, position adjustable seat backs in the manner specified in S8.3.2.2 of Standard 214 (49 CFR 571.214).

S8.20 *Adjustable steering controls—vehicle to pole test.* Adjustable steering controls shall be adjusted so that the steering control hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions.

S8.21 *Windows and sunroof—vehicle to pole test.* Movable windows and vents shall be placed in the fully open position. Any sunroof shall be placed in the fully closed position.

S8.22 *Convertible tops—vehicle to pole test.* The top, if any, of convertibles and open-body type vehicles shall be in the closed passenger compartment configuration.

S8.23 *Doors—vehicle to pole test.* Doors, including any rear hatchback or tailgate, shall be fully closed and latched but not locked.

S8.24 *Impact reference line—vehicle to pole test.* On the striking side of the vehicle, place an impact reference line at the intersection of the vehicle exterior and a transverse vertical plane passing through the center of gravity of the head of the dummy seated in accordance with S8.28, in any front outboard designated seating position.

S8.25 *Rigid Pole—vehicle to pole test.* The rigid pole is a vertical metal structure beginning no more than 102 millimeters (4 inches) above the lowest point of the tires on the striking side of the test vehicle when the vehicle is loaded as specified in S8.16 and extending above the highest point of the roof of the test vehicle. The pole is 254 mm ±3 mm (10 inches) in diameter and set off from any mounting surface, such as a barrier or other structure, so that the test vehicle will not contact such a mount or support at any time within 100 milliseconds of the initiation of vehicle to pole contact.

S8.26 *Impact configuration—vehicle to pole test.* The rigid pole shall be stationary. The test vehicle shall be propelled sideways so that its line of forward motion forms an angle of 90 degrees (±3 degrees) with the vehicle's longitudinal center line. The impact reference line shall be aligned with the center line of the rigid pole so that, when the vehicle-to-pole contact occurs, the center line of the pole contacts the vehicle area bounded by two transverse vertical planes 38 mm (1.5 inches) forward and aft of the impact reference line.

S8.27 *Anthropomorphic test dummy—vehicle to pole test.*

S8.27.1 The anthropomorphic test dummy used for evaluation of a vehicle's head impact protection shall conform to the requirements of subpart M of part 572 of this chapter (49 CFR part 572, subpart M). In a test in which the

test vehicle is striking its left side, the dummy is to be configured and instrumented to strike on its left side, in accordance with subpart M of part 572. In a test in which the test vehicle is striking its right side, the dummy is to be configured and instrumented to strike its right side, in accordance with subpart M of part 572.

S8.27.2 The part 572, subpart M, test dummy specified is clothed in form fitting cotton stretch garments with short sleeves and midcalf length pants. Each foot of the test dummy is equipped with a size 11EEE shoe, which meets the configuration size, sole, and heel thickness specifications of MIL-S-13192 (1976) and weighs 0.57 ±0.09 kilograms (1.25 ±0.2 pounds).

S8.27.3 Limb joints shall be set at between 1 and 2 g's. Leg joints are adjusted with the torso in the supine position.

S8.27.4 The stabilized temperature of the test dummy at the time of the side impact test shall be at any temperature between 20.6 degrees C. and 22.2 degrees C.

S8.27.5 The acceleration data from the accelerometers installed inside the skull cavity of the test dummy are processed according to the practices set forth in SAE Recommended Practice J211, March 1995, ''Instrumentation for Impact Tests,'' Class 1000.

S8.28 *Positioning procedure for the Part 572 Subpart M test dummy—vehicle to pole test.* The part 572, subpart M, test dummy is initially positioned in the front outboard seating position on the struck side of the vehicle in accordance with the provisions of S12.1 of Standard 214 (49 CFR 571.214), and the vehicle seat is positioned as specified in S8.3.2.1 and S8.3.2.2 of that standard. The position of the dummy is then measured as follows. Locate the horizontal plane passing through the dummy head center of gravity. Identify the rearmost point on the dummy head in that plane. Construct a line in the plane that contains the rearward point of the front door daylight opening and is perpendicular to the longitudinal vehicle centerline. Measure the longitudinal distance between the rearmost point on the dummy head and this line. If this distance is less than 50 mm (2 inches) or the point is not forward of the line, then the seat and/or dummy positions is adjusted as follows. First, the seat back angle is adjusted, a maximum of 5 degrees, until a 50 mm (2 inches) distance is achieved. If this is not sufficient to produce the 50 mm (2 inches) distance, the seat is moved forward until the 50 mm (2 inches) distance is achieved or until the knees of the dummy contact the dashboard or knee bolster, whichever comes first. If the required distance cannot be achieved through movement of the seat, the seat back angle is adjusted even further forward until the 50 mm (2 inches) distance is obtained or until the seat back is in its fully upright locking position.

S9. *Orthogonal Reference System.* The approach angles specified in S8.13.4 are determined using the reference system specified in S9.1 through S9.4.

S9.1 An orthogonal reference system consisting of a longitudinal X axis and a transverse Y axis in the same horizontal plane and a vertical Z axis through the intersection of X and Y is used to define the horizontal direction of approach of the headform. The X-Z plane is the vertical longitudinal zero plane and is parallel to the longitudinal centerline of the vehicle. The X-Y plane is the horizontal zero plane parallel to the ground. The Y-Z plane is the vertical transverse zero plane that is perpendicular to the X-Y and X-Z planes. The X coordinate is negative forward of the Y-Z plane and positive to the rear. The Y coordinate is negative to the left of the X-Z plane and positive to the right. The Z coordinate is negative below the X-Y plane and positive above it. (See Figure 1.)

S9.2 The origin of the reference system is the center of gravity of the headform at the time immediately prior to launch for each test.

S9.3 The horizontal approach angle is the angle between the X axis and the headform impact velocity vector projected onto the horizontal zero plane, measured in the horizontal zero plane in the counter-clockwise direction. A 0 degree horizontal vector and a 360 degree horizontal vector point in the positive X direction; a 90 degree horizontal vector points in the positive Y direction; a 180 degree horizontal vector points in the negative X direction;

and a 270 horizontal degree vector points in the negative Y direction. (See Figure 2.)

S9.4 The vertical approach angle is the angle between the horizontal plane and the velocity vector, measured in the midsagittal plane of the headform. A 0 degree vertical vector in Table I coincides with the horizontal plane and a vertical vector of greater than 0 degrees in Table I makes an upward angle of the same number of degrees with that plane.

S10 *Target Locations.*

(a) The target locations specified in S10.1 through S10.16 are located on both sides of the vehicle and, except as specified in S10(b), are determined using the procedures specified in those paragraphs.

(b) Except as specified in S10(c), if there is no combination of horizontal and vertical angles specified in S8.13.4 at which the forehead impact zone of the free motion headform can contact one of the targets located using the procedures in S10.1 through S10.16, the center of that target is moved to any location within a sphere with a radius of 25 mm, centered on the center of the original target, which the forehead impact zone can contact at one or more combination of angles.

(c) If there is no point within the sphere specified in S10(b) which the forehead impact zone of the free motion headform can contact at one or more combination of horizontal and vertical angles specified in S8.13.4, the radius of the sphere is increased by 25 mm increments until the sphere contains at least one point that can be contacted at one or more combination of angles.

S10.1 *A-pillar targets*

(a) *A-pillar reference point and target AP1.* On the vehicle exterior, locate a transverse vertical plane (Plane 1) which contacts the rearmost point of the windshield trim. The intersection of Plane 1 and the vehicle exterior surface is Line 1. Measuring along the vehicle exterior surface, locate a point (Point 1) on Line 1 that is 125 mm inboard of the intersection of Line 1 and a vertical plane tangent to the vehicle at the outboardmost point on Line 1 with the vehicle side door open. Measuring along the vehicle exterior surface in a longitudinal vertical plane (Plane 2) passing through Point 1, locate a point (Point 2) 50 mm rearward of Point 1. Locate the A-pillar reference point (Point APR) at the intersection of the interior roof surface and a line that is perpendicular to the vehicle exterior surface at Point 2. Target AP1 is located at point APR.

(b) *Target AP2.* Locate the horizontal plane (Plane 3) which intersects point APR. Locate the horizontal plane (Plane 4) which is 88 mm below Plane 3. Target AP2 is the point in Plane 4 and on the A-pillar which is closest to CG-F2 for the nearest seating position.

(c) *Target AP3.* Locate the horizontal plane (Plane 5) containing the highest point at the intersection of the dashboard and the A-pillar. Locate a horizontal plane (Plane 6) half-way between Plane 3 and Plane 5. Target AP3 is the point on Plane 6 and the A-pillar which is closest to CG-F1 for the nearest seating position.

S10.2 *B-pillar targets.*

(a) *B-pillar reference point and target BP1.* Locate the point (Point 3) on the vehicle interior at the intersection of the horizontal plane passing through the highest point of the forwardmost door opening and the centerline of the width of the B-pillar, as viewed laterally. Locate a transverse vertical plane (Plane 7) which passes through Point 3. Locate the point (Point 4) at the intersection of the interior roof surface, Plane 7, and the plane, described in S8.15(h), defining the nearest edge of the upper roof. The B-pillar reference point (Point BPR) is the point located at the middle of the line from Point 3 to Point 4 in Plane 7, measured along the vehicle interior surface. Target BP1 is located at Point BPR.

(b) *Target BP2.* If a seat belt anchorage is located on the B-pillar, Target BP2 is located at any point on the anchorage.

(c) *Target BP3.* Target BP3 is located in accordance with this paragraph. Locate a horizontal plane (Plane 8) which intersects Point BPR. Locate a horizontal plane (Plane 9) which passes through the lowest point of the daylight opening forward of the pillar. Locate a horizontal plane (Plane 10) halfway between Plane 8 and Plane 9. Target BP3 is the point located in Plane 10

and on the interior surface of the B-pillar, which is closest to CG-F(2) for the nearest seating position.

(d) *Target BP4.* Locate a horizontal plane (Plane 11) half-way between Plane 9 and Plane 10. Target BP4 is the point located in Plane 11 and on the interior surface of the B-pillar which is closest to CG-R for the nearest seating position.

S10.3 *Other pillar targets.*

(a) *Target OP1.*

(1) Except as provided in S10.3(a)(2), target OP1 is located in accordance with this paragraph. Locate the point (Point 5), on the vehicle interior, at the intersection of the horizontal plane through the highest point of the highest adjacent door opening or daylight opening (if no adjacent door opening) and the centerline of the width of the other pillar, as viewed laterally. Locate a transverse vertical plane (Plane 12) passing through Point 5. Locate the point (Point 6) at the intersection of the interior roof surface, Plane 12 and the plane, described in S8.15(h), defining the nearest edge of the upper roof. The other pillar reference point (Point OPR) is the point located at the middle of the line between Point 5 and Point 6 in Plane 12, measured along the vehicle interior surface. Target OP1 is located at Point OPR.

(2) If a seat belt anchorage is located on the pillar, Target OP1 is any point on the anchorage.

(b) *Target OP2.* Locate the horizontal plane (Plane 13) intersecting Point OPR. Locate a horizontal plane (Plane 14) passing through the lowest point of the daylight opening forward of the pillar. Locate a horizontal plane (Plane 15) half-way between Plane 13 and Plane 14. Target OP2 is the point located on the interior surface of the pillar at the intersection of Plane 15 and the centerline of the width of the pillar, as viewed laterally.

S10.4 *Rearmost pillar targets*

(a) *Rearmost pillar reference point and target RP1.* Locate the point (Point 7) at the corner of the upper roof nearest to the pillar. The distance between Point M, as described in S8.15(g), and Point 7, as measured along the vehicle interior surface, is D. Extend the line from Point M to Point 7 along the vehicle interior surface in the same vertical plane by (3*D/7) beyond Point 7 or until the edge of a daylight opening, whichever comes first, to locate Point 8. The rearmost pillar reference point (Point RPR) is at the midpoint of the line between Point 7 and Point 8, measured along the vehicle interior. Target RP1 is located at Point RPR.

(b) *Target RP2.*

(1) Except as provided in S10.4(b)(2), target RP2 is located in accordance with this paragraph. Locate the horizontal plane (Plane 16) through Point RPR. Locate the horizontal plane (Plane 17) 150 mm below Plane 16. Target RP2 is located in Plane 17 and on the pillar at the location closest to CG-R for the nearest designated seating position.

(2) If a seat belt anchorage is located on the pillar, Target RP2 is any point on the anchorage.

S10.5 *Front header targets.*

(a) *Target FH1.* Locate the contour line (Line 2) on the vehicle interior trim which passes through the APR and is parallel to the contour line (Line 3) at the upper edge of the windshield on the vehicle interior. Locate the point (Point 9) on Line 2 that is 125 mm inboard of the APR, measured along that line. Locate a longitudinal vertical plane (Plane 18) that passes through Point 9. Target FH1 is located at the intersection of Plane 18 and the upper vehicle interior, halfway between a transverse vertical plane (Plane 19) through Point 9 and a transverse vertical plane (Plane 20) through the intersection of Plane 18 and Line 3.

(b) *Target FH2.*

(1) Except as provided in S10.5(b)(2), target FH2 is located in accordance with this paragraph. Locate a point (Point 10) 275 mm inboard of Point APR, along Line 2. Locate a longitudinal vertical plane (Plane 21) that passes through Point 10. Target FH2 is located at the intersection of Plane 21 and the upper vehicle interior, halfway between a transverse vertical plane (Plane 22) through Point 10 and a transverse vertical plane (Plane 23) through the intersection of Plane 21 and Line 3.

(2) If a sun roof opening is located forward of the front edge of the upper roof and intersects the mid-sagittal plane of a dummy seated in either front outboard seating position, target

FH2 is the nearest point that is forward of a transverse vertical plane (Plane 24) through CG-F(2) and on the intersection of the mid-sagittal plane and the interior sunroof opening.

S10.6 *Targets on the side rail between the A-pillar and the B-pillar or rearmost pillar in vehicles with only two pillars on each side of the vehicle.*

(a) *Target SR1.* Locate a transverse vertical plane (Plane 25) 150 mm rearward of Point APR. Locate the point (Point 11) at the intersection of Plane 25 and the upper edge of the forwardmost door opening. Locate the point (Point 12) at the intersection of the interior roof surface, Plane 25 and the plane, described in S8.15(h), defining the nearest edge of the upper roof. Target SR1 is located at the middle of the line between Point 11 and Point 12 in Plane 25, measured along the vehicle interior.

(b) *Target SR2.* Locate a transverse vertical plane (Plane 26) 300 mm rearward of the APR or 300 mm forward of the BPR (or the RPR in vehicles with no B-pillar). Locate the point (Point 13) at the intersection of Plane 26 and the upper edge of the forwardmost door opening. Locate the point (Point 14) at the intersection of the interior roof surface, Plane 26 and the plane, described in S8.15(h), defining the nearest edge of the upper roof. Target SR2 is located at the middle of the line between Point 13 and Point 14 in Plane 26, measured along the vehicle interior.

S10.7 *Other side rail target (target SR3).*

(a) Except as provided in S10.7(b), target SR3 is located in accordance with this paragraph. Locate a transverse vertical plane (Plane 27) 150 mm rearward of either Point BPR or Point OPR. Locate the point (Point 15) as provided in either S10.7(a)(1) or S10.7(a)(2), as appropriate. Locate the point (Point 16) at the intersection of the interior roof surface, Plane 27 and the plane, described in S8.15(h), defining the nearest edge of the upper roof. Target SR3 is located at the middle of the line between Point 15 and Point 16 in Plane 27, measured along the vehicle interior surface.

(1) If Plane 27 intersects a door or daylight opening, the Point 15 is located at the intersection of Plane 27 and the upper edge of the door opening or daylight opening.

(2) If Plane 27 does not intersect a door or daylight opening, the Point 15 is located on the vehicle interior at the intersection of Plane 27 and the horizontal plane through the highest point of the door or daylight opening nearest Plane 27. If the adjacent door(s) or daylight opening(s) are equidistant to Plane 27, Point 15 is located on the vehicle interior at the intersection of Plane 27 and either horizontal plane through the highest point of each door or daylight opening.

(b) Except as provided in S10.7(c), if a grab handle is located on the side rail, target SR3 is located at any point on the anchorage of the grab-handle. Folding grab-handles are in their stowed position for testing.

(c) If a seat belt anchorage is located on the side rail, target SR3 is located at any point on the anchorage.

S10.8 *Rear header target (target RH).* Locate the point (Point 17) at the intersection of the surface of the upper vehicle interior, the mid-sagittal plane (Plane 28) of the outboard rearmost dummy and the plane, described in S8.15(h), defining the rear edge of the upper roof. Locate the point (Point 18) as provided in S10.8(a) or S10.8(b), as appropriate. Except as provided in S10.8(c), Target RH is located at the mid-point of the line that is between Point 17 and Point 18 and is in Plane 28, as measured along the surface of the vehicle interior.

(a) If Plane 28 intersects a rear door opening or daylight opening, then Point 18 is located at the intersection of Plane 28 and the upper edge of the door opening or the daylight opening (if no door opening).

(b) If Plane 28 does not intersect a rear door opening or daylight opening, then Point 18 is located on the vehicle interior at the intersection of Plane 28 and a horizontal plane through the highest point of the door or daylight opening nearest to Plane 28. If the adjacent door(s) or daylight opening(s) are equidistant to Plane 28, Point 18 is located on the vehicle interior at the intersection of Plane 28 and either horizontal plane through the highest point of each door or daylight opening.

(c) If Target RH is more than 112 mm from Point 18 on the line that is between Point 17 and Point 18 and is in Plane 28, as measured along the surface of the vehicle interior, then Target RH is the point on that line which is 112 mm from Point 18.

S10.9 *Upper roof target (target UR).* Target UR is any point on the upper roof.

S10.10 *Sliding door track target (target SD).* Locate the transverse vertical plane (Plane 29) passing through the middle of the widest opening of the sliding door, measured horizontally and parallel to the vehicle longitudinal centerline. Locate the point (Point 19) at the intersection of the surface of the upper vehicle interior, Plane 29 and the plane, described in S8.15(h), defining the nearest edge of the upper roof. Locate the point (Point 20) at the intersection of Plane 29 and the upper edge of the sliding door opening. Target SD is located at the middle of the line between Point 19 and Point 20 in Plane 29, measured along the vehicle interior.

S10.11 *Roll-bar targets.*

(a) *Target RB1.* Locate a longitudinal vertical plane (Plane 30) at the mid-sagittal plane of a dummy seated in any outboard designated seating position. Target RB1 is located on the roll-bar and in Plane 30 at the location closest to either CG-F2 or CG-R, as appropriate, for the same dummy.

(b) *Target RB2.* If a seat belt anchorage is located on the roll-bar, Target RB2 is any point on the anchorage.

S10.12 *Stiffener targets.*

(a) *Target ST1.* Locate a transverse vertical plane (Plane 31) containing either CG-F2 or CG-R, as appropriate, for any outboard designated seating position. Target ST1 is located on the stiffener and in Plane 31 at the location closest to either CG-F2 or CG-R, as appropriate.

(b) *Target ST2.* If a seat belt anchorage is located on the stiffener, Target ST2 is any point on the anchorage.

S10.13 *Brace target (target BT)* Target BT is any point on the width of the brace as viewed laterally from inside the passenger compartment.

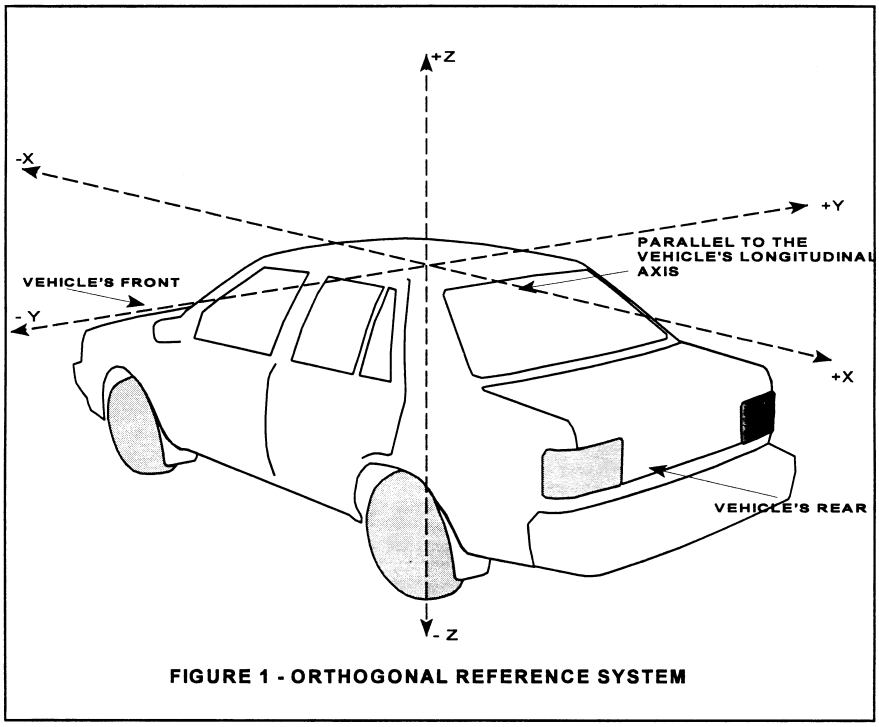
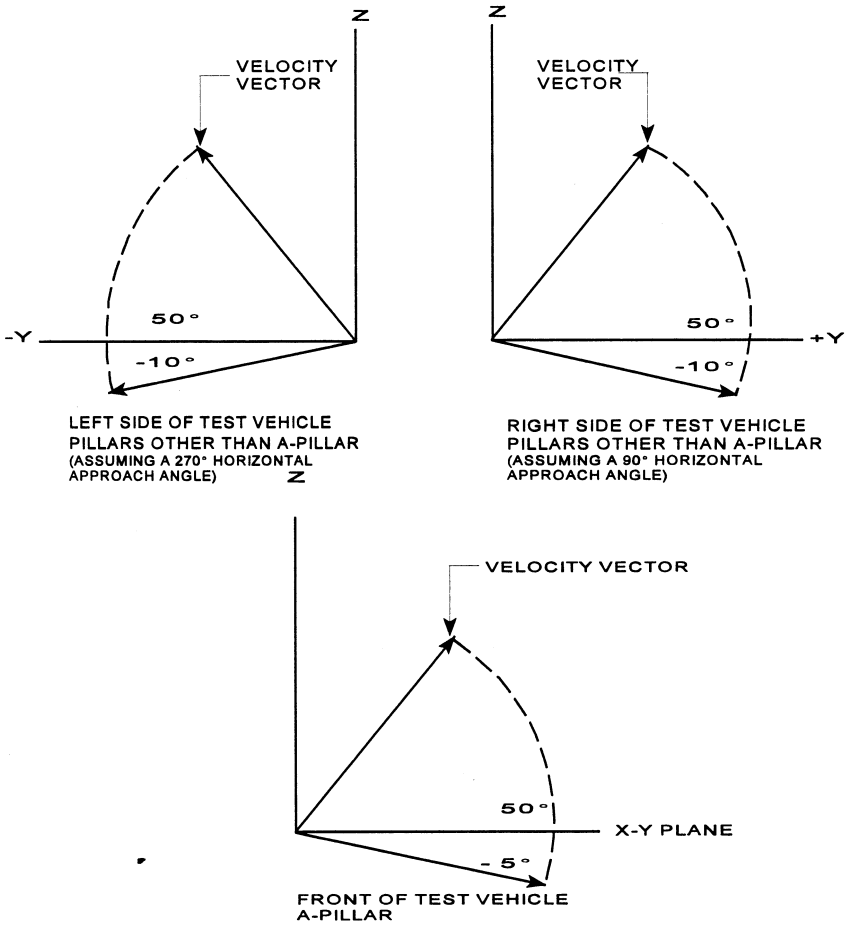


FIGURE 1 - ORTHOGONAL REFERENCE SYSTEM



VERTICAL AND HORIZONTAL APPROACH ANGLE PLANE
FIGURE 2

S10.14 *Door frame targets.*

(a) *Target DF 1.* Locate the point (Point 21) on the vehicle interior at the intersection of the horizontal plane passing through the highest point of the forward door opening and a transverse vertical plane (Plane 32) tangent to the rearmost edge of the forward door, as viewed laterally with the adjacent door open. Locate the point (Point 22) at the intersection of the interior roof surface, Plane 32, and the plane, described in S8.15(h), defining the nearest edge of the upper roof. The door frame reference point (Point DFR) is the point located at the middle of the line from Point 21 to Point 22 in Plane 32, measured along the vehicle interior surface. Target DF1 is located at Point DFR.

(b) *Target DF2.* If a seat belt anchorage is located on the door frame, Target DF2 is located at any point on the anchorage.

(c) *Target DF3.* Locate a horizontal plane (Plane 33) which intersects Point

DFR. Locate a horizontal plane (Plane 34) that passes through the lowest point of the adjacent daylight opening forward of the door frame. Locate a horizontal plane (Plane 35) half-way between Plane 33 and Plane 34. Target DF3 is the point located in Plane 35 and on the interior surface of the door frame, which is closest to CG-F2 for the nearest seating position.

(d) *Target DF4.* Locate a horizontal plane (Plane 36) half-way between Plane 34 and Plane 35. Target DF4 is the point located in Plane 36 and on the interior surface of the door frame that is closest to CG-R for the nearest seating position.

S10.15 *Other door frame targets.*

(a) *Target OD1.*

(1) Except as provided in S10.15(a)(2), target OD1 is located in accordance with this paragraph. Locate the point (Point 23) on the vehicle interior, at the intersection of the horizontal plane through the highest point of the highest adjacent door opening or daylight opening (if there is no adjacent door opening) and the center line of the width of the other door frame, as viewed laterally with the doors in the closed position. Locate a transverse vertical plane (Plane 37) passing through Point 23. Locate the point (Point 24) at the intersection of the interior roof surface, Plane 37 and the plane, described in S8.15(h), defining the nearest edge of the upper roof. The other door frame reference point (Point ODR) is the point located at the middle of the line between Point 23 and Point 24 in Plane 37, measured along the vehicle interior surface. Target OD1 is located at Point ODR.

(2) If a seat belt anchorage is located on the door frame, Target OD1 is any point on the anchorage.

(b) *Target OD2.* Locate the horizontal plane (Plane 38) intersecting Point ODR. Locate a horizontal plane (Plane 39) passing through the lowest point of the daylight opening forward of the door frame. Locate a horizontal plane (Plane 40) half-way between Plane 38 and Plane 39. Target OD2 is the point located on the interior surface of the door frame at the intersection of Plane 40 and the center line of the width of the door frames, as viewed laterally, with the doors in the closed position.

S10.16 *Seat belt mounting structure targets.*

(a) *Target SB1.* Target SB1 is located at any point on the seat belt anchorage mounted on the seat belt mounting structure.

(b) *Target SB2.* Locate a horizontal plane (Plane 41), containing either CG-F2 or CG-R, as appropriate, for any outboard designated seating position whose seating reference point, SgRP, is forward of and closest to, the vertical center line of the width of the seat belt mounting structure as viewed laterally. Target SB2 is located on the seat belt mounting structure and in Plane 41 at the location closest to either CG-F2 or CG-R, as appropriate.

(c) *Target SB3.* Locate a horizontal plane (Plane 42), containing CG-R for any outboard designated seating position rearward of the forwardmost designated seating position or positions whose seating reference point, SgRP, is rearward of and closest to, the vertical center line of the width of the seat belt mounting structure, as viewed laterally. Locate a horizontal plane (Plane 43) 200 mm below Plane 42. Target SB3 is located on the seat belt mounting structure and in Plane 43 at the location closest to CG-R, as appropriate.

[62 FR 16725, Apr. 8, 1997]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 571.201, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 571.202 Standard No. 202; Head restraints; Applicable at the manufacturers option until September 1, 2009.

S1. *Purpose and scope.* This standard specifies requirements for head restraints to reduce the frequency and severity of neck injury in rear-end and other collisions.

S2. *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kg or less, manufactured before September 1, 2009. Until September 1, 2009, manufacturers may comply with the standard in this § 571.202, with the European regulations referenced in S4.3 of this § 571.202, or

with the standard in § 571.202a. For vehicles manufactured on or after September 1, 2009 and before September 1, 2010, manufacturers may comply with the standard in this § 571.202 or with the European regulations referenced in S4.3 of this § 571.202, instead of the standard in § 571.202a, only to the extent consistent with phase-in specified in § 571.202a.

S3. *Definitions.*

Head restraint means a device that limits rearward displacement of a seated occupant's head relative to the occupant's torso.

Height means, when used in reference to a head restraint, the distance from the H-point, measured parallel to the torso reference line defined by the three dimensional SAE Standard J826 JUL95 (incorporated by reference, see § 571.5) manikin, to a plane normal to the torso reference line.

Top of the head restraint means the point on the head restraint with the greatest height.

S4. *Requirements.*

S4.1 Each passenger car, and multipurpose passenger vehicle, truck and bus with a GVWR of 4,536 kg or less, must comply with, at the manufacturer's option, S4.2, S4.4 or S4.5 of this section.

S4.2 Except for school buses, a head restraint that conforms to either S4.2 (a) or (b) of this section must be provided at each outboard front designated seating position. For school buses, a head restraint that conforms to either S4.2 (a) or (b) of this section must be provided at the driver's seating position.

(a) When tested in accordance with S5.1 of this section, limit rearward angular displacement of the head reference line to 45 degrees from the torso reference line; or

(b) When adjusted to its fully extended design position, conform to each of the following:

(1) When measured parallel to the torso line, the top of the head restraint must not be less than 700 mm above the seating reference point;

(2) When measured either 64 mm below the top of the head restraint or 635 mm above the seating reference point, the lateral width of the head restraint must be not less than:

(i) 254 mm for use with bench-type seats; and

(ii) 170 mm for use with individual seats;

(3) When tested in accordance with S5.2 of this section, any portion of the head form in contact with the head restraint must not be displaced to more than 102 mm perpendicularly rearward of the displaced extended torso reference line during the application of the load specified in S5.2 (c) of this section; and

(4) When tested in accordance with S5.2 of this section, the head restraint must withstand an increasing load until one of the following occurs:

(i) Failure of the seat or seat back; or,

(ii) Application of a load of 890N.

S4.3 [Reserved]

S4.4. Except for school buses, a head restraint that conforms to S4.4 (a) and (b) of this section must be provided at each outboard front designated seating position. For school buses, a head restraint that conforms to S4.4 (a) and (b) of this section must be provided at the driver's seating position.

(a) The head restraint must comply with Paragraphs 5.1.1, 5.1.3, 5.3.1, 5.5 through 5.13, 6.1.1, 6.1.3, and 6.4 through 6.8 of the English language version of the UNECE Regulation 17 (incorporated by reference, see § 571.5).

(b) The head restraint must meet the width requirements specified in S4.2(b)(2) of this section.

S4.5 Except for school buses, head restraints that conform to the requirements of § 571.202a must be provided at each front outboard designated seating position. If a rear head restraint (as defined in § 571.202a) is provided at a rear outboard designated seating position, it must conform to the requirements of § 571.202a applicable to rear head restraints. For school buses, a head restraint that conforms to the requirements of § 571.202a must be installed at the driver's seating position.

S4.6 Where manufacturer options are specified in this section or § 571.202a, the manufacturer must select an option by the time it certifies the vehicle and may not thereafter select a different option for that vehicle. The manufacturer may select different

compliance options for different designated seating positions to which the requirements of this section are applicable. Each manufacturer must, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S5. *Demonstration procedures.*

S5.1 Compliance with S4.2(a) of this section is demonstrated in accordance with the following with the head restraint in its fully extended design position:

(a) On the exterior profile of the head and torso of a dummy having the weight and seated height of a 95th percentile adult male with an approved representation of a human, articulated neck structure, or an approved equivalent test device, establish reference lines by the following method:

(1) Position the dummy's back on a horizontal flat surface with the lumbar joints in a straight line.

(2) Rotate the head of the dummy rearward until the back of the head contacts the flat horizontal surface specified in S5.1(a)(1) of this section.

(3) Position the SAE Standard J826 JUL95 (incorporated by reference, see §571.5) two-dimensional manikin's back against the flat surface specified in S5.1(a)(1) of this section, alongside the dummy with the H-point of the manikin aligned with the H-point of the dummy.

(4) Establish the torso line of the manikin as defined in SAE Aerospace-Automotive Drawing Standards (1963) (incorporated by reference, see §571.5), sec. 2.3.6, P.E1.01.

(5) Establish the dummy torso reference line by superimposing the torso line of the manikin on the torso of the dummy.

(6) Establish the head reference line by extending the dummy torso reference line onto the head.

(b) At each designated seating position having a head restraint, place the dummy, snugly restrained by Type 2 seat belt, in the manufacturer's recommended design seating position.

(c) During forward acceleration applied to the structure supporting the seat as described in this paragraph, measure the maximum rearward angular displacement between the dummy torso reference line and head reference line. When graphically depicted, the magnitude of the acceleration curve shall not be less than that of a half-sine wave having the amplitude of 78 m/s^2 and a duration of 80 milliseconds and not more than that of a half-sine wave curve having an amplitude of 94 m/s^2 and a duration of 96 milliseconds.

S5.2 Compliance with S4.2(b) of this section is demonstrated in accordance with the following with the head restraint in its fully extended design position:

(a) Place a test device, having the back plan dimensions and torso line (centerline of the head room probe in full back position), of the three dimensional SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin, at the manufacturer's recommended design seated position.

(b) Establish the displaced torso reference line by applying a rearward moment of 373 Nm about the seating reference point to the seat back through the test device back pan specified in S5.2(a) of this section.

(c) After removing the back pan, using a 165 mm diameter spherical head form or cylindrical head form having a 165 mm diameter in plan view and a 152 mm height in profile view, apply, perpendicular to the displaced torso reference line, a rearward initial load 64 mm below the top of the head restraint that will produce a 373 Nm moment about the seating reference point.

(d) Gradually increase this initial load to 890 N or until the seat or seat back fails, whichever occurs first.

[36 FR 22902, Dec. 2, 1971, as amended at 54 FR 39187, Sept. 25, 1989; 61 FR 27025, May 30, 1996; 63 FR 28935, May 27, 1998; 69 FR 74883, Dec. 14, 2005; 72 FR 25514, May 4, 2007; 77 FR 761, Jan. 6, 2012]

§571.202a Standard No. 202a; Head restraints; Mandatory applicability begins on September 1, 2009.

S1. *Purpose and scope.* This standard specifies requirements for head restraints to reduce the frequency and severity of neck injury in rear-end and other collisions.

S2 *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses

with a GVWR of 4,536 kg or less, manufactured on or after September 1, 2009. However, the standard's requirements for rear head restraints do not apply to vehicles manufactured before September 1, 2010, and, for vehicles manufactured between September 1, 2010 and August 31, 2011, the requirements for rear head restraints apply only to the extent provided in S7. Until September 1, 2009, manufacturers may comply with the standard in this §571.202a, with the standard in §571.202, or with the European regulations referenced in S4.3(a) of §571.202. For vehicles manufactured on or after September 1, 2009 and before September 1, 2010, manufacturers may comply with the standard in §571.202 or with the European regulations referenced in S4.3(a) of §571.202, instead of the standard in this §571.202a, only to the extent consistent with the phase-in specified in this §571.202a.

S3. Definitions.

Backset means the minimum horizontal distance between the rear of a representation of the head of a seated 50th percentile male occupant and the head restraint, as measured by the head restraint measurement device.

Head restraint means a device that limits rearward displacement of a seated occupant's head relative to the occupant's torso.

Head restraint measurement device (HRMD) means the three dimensional SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin with a head form attached, representing the head position of a seated 50th percentile male, with sliding scale at the back of the head for the purpose of measuring backset. The head form is designed by and available from the ICBC, 151 West Esplanade, North Vancouver, BC V7M 3H9, Canada (*www.icbc.com*).

Height means, when used in reference to a head restraint, the distance from the H-point, measured parallel to the torso reference line defined by the three dimensional SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin, to a plane normal to the torso reference line.

Intended for occupant use means, when used in reference to the adjustment of a seat, positions other than that intended solely for the purpose of allowing ease of ingress and egress of occupants and access to cargo storage areas of a vehicle.

Rear head restraint means, at any rear outboard designated seating position, a rear seat back, or any independently adjustable seat component attached to or adjacent to a seat back, that has a height equal to or greater than 700 mm, in any position of backset and height adjustment, as measured in accordance with S5.1.1.

Top of the head restraint means the point on the head restraint with the greatest height.

S4. *Requirements.* Except as provided in S4.4, S4.2.1(a)(2) and S4.2.1(b)(2) of this section, each vehicle must comply with S4.1 of this section with the seat adjusted as intended for occupant use. Whenever a range of measurements is specified, the head restraint must meet the requirement at any position of adjustment within the specified range.

S4.1 *Performance levels.* In each vehicle other than a school bus, a head restraint that conforms to either S4.2 or S4.3 of this section must be provided at each front outboard designated seating position. In each equipped with rear outboard head restraints, the rear head restraint must conform to either S4.2 or S4.3 of this section. In each school bus, a head restraint that conforms to either S4.2 or S4.3 of this section must be provided for the driver's seating position. At each designated seating position incapable of seating a 50th percentile male Hybrid III test dummy specified in 49 CFR part 572, subpart E, the applicable head restraint must conform to S4.2 of this section.

S4.2 *Dimensional and static performance.* Each head restraint located in the front outboard designated seating position and each head restraint located in the rear outboard designated seating position must conform to paragraphs S4.2.1 through S4.2.7 of this section. Compliance is determined for the height requirements of S4.2.1 and the backset requirements of S4.2.3 of this section by taking the arithmetic average of three measurements.

S4.2.1 *Minimum height.*

(a) *Front outboard designated seating positions.* (1) Except as provided in

S4.2.1(a)(2) of this section, when measured in accordance with S5.2.1(a)(1) of this section, the top of a head restraint located in a front outboard designated seating position must have a height not less than 800 mm in at least one position of adjustment.

(2) Exception. The requirements of S4.2.1(a)(1) do not apply if the interior surface of the vehicle at the roofline physically prevents a head restraint, located in the front outboard designated seating position, from attaining the required height. In those instances in which this head restraint cannot attain the required height, when measured in accordance with S5.2.1(a)(2), the maximum vertical distance between the top of the head restraint and the interior surface of the vehicle at the roofline must not exceed 50 mm for convertibles and 25 mm for all other vehicles. Notwithstanding this exception, when measured in accordance with S5.2.1(a)(2), the top of a head restraint located in a front outboard designated seating position must have a height not less than 700 mm in the lowest position of adjustment.

(b) *All outboard designated seating positions equipped with head restraints.*

(1) Except as provided in S4.2.1(b)(2) of this section, when measured in accordance with S5.2.1(b)(1) of this section, the top of a head restraint located in an outboard designated seating position must have a height not less than 750 mm in any position of adjustment.

(2) Exception. The requirements of S4.2.1(b)(1) do not apply if the interior surface of the vehicle at the roofline or the interior surface of the backlight physically prevent a head restraint, located in the rear outboard designated seating position, from attaining the required height. In those instances in which this head restraint cannot attain the required height, when measured in accordance with S5.2.1(b)(2), the maximum vertical distance between the top of the head restraint and the interior surface of the vehicle at the roofline or the interior surface of the backlight must not exceed 50 mm for convertibles and 25 mm for all other vehicles.

S4.2.2 *Width.* When measured in accordance with S5.2.2 of this section, 65 ±3 mm below the top of the head restraint, the lateral width of a head restraint must be not less than 170 mm, except the lateral width of the head restraint for front outboard designated seating positions in a vehicle with a front center designated seating position, must be not less than 254 mm.

S4.2.3 *Front Outboard Designated Seating Position Backset.* When measured in accordance with S5.2.3 of this section, the backset must not be more than 55 mm, when the seat is adjusted in accordance with S5.1. For adjustable restraints, the requirements of this section must be met with the top of the head restraint in any height position of adjustment between 750 mm and 800 mm, inclusive. If the top of the head restraint, in its lowest position of adjustment, is above 800 mm, the requirements of this section must be met at that position. If the head restraint position is independent of the seat back inclination position, the head restraint must not be adjusted such that backset is more than 55 mm when the seat back inclination is positioned closer to vertical than the position specified in S5.1.

S4.2.4 *Gaps.*

All head restraints must meet limits for gaps in the head restraint specified in S4.2.4.1. For gaps between the seat and head restraint, adjustable head restraints must meet either the limits specified in S4.2.4.1 or S4.2.4.2.

S4.2.4.1 *Gaps within the head restraint and between the head restraint and seat using a 165 mm sphere.* When measured in accordance with S5.2.4.1 of this section using the head form specified in that paragraph, there must not be any gap greater than 60 mm within or between the anterior surface of the head restraint and anterior surface of the seat, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

S4.2.4.2 *Gaps between the head restraint and seat using a 25 mm cylinder.* The following option is only available to head restraints that can move with respect to the seat. When measured in accordance with S5.2.4.2 of this section using the 25 mm cylinder specified in that paragraph, there must not be any gap greater than 25 mm between the anterior surface of the head restraint

and anterior surface of the seat, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

S4.2.5 *Energy absorption.* When the anterior surface of the head restraint is impacted in accordance with S5.2.5 of this section by the head form specified in that paragraph at any velocity up to and including 24.1 km/h, the deceleration of the head form must not exceed 785 m/s^2 (80 g) continuously for more than 3 milliseconds.

S4.2.6 *Height retention.* When tested in accordance with S5.2.6 of this section, the cylindrical test device specified in S5.2.6(b) must return to within 13 mm of its initial reference position after application of at least a 500 N load and subsequent reduction of the load to 50 N ±1 N. During application of the initial 50 N reference load, as specified in S5.2.6(b)(2) of this section, the cylindrical test device must not move downward more than 25 mm.

S4.2.7 *Backset retention, displacement, and strength.*

(a) *Backset retention and displacement.* When tested in accordance with S5.2.7 of this section, the described head form must:

(1) Not be displaced more than 25 mm during the application of the initial reference moment of 37 ±0.7 Nm;

(2) Not be displaced more than 102 mm perpendicularly and posterior of the displaced extended torso reference line during the application of a 373 ±7.5 Nm moment about the H-point; and

(3) Return to within 13 mm of its initial reference position after the application of a 373 ±7.5 Nm moment about the H-point and reduction of the moment to 37 ±0.7 Nm.

(b) *Strength.* When the head restraint is tested in accordance with S5.2.7(b) of this section with the test device specified in that paragraph, the load applied to the head restraint must reach 890 N and remain at 890 N for a period of 5 seconds.

S4.3 *Dynamic performance and width.* At each forward-facing outboard designated seating position equipped with a head restraint, the head restraint adjusted midway between the lowest and the highest position of adjustment, and at any position of backset adjustment, must conform to the following:

S4.3.1 *Injury criteria.* When tested in accordance with S5.3 of this section, during a forward acceleration of the dynamic test platform described in S5.3.1, the head restraint must:

(a) *Angular rotation.* Limit posterior angular rotation between the head and torso of the 50th percentile male Hybrid III test dummy specified in 49 CFR part 572, subpart E, fitted with sensors to measure rotation between the head and torso, to 12 degrees for the dummy in all outboard designated seating positions;

(b) *Head injury criteria.* Limit the maximum HIC_{15} value to 500. HIC_{15} is calculated as follows—

For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) is determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and is calculated using the expression:

$$HIC = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 - t_1)$$

4.3.2 *Width.* The head restraint must have the lateral width specified in S4.2.2 of this section.

S4.4 *Folding or retracting rear head restraints non-use positions.* A rear head restraint may be adjusted to a position at which its height does not comply with the requirements of S4.2.1 of this section. However, in any such position, the head restraint must meet either S4.4(a), (b) or (c) of this section.

(a) The head restraint must automatically return to a position in which its minimum height is not less than that specified in S4.2.1(b) of this section when a test dummy representing a 5th percentile female Hybrid III test dummy specified in 49 CFR part 572, subpart O is positioned according to S5.4(a); or

(b) The head restraint must, when tested in accordance with S5.4(b) of this section, be capable of manually rotating forward or rearward by not less than 60 degrees from any position of adjustment in which its minimum

height is not less than that specified in S4.2.1(b) of this section.

(c) The head restraint must, when tested in accordance with S5.4(b) of this section, cause the torso reference line angle to be at least 10 degrees closer to vertical than when the head restraint is in any position of adjustment in which its height is not less than that specified in S4.2.1(b)(1) of this section.

S4.5 *Removability of head restraints.* The head restraint must not be removable without a deliberate action distinct from any act necessary for upward adjustment.

S4.6 *Compliance option selection.* Where manufacturer options are specified in this section, the manufacturer must select an option by the time it certifies the vehicle and may not thereafter select a different option for that vehicle. The manufacturer may select different compliance options for different designated seating positions to which the requirements of this section are applicable. Each manufacturer must, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S4.7 Information in owner's manual.

S4.7.1 The owner's manual for each vehicle must emphasize that all occupants, including the driver, should not operate a vehicle or sit in a vehicle's seat until the head restraints are placed in their proper positions in order to minimize the risk of neck injury in the event of a crash.

S4.7.2 The owner's manual for each vehicle must—

(a) Include an accurate description of the vehicle's head restraint system in an easily understandable format. The owner's manual must clearly identify which seats are equipped with head restraints;

(b) If the head restraints are removable, the owner's manual must provide instructions on how to remove the head restraint by a deliberate action distinct from any act necessary for upward adjustment, and how to reinstall head restraints;

(c) Warn that all head restraints must be reinstalled to properly protect vehicle occupants.

(d) Describe in an easily understandable format the adjustment of the head restraints and/or seat back to achieve appropriate head restraint position relative to the occupant's head. This discussion must include, at a minimum, accurate information on the following topics:

(1) A presentation and explanation of the main components of the vehicle's head restraints.

(2) The basic requirements for proper head restraint operation, including an explanation of the actions that may affect the proper functioning of the head restraints.

(3) The basic requirements for proper positioning of a head restraint in relation to an occupant's head position, including information regarding the proper positioning of the center of gravity of an occupant's head or some other anatomical landmark in relation to the head restraint.

S5 *Procedures.* Demonstrate compliance with S4.2 through S4.4 of this section as follows. The positions of seat adjustment specified in S5 and S5.1 are conditions to be met concurrently and are not a sequential list of adjustments. Any adjustable lumbar support is adjusted to its most posterior nominal design position. If the seat cushion adjusts independently of the seat back, position the seat cushion such that the highest H-point position is achieved with respect to the seat back, as measured by SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin, with leg length specified in S10.4.2.1 of §571.208 of this Part. If the specified position of the H-point can be achieved with a range of seat cushion inclination angles, adjust the seat inclination such that the most forward part of the seat cushion is at its lowest position with respect to the most rearward part. All tests specified by this standard are conducted with the ambient temperature between 18 degrees C. and 28 degrees C.

S5.1 Except as specified in S5.2.3 and S5.3 of this section, if the seat back is adjustable, it is set at an initial inclination position closest to the manufacturer's design seat back angle, as measured by SAE Standard J826 JUL95 (incorporated by reference, see §571.5)

manikin. If there is more than one inclination position closest to the design angle, set the seat back inclination to the position closest to and rearward of the design angle.

S5.1.1 *Procedure for determining presence of head restraints in rear outboard seats.* Measure the height of the top of a rear seat back or the top of any independently adjustable seat component attached to or adjacent to the rear seat back in its highest position of adjustment using the scale incorporated into the SAE Standard J826 JUL95 (incorporated by reference, see § 571.5) manikin or an equivalent scale, which is positioned laterally within 15 mm of the centerline of the rear seat back or any independently adjustable seat component attached to or adjacent to the rear seat back.

S5.2 *Dimensional and static performance procedures.* Demonstrate compliance with S4.2 of this section in accordance with S5.2.1 through S5.2.7 of this section. Position the SAE Standard J826 JUL95 (incorporated by reference, see § 571.5) manikin according to the seating procedure found in SAE Standard J826 JUL95.

S5.2.1 *Procedure for height measurement.* Demonstrate compliance with S4.2.1 of this section in accordance with S5.2.1 (a) and (b) of this section, using the headroom probe scale incorporated into the SAE Standard J826 JUL95 (incorporated by reference, see § 571.5) manikin with the appropriate offset for the H-point position or an equivalent scale, which is positioned laterally within 15 mm of the head restraint centerline. If the head restraint position is independent of the seat back inclination position, compliance is determined at a seat back inclination position closest to the design seat back angle, and each seat back inclination position less than the design seat back angle.

(a)(1) For head restraints in front outboard designated seating positions, adjust the top of the head restraint to the highest position and measure the height.

(2) For head restraints located in the front outboard designated seating positions that are prevented by the interior surface of the vehicle at the roofline from meeting the required height as specified in S4.2.1(a)(1), measure the clearance between the top of the head restraint and the interior surface of the vehicle at the roofline, with the seat adjusted to its lowest vertical position intended for occupant use, by attempting to pass a 25 mm sphere between them. Adjust the top of the head restraint to the lowest position and measure the height.

(b)(1) For head restraints in all outboard designated seating positions equipped with head restraints, adjust the top of the head restraint to the lowest position other than allowed by S4.4 and measure the height.

(2) For head restraints located in rear outboard designated seating positions that are prevented by the interior surface of the vehicle at the roofline or the interior surface of the rear backlight from meeting the required height as specified in S4.2.1(b)(1), measure the clearance between the top of the head restraint or the seat back and the interior surface of the vehicle at the roofline or the interior surface of the rear backlight, with the seat adjusted to its lowest vertical position intended for occupant use, by attempting to pass a 25 mm sphere between them.

S5.2.2 *Procedure for width measurement.* Demonstrate compliance with S4.2.2 of this section using calipers to measure the maximum dimension perpendicular to the vehicle vertical longitudinal plane of the intersection of the head restraint with a plane that is normal to the torso reference line of SAE Standard J826 JUL95 (incorporated by reference, see § 571.5) manikin and 65 ±3 mm below the top of the head restraint.

S5.2.3 *Procedure for backset measurement.* Demonstrate compliance with S4.2.3 of this section using the HRMD positioned laterally within 15 mm of the head restraint centerline. Adjust the front head restraint so that its top is at any height between and inclusive of 750 mm and 800 mm and its backset is in the maximum position other than allowed by S4.4. If the lowest position of adjustment is above 800 mm, adjust the head restraint to that position. If the head restraint position is independent of the seat back inclination position, compliance is determined at

each seat back inclination position closest to and less than the design seat back angle.

S5.2.4 *Procedures for gap measurement.*

S5.2.4.1 Procedure using a 165 mm sphere.

Demonstrate compliance with S4.2.4.1 of this section in accordance with the procedures of S5.2.4.1 (a) through (c) of this section, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

(a) The area of measurement is anywhere on the anterior surface of the head restraint or seat with a height greater than 540 mm and within the following distances from the centerline of the seat—

(1) 127 mm for seats required to have 254 mm minimum head restraint width; and

(2) 85 mm for seats required to have a 170 mm head restraint width.

(b) Applying a load of no more than 5 N against the area of measurement specified in subparagraph (a), place a 165 ±2 mm diameter spherical head form against any gap such that at least two points of contact are made within the area. The surface roughness of the head form is less than 1.6 μm, root mean square.

(c) Determine the gap dimension by measuring the vertical straight line distance between the inner edges of the two furthest contact points, as shown in Figures 2, 3 and 4.

S5.2.4.2 Procedure using a 25 mm cylinder.

Demonstrate compliance with S4.2.4.2 of this section in accordance with the procedures of S5.2.4.2 (a) through (c) of this section, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

(a) The area of measurement is between the anterior surface of the head restraint and seat with a height greater than 540 mm and within the following distances from the centerline of the seat—

(1) 127 mm for seats required to have 254 mm minimum head restraint width; and

(2) 85 mm for seats required to have a 170 mm head restraint width.

(b) Orient a 25 ±1 mm diameter cylinder such that its long axis is perpendicular to the seat back angle and in a vertical longitudinal vehicle plane. Applying a load of no more than 5 N along the axis of the cylinder, place the cylinder against any gap within the area of measurement specified in subparagraph (a). The surface roughness of the cylinder is less than 1.6 μm, root mean square.

(c) Determine if at least 125 mm of the cylinder can completely pass through the gap. If 125 mm or more of the cylinder can completely pass through the gap, the gap is not in compliance.

S5.2.5 *Procedures for energy absorption.* Demonstrate compliance with S4.2.5 of this section in accordance with S5.2.5 (a) through (e) of this section, with adjustable head restraints in any height and backset position of adjustment.

(a) Use an impactor with a semispherical head form with a 165 ±2 mm diameter and a surface roughness of less than 1.6 μm, root mean square. The head form and associated base have a combined mass of 6.8 ±0.05 kg.

(b) Instrument the impactor with an acceleration sensing device whose output is recorded in a data channel that conforms to the requirements for a 600 Hz channel class as specified in SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5). The axis of the acceleration-sensing device coincides with the geometric center of the head form and the direction of impact.

(c) Propel the impactor toward the head restraint. At the time of launch, the longitudinal axis of the impactor is within 2 degrees of being horizontal and parallel to the vehicle longitudinal axis. The direction of travel is posteriorly.

(d) Constrain the movement of the head form so that it travels linearly along the path described in S5.2.5(c) of this section for not less than 25 mm before making contact with the head restraint.

(e) Impact the anterior surface of the seat or head restraint at any point with a height greater than 635 mm and within a distance of the head restraint vertical centerline of 70 mm.

S5.2.6 *Procedures for height retention.* Demonstrate compliance with S4.2.6 of this section in accordance with S5.2.6(a) through (e) of this section. For head restraints that move with respect to the seat when occupant loading is applied to the seat back, S5.2.6(a) through (e) may be performed with the head restraint fixed in a position corresponding to the position when the seat is unoccupied.

(a) Adjust the adjustable head restraint so that its top is at any of the following height positions at any backset position—

(1) For front outboard designated seating positions—

(i) The highest position; and

(ii) Not less than, but closest to 800 mm; and

(2) For rear outboard designated seating positions equipped with head restraints—

(i) The highest position; and

(ii) Not less than, but closest to 750 mm.

(b)(1) Orient a cylindrical test device having a 165 ±2 mm diameter in plan view (perpendicular to the axis of revolution), and a 152 mm length in profile (through the axis of revolution) with a surface roughness of less than 1.6 μm, root mean square, such that the axis of the revolution is horizontal and in the longitudinal vertical plane through the longitudinal centerline of the head restraint. Position the midpoint of the bottom surface of the cylinder in contact with the head restraint.

(2) Establish initial reference position by applying a vertical downward load of 50 ±1 N at the rate of 250 ±50 N/minute. Determine the reference position after 5.5 ±0.5 seconds at this load.

(c) Increase the load at the rate of 250 ±50 N/minute to at least 500 N and maintain this load for 5.5 ±0.5 seconds.

(d) Reduce the load at the rate of 250 ±50 N/minute until the load is completely removed. Maintain this condition for two minutes ±5 seconds.

(e) Increase the load at the rate of 250 ±50 N/minute to 50 ±1 N and, after 5.5 ±0.5 seconds at this load, determine the position of the cylindrical device with respect to its initial reference position.

S5.2.7 *Procedures for backset retention, displacement, and strength.* Demonstrate compliance with S4.2.7 of this section in accordance with S5.2.7(a) and (b) of this section. The load vectors that generate moment on the head restraint are initially contained in a vertical plane parallel to the vehicle longitudinal centerline.

(a) *Backset retention and displacement.* For head restraints that move with respect to the seat when occupant loading is applied to the seat back, S5.2.7(a)(1) through (8) may be performed with the head restraint fixed in a position corresponding to the position when the seat is unoccupied. This fixation is applied to the member(s) that first transmit(s) the seat back loading from the occupant to the head restraint.

(1) Adjust the head restraint so that its top is at a height closest to and not less than:

(i) 800 mm for front outboard designated seating positions (or the highest position of adjustment for head restraints subject to S4.2.1(a)(2)); and

(ii) 750 mm for rear outboard designated seating positions equipped with head restraints (or the highest position of adjustment for rear head restraints subject to S4.2.1(b)(2)).

(2) Adjust the head restraint to any backset position.

(3) In the seat, place a test device having the back pan dimensions and torso reference line (vertical center line), when viewed laterally, with the head room probe in the full back position, of the three dimensional SAE Standard J826 JUL95 (incorporated by reference, see § 571.5) manikin;

(4) Establish the displaced torso reference line by creating a posterior moment of 373 ±7.5 Nm about the H-point by applying a force to the seat back through the back pan at the rate of 187 ±37 Nm/minute. The initial location on the back pan of the moment generating force vector has a height of 290 mm ±13 mm. Apply the force vector normal to the torso reference line and maintain it within 2 degrees of a vertical plane parallel to the vehicle longitudinal centerline. Constrain the back pan to rotate about the H-point. Rotate the force vector direction with the back pan.

(5) Maintain the position of the back pan as established in S5.2.7(a)(4) of this section. Using a 165 ±2 mm diameter spherical head form with a surface

roughness of less than 1.6 μm, root mean square, establish the head form initial reference position by aligning the centerline of the head form perpendicular to the displaced torso reference line, on the seat centerline, and at a height 65 ±3 mm below the top of the head restraint. Apply a posterior initial load that will produce a 37 ±0.7 Nm moment about the H-point. After maintaining this moment for 5.5 ±0.5 seconds, measure the posterior displacement of the head form during the application of the load.

(6) Increase the initial load at the rate of 187 ±37 Nm/minute until a 373 ±7.5 Nm moment about the H-point is produced. Maintain the load level producing that moment for 5.5 ±0.5 seconds and then measure the posterior displacement of the head form relative to the displaced torso reference line.

(7) Reduce the load at the rate of 187 ±37 Nm/minute until it is completely removed. Maintain this condition for two minutes ±5 seconds.

(8) Increase the load at the rate of 187 ±37 Nm/minute until a 37 ±0.7 Nm moment about the H-point is produced. After maintaining the load level producing that moment for 5.5 ±0.5 seconds, measure the posterior displacement of the head form position with respect to its initial reference position; and

(b) *Strength.* Increase the load specified in S5.2.7(a)(7) of this section at the rate of 250 ±50 N/minute to at least 890 N and maintain this load level for 5.5 ±0.5 seconds.

S5.3 *Procedures for dynamic performance.* Demonstrate compliance with S4.3 of this section in accordance with S5.3.1 though S5.3.9 of this section with a 50th percentile male Hybrid III test dummy specified in 49 CFR part 572 subpart E, fitted with sensors to measure head to torso rotation. The dummy with all sensors is to continue to meet all specifications in 49 CFR part 572 subpart E. The restraint is positioned midway between the lowest and the highest position of adjustment, and at any position of backset.

S5.3.1 Mount the vehicle on a dynamic test platform at the vehicle altitude set forth in S13.3 of §571.208 of this part, so that the longitudinal centerline of the vehicle is parallel to the direction of the test platform travel and so that movement between the base of the vehicle and the test platform is prevented. Instrument the platform with an accelerometer and data processing system. Position the accelerometer sensitive axis parallel to the direction of test platform travel.

S5.3.2 Remove the tires, wheels, fluids, and all unsecured components. Remove or rigidly secure the engine, transmission, axles, exhaust, vehicle frame and any other vehicle component necessary to assure that all points on the acceleration vs. time plot measured by an accelerometer on the dynamic test platform fall within the corridor described in Figure 1 and Table 1.

S5.3.3 Place any moveable windows in the fully open position.

S5.3.4 *Seat Adjustment.* The following seat adjustments specify conditions to be met concurrently and are not a sequential list of adjustments. At each outboard designated seating position, using any control that primarily moves the entire seat vertically, place the seat in the lowest position. Using any control that primarily moves the entire seat in the fore and aft directions, place the seat midway between the forwardmost and rearmost position. If an adjustment position does not exist midway between the forwardmost and rearmost positions, the closest adjustment position to the rear of the midpoint is used. Adjust the seat cushion and seat back as required by S5 of this section. If the seat back is adjustable, it is set at an inclination position closest to 25 degrees from the vertical, as measured by SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin. If there is more than one inclination position closest to 25 degrees from the vertical, set the seat back inclination to the position closest to and rearward of 25 degrees. If the head restraint is adjustable, adjust the top of the head restraint to a position midway between the lowest position of adjustment and the highest position of adjustment. If an adjustment position midway between the lowest and the highest position does not exist, adjust the head restraint to a position below and nearest to midway between the lowest position of adjustment and the highest position of adjustment.

S5.3.5 *Seat Belt Adjustment.* Prior to placing the Type 2 seat belt around the test dummy, fully extend the webbing from the seat belt retractor(s) and release it three times to remove slack. If an adjustable seat belt D-ring anchorage exists, place it in the adjustment position closest to the mid-position. If an adjustment position does not exist midway between the highest and lowest position, the closest adjustment position above the midpoint is used.

S5.3.6 Dress and adjust each test dummy as specified in S8.1.8.2 through S8.1.8.3 of § 571.208 of this part. The stabilized test temperature of the test dummy is at any temperature level between 69 degrees F and 72 degrees F, inclusive.

S5.3.7 *Test dummy positioning procedure.* Place a test dummy at each outboard designated seating position equipped with a head restraint.

S5.3.7.1 *Head.* The transverse instrumentation platform of the head is level within ½ degree. To level the head of the test dummy, the following sequence is followed. First, adjust the position of the H-point within the limits set forth in S10.4.2.1 of § 571.208 to level the transverse instrumentation platform of the head of the test dummy. If the transverse instrumentation platform of the head is still not level, then adjust the pelvic angle of the test dummy. If the transverse instrumentation platform of the head is still not level, then adjust the neck bracket of the dummy the minimum amount necessary from the non-adjusted ''0'' setting to ensure that the transverse instrumentation platform of the head is horizontal within ½ degree. The test dummy remains within the limits specified in S10.4.2.1 of § 571.208 after any adjustment of the neck bracket.

S5.3.7.2 *Upper arms and hands.* Position each test dummy as specified in S10.2 and S10.3 of § 571.208 of this part.

S5.3.7.3 *Torso.* Position each test dummy as specified in S10.4.1.1, S10.4.1.2, and S10.4.2.1 of § 571.208 of this Part, except that the midsagittal plane of the dummy is aligned within 15 mm of the head restraint centerline. If the midsagittal plane of the dummy cannot be aligned within 15 mm of the head restraint centerline then align the midsagittal plane of the dummy as close as possible to the head restraint centerline.

S5.3.7.4 *Legs.* Position each test dummy as specified in S10.5 of § 571.208 of this part, except that final adjustment to accommodate placement of the feet in accordance with S5.3.7.5 of this section is permitted.

S5.3.7.5 *Feet.* Position each test dummy as specified in S10.6 of § 571.208 of this part, except that for rear outboard designated seating positions the feet of the test dummy are placed flat on the floorpan and beneath the front seat as far forward as possible without front seat interference. For rear outboard designated seating positions, if necessary, the distance between the knees can be changed in order to place the feet beneath the seat.

S5.3.8 Accelerate the dynamic test platform to 17.3 ±0.6 km/h. All of the points on the acceleration vs. time curve fall within the corridor described in Figure 1 and Table 1 when filtered to channel class 60, as specified in the SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see § 571.5). Measure the maximum posterior angular displacement.

S5.3.9 Calculate the angular displacement from the output of instrumentation placed in the torso and head of the test dummy and an algorithm capable of determining the relative angular displacement to within one degree and conforming to the requirements of a 600 Hz channel class, as specified in SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see § 571.5). No data generated after 200 ms from the beginning of the forward acceleration are used in determining angular displacement of the head with respect to the torso.

S5.3.10 Calculate the HIC_{15} from the output of instrumentation placed in the head of the test dummy, using the equation in S4.3.1(b) of this section and conforming to the requirements for a 1000 Hz channel class as specified in SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see § 571.5). No data generated after 200 ms from the beginning of the forward acceleration are used in determining HIC.

S5.4 Procedures for folding or retracting head restraints for unoccupied

rear outboard designated seating positions.

(a) Demonstrate compliance with S4.4 (a) of this section, using a 5th percentile female Hybrid III test dummy specified in 49 CFR part 572, subpart O, in accordance with the following procedure—

(1) Position the test dummy in the seat such that the dummy's midsaggital plane is aligned within the 15 mm of the head restraint centerline and is parallel to a vertical plane parallel to the vehicle longitudinal centerline.

(2) Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

(3) Place the legs as close as possible to 90 degrees to the thighs. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion such that the angle between the dummy's thighs and legs begins to change.

(4) Note the position of the head restraint. Remove the dummy from the seat. If the head restraint returns to a retracted position upon removal of the dummy, manually place it in the noted position. Determine compliance with the height requirements of S4.2.1 of this section by using the test procedures of S5.2.1 of this section.

(b) Demonstrate compliance with S4.4 (b) of this section in accordance with the following procedure:

(1) Place the rear head restraint in any position meeting the requirements of S4.2 of this section;

(2) Strike a line on the head restraint. Measure the angle or range of angles of the head restraint reference line as projected onto a vertical longitudinal vehicle plane. Alternatively, measure the torso reference line angle with the SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin;

(3) Fold or retract the head restraint to a position in which its minimum height is less than that specified in S4.2.1 (b) of this section;

(4) Determine the minimum change in the head restraint reference line angle as projected onto a vertical longitudinal vehicle plane from the angle or range of angles measured in 5.4(b)(2). Alternatively, determine the change in the torso reference line angle with the SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin.

S6 *Vehicles manufactured on or after September 1, 2009, and before September 1, 2010 (Phase-in of §571.202a).*

(a) For vehicles manufactured for sale in the United States on or after September 1, 2009, and before September 1, 2010, a percentage of the manufacturer's production, as specified in S6.1, shall meet the requirements specified in this §571.202a without regard to any option to comply with the standard in §571.202 or with the European regulations referenced in S4.3(a) of §571.202. So long as this percentage requirement is met, a vehicle may comply with the standard in this §571.202a, with the standard in §571.202, or with the European regulations referenced in S4.3(a) of §571.202.

(b) Notwithstanding S6(a), vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter may comply with the standard in this §571.202a, with the standard in §571.202, or with the European regulations referenced in S4.3(a) of §571.202.

S6.1 *Phase-in percentage.* For vehicles manufactured by a manufacturer on or after September 1, 2009, and before September 1, 2010, the amount of vehicles complying with S6(a) shall be not less than 80 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2009, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2007, and before September 1, 2010, or

(b) The manufacturer's production on or after September 1, 2009, and before September 1, 2010.

S6.2 *Vehicles produced by more than one manufacturer.*

S6.2.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number

of vehicles manufactured by each manufacturer under S6.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S6.2.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S6.2.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S6.2.1.

S7. *Vehicles manufactured on or after September 1, 2010, and before September 1, 2011 (Phase-in of rear seat requirements of § 571.202a).*

(a) For vehicles manufactured for sale in the United States on or after September 1, 2010, and before September 1, 2011 a percentage of the manufacturer's production of vehicles equipped with rear outboard head restraints, as specified in S7.1, shall meet the requirements specified in this § 571.202a for rear head restraints.

(b) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirement specified in S7(a).

S7.1 *Phase-in percentage.* For vehicles manufactured by a manufacturer on or after September 1, 2010, and before September 1, 2011, the amount of vehicles equipped with rear outboard head restraints complying with S7(a) shall be not less than 80 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2010, the manufacturer's average annual production of vehicles equipped with rear outboard head restraints manufactured on or after September 1, 2008, and before September 1, 2011, or

(b) The manufacturer's production of vehicles equipped with rear outboard head restraints on or after September 1, 2010, and before September 1, 2011.

S7.2 *Vehicles produced by more than one manufacturer.*

S7.2.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S7.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S7.2.2.

S7.2.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S7.2.1.

Table 1 of 571.202a – Sled pulse corridor reference point locations.

Reference Point	Time (ms)	Acceleration (m/s^2)
A	0	10
B	28	94
C	60	94
D	92	0
E	4	0
F	38.5	80
G	49.5	80
H	84	0

Figure 1 of §571.202a - Sled pulse acceleration corridor. The target acceleration with time expressed in milliseconds is $a = 86 \sin(\pi t/88)$ m/s^2, for V = 17.3 ± 0.6 km/h. The time zero for the test is defined by the point when the sled acceleration achieves 2.5 m/s^2 (0.25 G's).

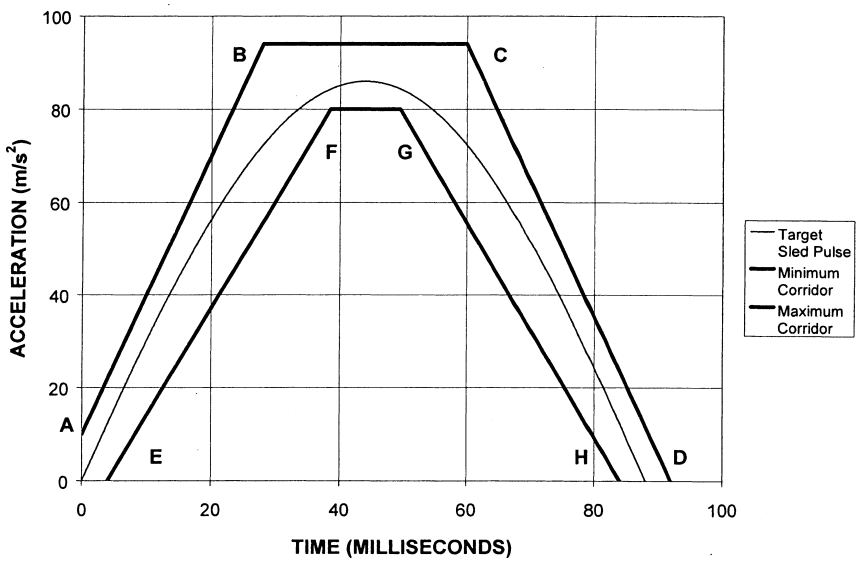


Figure 2 of §571.202a - Measurement of a vertical gap "a".

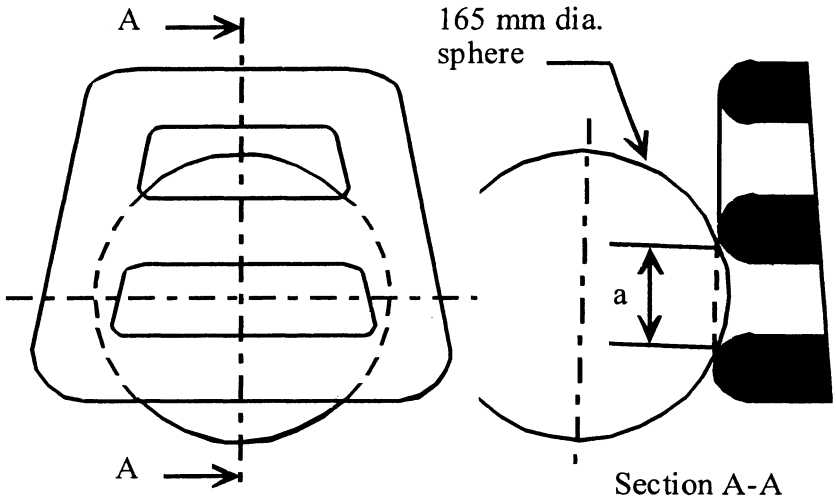


Figure 3 of §571.202a - Measurement of a horizontal gap "a".

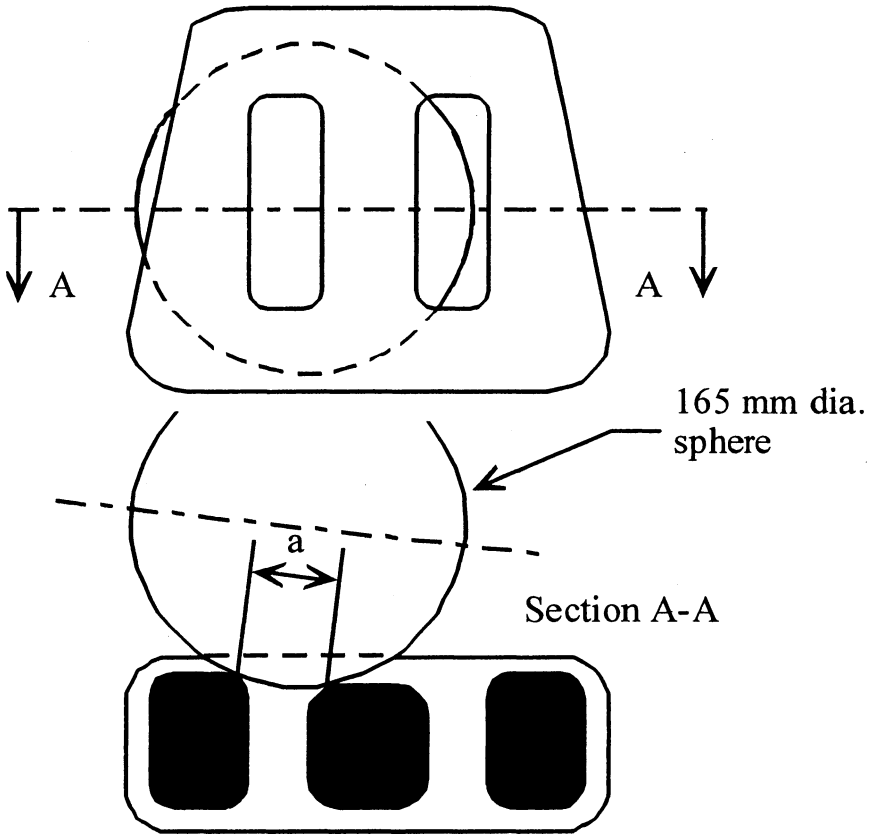
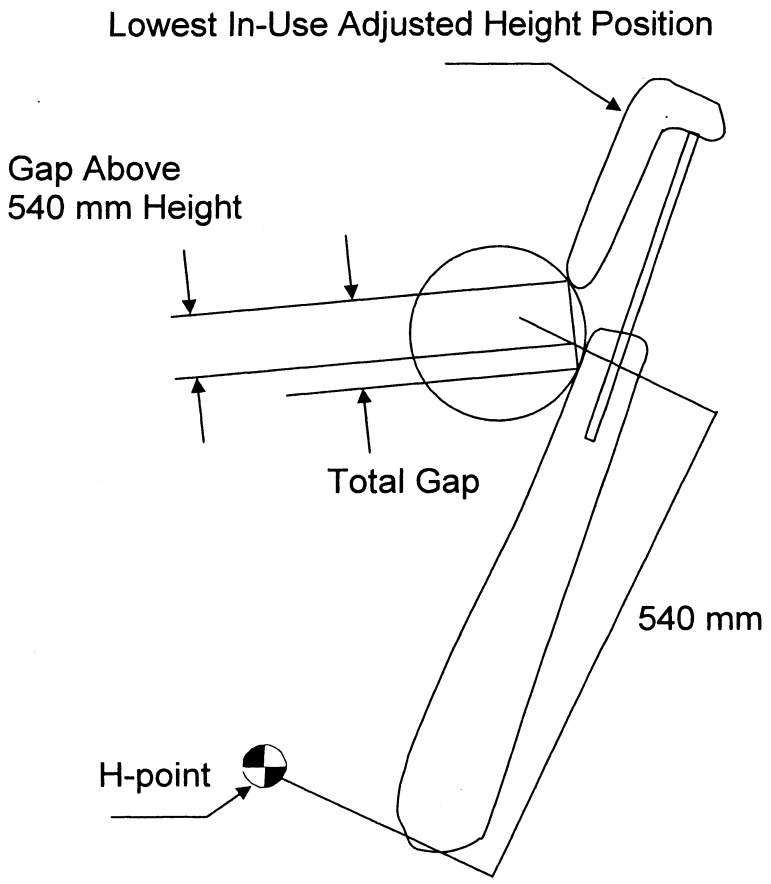


Figure 4 of §571.202a – Portion of gap above 540 mm height.



[72 FR 25514, May 4, 2007, as amended at 75 FR 67246, Nov. 2, 2010; 77 FR 761, Jan. 6, 2012]

§ 571.203 Standard No. 203; Impact protection for the driver from the steering control system.

S1. *Purpose and scope.* This standard specifies requirements for steering control systems that will minimize chest, neck, and facial injuries to the driver as a result of impact.

S2. *Application.* This standard applies to passenger cars and to multipurpose passenger vehicles, trucks and buses with a gross vehicle weight rating of 4,536 kg or less. However, it does not apply to vehicles that conform to the frontal barrier crash requirements (S5.1) of Standard No. 208 (49 CFR 571.208) by means of other than seat belt assemblies. It also does not apply to walk-in vans or vehicles without a steering control.

S3. [Reserved]

S4. *Requirements.* Each passenger car and each multipurpose passenger vehicle, truck and bus with a gross vehicle

weight rating of 4,536 kg or less manufactured on or after September 1, 1981 shall meet the requirements of S5.1 and S5.2.

S5. *Impact protection requirements.*

S5.1 Except as provided in this paragraph, the steering control system of any vehicle to which this standard applies shall be impacted in accordance with S5.1(a).

(a) When the steering control system is impacted by a body block in accordance with SAE Recommended Practice J944 JUN80 (incorporated by reference, see § 571.5), at a relative velocity of 24 km/h, the impact force developed on the chest of the body block transmitted to the steering control system shall not exceed 11,120 N, except for intervals whose cumulative duration is not more than 3 milliseconds.

(b) [Reserved]

S5.2 The steering control system shall be so constructed that no components or attachments, including horn actuating mechanisms and trim hardware, can catch the driver's clothing or jewelry during normal driving maneuvers.

NOTE: The term jewelry refers to watches, rings, and bracelets without loosely attached or dangling members.

[36 FR 22902, Dec. 2, 1971, as amended at 44 FR 68475, Nov. 29, 1979; 47 FR 47842, Oct. 28, 1982; 58 FR 26527, May 4, 1993; 58 FR 63304, Dec. 1, 1993; 63 FR 28935, May 27, 1998; 63 FR 51003, Sept. 24, 1998; 76 FR 762, Jan. 6, 2012; 87 FR 18588, Mar. 30, 2022]

§ 571.204 Standard No. 204; Steering control rearward displacement.

S1. *Purpose and scope.* This standard specifies requirements limiting the rearward displacement of the steering control into the passenger compartment to reduce the likelihood of chest, neck, or head injury.

S2. *Application.* This standard applies to passenger cars and to multipurpose passenger vehicles, trucks, and buses. However, it does not apply to walk-in vans or vehicles without steering controls.

S3. *Definitions.*

Steering column means a structural housing that surrounds a steering shaft.

Steering shaft means a component that transmits steering torque from the steering wheel to the steering gear.

S4 *Requirements.*

S4.1 *Vehicles manufactured before September 1, 1991.* When a passenger car or a truck, bus, or multipurpose passenger vehicle with a gross vehicle weight rating of 10,000 pounds or less and an unloaded vehicle weight of 4,000 pounds or less is tested under the conditions of S5 in a 30 mile per hour perpendicular impact into a fixed collision barrier, the upper end of the steering column and shaft in the vehicle shall not be displaced more than 5 inches in a horizontal rearward direction parallel to the longitudinal axis of the vehicle. The amount of displacement shall be measured relative to an undisturbed point on the vehicle and shall represent the maximum dynamic movement of the upper end of the steering column and shaft during the crash test.

S4.2 *Vehicles manufactured on or after September 1, 1991.* When a passenger car or a truck, bus or multipurpose passenger vehicle with a gross vehicle weight rating of 4,536 kg or less and an unloaded vehicle weight of 2,495 kg or less is tested under the conditions of S5 in a 48 km/h perpendicular impact into a fixed collision barrier, the upper end of the steering column and shaft in the vehicle shall not be displaced more than 127 mm in a horizontal rearward direction parallel to the longitudinal axis of the vehicle. The amount of displacement shall be measured relative to an undisturbed point on the vehicle and shall represent the maximum dynamic movement of the upper end of the steering column and shaft during the crash test.

S5. *Test conditions.* The requirements of S4 shall be met when the vehicle is tested in accordance with the following conditions.

S5.1 The vehicle, including test devices and instrumentation, is loaded to its unloaded vehicle weight.

S5.2 Adjustable steering controls are adjusted so that a tilting steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. A telescoping steering control is set at the adjustment position midway between the forwardmost and rearwardmost position.

S5.3 Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S5.4 Doors are fully closed and latched but not locked.

S5.5 The fuel tank is filled to any level from 90 to 95 percent of capacity.

S5.6 The parking brake is disengaged and the transmission is in neutral.

S5.7 Tires are inflated to the vehicle manufacturer's specifications.

[52 FR 44897, Nov. 23, 1987, as amended at 63 FR 28935, May 27, 1998; 63 FR 51003, Sept. 24, 1998; 87 FR 18588, Mar. 30, 2022]

§ 571.205 Standard No. 205, Glazing materials.

S1. *Scope*. This standard specifies requirements for glazing materials for use in motor vehicles and motor vehicle equipment.

S2. *Purpose*. The purpose of this standard is to reduce injuries resulting from impact to glazing surfaces, to ensure a necessary degree of transparency in motor vehicle windows for driver visibility, and to minimize the possibility of occupants being thrown through the vehicle windows in collisions.

S3. *Application*.

(a) This standard applies to passenger cars, multipurpose passenger vehicles, trucks designed to carry at least one person, buses, motorcycles, slide-in campers, pickup covers designed to carry persons while in motion and low speed vehicles, and to glazing materials for use in those vehicles.

(b) For glazing materials manufactured before September 1, 2006, and for motor vehicles, slide-in campers and pickup covers designed to carry persons while in motion, manufactured before November 1, 2006, the manufacturer may, at its option, comply with 49 CFR 571.205(a) of this section.

S4. *Definitions*.

Bullet resistant shield means a shield or barrier that is installed completely inside a motor vehicle behind and separate from glazing materials that independently comply with the requirements of this standard.

Camper means a structure designed to be mounted in the cargo area of a truck, or attached to an incomplete vehicle with motive power, for the purpose of providing shelter for persons.

Glass-plastic glazing material means a laminate of one or more layers of glass and one or more layers of plastic in which a plastic surface of the glazing faces inward when the glazing is installed in a vehicle.

Pickup cover means a camper having a roof and sides but without a floor, designed to be mounted on and removable from the cargo area of a truck by the user.

Prime glazing manufacturer means a manufacturer that fabricates, laminates, or tempers glazing materials.

Slide-in camper means a camper having a roof, floor, and sides, designed to be mounted on and removable from the cargo area of a truck by the user.

S5. *Requirements*.

S5.1 Glazing materials for use in motor vehicles must conform to ANSI/SAE Z26.1–1996 (incorporated by reference, see § 571.5), unless this standard provides otherwise. SAE Recommended Practice J673 (1993) (incorporated by reference, see § 571.5) is referenced in ANSI/SAE Z26.1–1996.

S5.1.1 *Multipurpose passenger vehicles*. Except as otherwise specifically provided by this standard, glazing for use in multipurpose passenger vehicles shall conform to the requirements for glazing for use in trucks as specified in ANSI/SAE Z26.1–1996 (incorporated by reference, see § 571.5).

S5.1.2 *Aftermarket replacement glazing*. Glazing intended for aftermarket replacement is required to meet the requirements of this standard or the requirements of 49 CFR 571.205(a) applicable to the glazing being replaced.

S5.1.3 *Location of arrow within ''AS'' markings*. In ANSI/SAE Z26.1–1996 (incorporated by reference, see § 571.5) Section 7. ''Marking of Safety Glazing Materials,'' on page 33, in the right column, in the first complete sentence, the example markings ''AS↓1'', ''AS↓14'' and ''AS↑2'' are corrected to read ''A↓S1'', ''A↓S14'' and ''A↑S2''. Note that the arrow indicating the portion of the material that complies with Test 2 is placed with its base adjacent to a horizontal line.

S5.2 Each of the test specimens described in ANSI/SAE Z26.1–1996 (incorporated by reference, see §571.5) Section 5.7 (fracture test) must meet the fracture test requirements of that section when tested in accordance with the test procedure set forth in that section.

S5.3 *Shade Bands.* Shade band areas for windshields shall comply with the requirements of either S5.3.1 or S5.3.2.

S5.3.1 Shade bands for windshields shall comply with SAE Recommended Practice J100 (1995) (incorporated by reference, see §571.5).

S5.3.2 Except as provided in S5.3.2.1, the lower boundary of shade bands for windshields shall be a plane inclined upwards from the X axis of the vehicle at 7 degrees, passing through point V_1, and parallel to the Y axis. The coordinate system and point V_1 shall be as specified in Annexes 18 and 19 of European Commission for Europe (ECE) Regulation No. 43 Revision 2—Amendment 1.

S5.3.2.1 In the area 300 mm wide centered on the intersection of the windshield surface and longitudinal vertical median plane of the vehicle, the lower boundary of shade bands for windshields shall be a plane inclined upwards from the X axis of the vehicle at 3 degrees, passing through point V_1, and parallel to the Y axis.

S5.4 *Low speed vehicles.* Windshields of low speed vehicles must meet the ANSI/SAE Z26.1–1996 specifications for either AS–1 or AS–4 glazing.

S5.5 Item 4A Glazing. Item 4A glazing may be used in all areas in which Item 4 safety glazing may be used, and also for side windows rearward of the ''C'' pillar. I.e., Item 4A glazing may be used under Item 4A paragraph (b) of ANSI/SAE Z26.1–1996 only in side windows rearward of the ''C'' pillar.

S6. *Certification and marking.*

S6.1 A prime glazing material manufacturer must certify, in accordance with 49 U.S.C. 30115, each piece of glazing material to which this standard applies that is designed—

(a) As a component of any specific motor vehicle or camper; or

(b) To be cut into components for use in motor vehicles or items of motor vehicle equipment.

S6.2 A prime glazing manufacturer certifies its glazing by adding to the marks required by section 7 of ANSI/SAE Z26.1–1996, in letters and numerals of the same size, the symbol ''DOT'' and a manufacturer's code mark that NHTSA assigns to the manufacturer. NHTSA will assign a code mark to a manufacturer after the manufacturer submits a written request to the Office of Vehicle Safety Compliance, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. The request must include the company name, address, and a statement from the manufacturer certifying its status as a prime glazing manufacturer as defined in S4.

S6.3 A manufacturer or distributor who cuts a section of glazing material to which this standard applies, for use in a motor vehicle or camper, must—

(a) Mark that material in accordance with section 7 of ANSI/SAE Z26.1–1996; and

(b) Certify that its product complies with this standard in accordance with 49 U.S.C. 30115.

[37 FR 12239, June 21, 1972]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.205, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov.*

§571.205(a) Glazing equipment manufactured before September 1, 2006 and glazing materials used in vehicles manufactured before November 1, 2006.

S1. *Scope.* This standard specifies requirements for glazing equipment manufactured before September 1, 2006 for use in motor vehicles and motor vehicle equipment, and specifies requirements for motor vehicles manufactured before November 1, 2006 and for replacement glazing for those vehicles. A manufacturer may, at its option, comply with 49 CFR 571.205 instead of this standard.

S2. *Purpose.* The purpose of this standard is to reduce injuries resulting from impact to glazing surfaces, to ensure a necessary degree of transparency in motor vehicle windows for driver visibility, and to minimize the possibility of occupants being thrown

through the vehicle windows in collisions.

S3. *Application.* This standard applies to glazing equipment manufactured before September 1, 2006 for use in motor vehicles and motor vehicle equipment. In addition, this standard applies to the following vehicles manufactured before November 1, 2006: passenger cars, low speed vehicles, multipurpose passenger vehicles, trucks, buses, and motorcycles. This standard also applies to slide-in campers, and pickup covers designed to carry persons while in motion, manufactured before November 1, 2006.

S4. Definitions

Bullet resistant shield means a shield or barrier that is installed completely inside a motor vehicle behind and separate from glazing materials that independently comply with the requirements of this standard.

Camper means a structure designed to be mounted in the cargo area of a truck, or attached to an incomplete vehicle with motive power, for the purpose of providing shelter for persons.

Glass-plastic glazing material means a laminate of one or more layers of glass and one or more layers of plastic in which a plastic surface of the glazing faces inward when the glazing is installed in a vehicle.

Motor home means a multipurpose passenger vehicle that provides living accommodations for persons.

Pickup cover means a camper having a roof and sides but without a floor, designed to be mounted on and removable from the cargo area of a truck by the user.

Slide-in camper means a camper having a roof, floor, and sides, designed to be mounted on and removable from the cargo area of a truck by the user.

S5. Requirements

S5.1. Materials

S5.1.1 Glazing materials for use in motor vehicles, except as otherwise provided in this standard shall conform to ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5). However, Item 11B glazing as specified in that standard may not be used in motor vehicles at levels requisite for driving visibility, and Item 11B glazing is not required to pass Tests Nos. 17, 30, and 31.

S5.1.1.1 The chemicals specified for testing chemical resistance in Tests Nos. 19 and 20 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5) shall be:

(a) One percent solution of nonabrasive soap.

(b) Kerosene.

(c) Undiluted denatured alcohol, Formula SD No. 30 (1 part 100-percent methyl alcohol in 10 parts 190-proof ethyl alcohol by volume).

(d) Gasoline, ASTM Reference Fuel C, which is composed of Isooctane 50 volume percentage and Toluene 50 volume percentage. Isooctane must conform to A2.7 in the ASTM Motor Fuels section (incorporated by reference, see §571.5), and Toluene must conform to ASTM D362–84 (incorporated by reference, see §571.5), Standard Specification for Industrial Grade Toluene. ASTM Reference Fuel C must be used as specified in:

(1) Paragraph A2.3.2 and A2.3.3 in the ASTM Motor Fuels section (incorporated by reference, see §571.5); and

(2) OSHA Standard 29 CFR 1910.106—''Handling Storage and Use of Flammable Combustible Liquids.''

S5.1.1.2 The following locations are added to the lists specified in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5) in which item 4, item 5, item 8, and item 9 safety glazing may be used:

(a)–(i) [Reserved]

(j) Windows and doors in motor homes, except for the windshield and windows to the immediate right or left of the driver.

(k) Windows and doors in slide-in campers and pickup covers.

(l) Windows and doors in buses except for the windshield, windows to the immediate right or left of the driver, and rearmost windows if used for driving visibility.

(m) For Item 5 safety glazing only: Motorcycle windscreens below the intersection of a horizontal plane 380 millimeters vertically above the lowest seating position.

S5.1.1.3 The following locations are added to the lists specified in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference,

see §571.5) in which item 6 and item 7 safety glazing may be used:

(a)–(i) [Reserved]

(j) Windows and doors in motor homes, except for the windshield, forward-facing windows, and windows to the immediate right or left of the driver.

(k) Windows, except forward-facing windows, and doors in slide-in campers and pickup covers.

(l) For item 7 safety glazing only:

(1) Standee windows in buses.

(2) Interior partitions.

(3) Openings in the roof.

S5.1.1.4 The following locations are added to the lists specified in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5) in which item 8 and item 9 safety glazing may be used:

(a)–(e) [Reserved]

(f) Windows and doors in motor homes, except for the windshield and windows to the immediate right or left of the driver.

(g) Windows and doors in slide-in campers and pickup covers.

S5.1.1.5 The phrase ''readily removable'' windows as defined in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5), for the purposes of this standard, in buses having a GVWR of more than 4536 kilograms (10,000 pounds), shall include pushout windows and windows mounted in emergency exits that can be manually pushed out of their location in the vehicle without the use of tools, regardless of whether such windows remain hinged at one side to the vehicle.

S5.1.1.6 Multipurpose passenger vehicles. Except as otherwise specifically provided by this standard, glazing for use in multipurpose passenger vehicles shall conform to the requirements for glazing for use in trucks as specified in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5).

S5.1.1.7 Test No. 17 is deleted from the list of tests specified in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5) for Item 5 glazing material and Test No. 18 is deleted from the lists of tests specified in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980, for Item 3 and Item 9 glazing material.

S5.1.2 In addition to the glazing materials specified in ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5), materials conforming to S5.1.2.1, S5.1.2.2, S5.1.2.3, S5.1.2.4, S5.1.2.5, S5.1.2.6, S5.1.2.7, S5.1.2.8, and S5.1.2.11 may be used in the locations of motor vehicles specified in those sections.

S5.1.2.1 Item 11C—Safety Glazing Material for Use in Bullet Resistant Shields. Bullet resistant glazing that complies with Tests Nos. 2, 17, 19, 20, 21, 24, 27, 28, 29, 30 and 32 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5) and the labeling requirements of S5.1.2.5 may be used only in bullet resistant shields that can be removed from the motor vehicle easily for cleaning and maintenance. A bullet resistant shield may be used in areas requisite for driving visibility only if the combined parallel luminous transmittance with perpendicular incidence through both the shield and the permanent vehicle glazing is at least 60 percent.

S5.1.2.2 Item 12—Rigid Plastics. Safety plastics materials that comply with Tests Nos. 10, 13, 16, 19, 20, 21, and 24 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5), with the exception of the test for resistance to undiluted denatured alcohol Formula SD No. 30, and that comply with the labeling requirements of S5.1.2.5, may be used in a motor vehicle only in the following specified locations at levels not requisite for driving visibility.

(a) Window and doors in slide-in campers and pickup covers.

(b) Motorcycle windscreens below the intersection of a horizontal plane 380 millimeters vertically above the lowest seating position.

(c) Standee windows in buses.

(d) Interior partitions.

(e) Openings in the roof.

(f) Flexible curtains or readily removable windows or in ventilators used in conjunction with readily removable windows.

(g) Windows and doors in motor homes, except for the windshield and

windows to the immediate right or left of the driver.

(h) Windows and doors in buses, except for the windshield and window to the immediate right and left of the driver.

S5.1.2.3 Item 13—Flexible plastics. Safety plastic materials that comply with Tests Nos. 16, 19, 20, 22, and 23 or 24 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5), with the exception of the test for resistance to undiluted denatured alcohol Formula SD No. 30, and that comply with the labeling requirements of S5.1.2.5 may be used in the following specific locations at levels not requisite for driving visibility.

(a) Windows, except forward-facing windows, and doors in slide-in campers and pickup covers.

(b) Motorcycle windscreens below the intersection of a horizontal plane 380 millimeters vertically above the lowest standing position.

(c) Standee windows in buses.

(d) Interior partitions.

(e) Openings in the roof.

(f) Flexible curtains or readily removable windows or in ventilators used in conjunction with readily removable windows.

(g) Windows and doors in motor homes, except for the windshield, forward-facing windows, and windows to the immediate right or left of the driver.

S5.1.2.4 Item 14—Glass Plastics. Glass-plastic glazing materials that comply with the labeling requirements of S5.1.2.10 and Tests Nos. 1, 2, 3, 4, 9, 12, 15, 16, 17, 18, 19, 24, 26, and 28, as those tests are modified in S5.1.2.9, Test Procedures for Glass-Plastics, may be used anywhere in a motor vehicle, except that it may not be used in windshields of any of the following vehicles: convertibles, vehicles that have no roof, vehicles whose roofs are completely removable.

S5.1.2.5 Item 15A—Annealed Glass-Plastic for Use in All Positions in a Vehicle Except the Windshield. Glass-plastic glazing materials that comply with Tests Nos. 1, 2, 3, 4, 9, 12, 16, 17, 18, 19, 24, and 28, as those tests are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used anywhere in a motor vehicle except the windshield.

S5.1.2.6 Item 15B—Tempered Glass-Plastic for Use in All Positions in a Vehicle Except the Windshield. Glass-plastic glazing materials that comply with Tests Nos. 1, 2, 3, 4, 6, 7, 8, 16, 17, 18, 19, 24, and 28, as those tests are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used anywhere in a motor vehicle except the windshield.

S5.1.2.7 Item 16A—Annealed Glass-Plastic for Use in All Positions in a Vehicle Not Requisite for Driving Visibility. Glass-plastic glazing materials that comply with Tests Nos. 3, 4, 9, 12, 16, 19, 24, and 28, as those tests are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used in a motor vehicle in all locations not requisite for driving visibility.

S5.1.2.8 Item 16B—Tempered Glass-Plastic for Use in All Positions in a Vehicle Not Requisite for Driving Visibility. Glass-plastic glazing materials that comply with Tests Nos. 3, 4, 6, 7, 8, 16, 19, 24, and 28, as those tests are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used in a motor vehicle in all locations not requisite for driving visibility.

S5.1.2.9—Test Procedures for Glass-Plastics. (a) Tests Nos. 6, 7, 8, 9, 12, 16, and 18, shall be conducted on the glass side of the specimen, i.e., the surface which would face the exterior of the vehicle. Tests Nos. 17, 19, 24, and 26 shall be conducted on the plastic side of the specimen, i.e., the surface which would face the interior of the vehicle. Test No. 15 should be conducted with the glass side of the glazing facing the illuminated box and the screen, respectively. For Test No. 19, add the following to the specified list: an aquaeous solution of isopropanol and glycol ether solvents in concentration no greater than ten percent or less than five percent by weight and ammonium hydroxide no greater than five percent or less than one percent by weight, simulating typical commercial windshield cleaner.

(b) Glass-plastic specimens shall be exposed to an ambient air temperature of −40 degrees Celsius (plus or minus 5 degrees Celsius), for a period of 6 hours at the commencement of Test No. 28,

rather than at the initial temperature specified in that test. After testing, the glass-plastic specimens shall show no evidence of cracking, clouding, delaminating, or other evidence of deterioration.

(c) Glass-plastic specimens tested in accordance with Test No. 17 shall be carefully rinsed with distilled water following the abrasion procedure and wiped dry with lens paper. After this procedure, the arithmetic means of the percentage of light scattered by the three specimens as a result of abrasion shall not exceed 4.0 percent.

(d) Data obtained from Test No. 1 should be used when conducting Test No. 2.

(e)(1) Except as provided in S5.1.2.9(e)(2), glass-plastic glazing specimens tested in accordance with Tests Nos. 9, 12, and 26 shall be clamped in the test fixture in Figure 1 of this standard in the manner shown in that figure. The clamping gasket shall be made of rubber 3 millimeters (mm) thick of hardness 50 IRHD (International Rubber Hardness Degrees), plus or minus five degrees. Movement of the test specimen, measured after the test, shall not exceed 2 mm at any point along the inside periphery of the fixture. Movement of the test specimen beyond the 2 mm limit shall be considered an incomplete test, not a test failure. A specimen used in such an incomplete test shall not be retested.

(2) At the option of the manufacturer, glass-plastic glazing specimens tested in accordance with Tests Nos. 9 and 12 may be tested unclamped. Such specimens shall be tested using the fixture in Figure 1 of the standard, including the upper frame (unclamped) which holds the specimen in place.

S5.1.2.10 Cleaning Instructions. (a) Each manufacturer of glazing materials designed to meet the requirements of S5.1.2.1., S5.1.2.2, S5.1.2.3, S5.1.2.4, S5.1.2.5, S5.1.2.6, S5.1.2.7, S5.1.2.8, or S5.1.2.11 shall affix a label, removable by hand without tools, to each item of glazing materials. The label shall identify the product involved, specify instructions and agents for cleaning the material that will minimize the loss of transparency, and instructions for removing frost and ice, and, at the option of the manufacturer, refer owners to the vehicle's Owners Manual for more specific cleaning and other instructions.

(b) Each manufacturer of glazing materials designed to meet the requirements of paragraphs S5.1.2.4, S5.1.2.5, S5.1.2.6, S5.1.2.7, or S5.1.2.8 may permanently and indelibly mark the lower center of each item of such glazing material, in letters not less than 4.5 millimeters nor more than 6 millimeters high, the following words, GLASS PLASTIC MATERIAL—SEE OWNER'S MANUAL FOR CARE INSTRUCTIONS.

S5.1.2.11 Test Procedures for Item 4A—Rigid Plastic for Use in Side Windows Rearward of the ''C'' Pillar. (a) Glazing materials that comply with Tests Nos. 2, 10, 13, 16, 17, as that test is modified in S5.1.2.9(c) (on the interior side only), 17, as that test is modified in paragraph (b) of this section (on the exterior side only), 19, 20, 21, and 24 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5), may be used in the following specific locations:

(1) All areas in which item 4 safety glazing may be used.

(2) Any side window that meets the criteria in S5.1.2.11(a)(2)(i) and (ii):

(i) Is in a vehicle whose rearmost designated seating position is forward-facing and cannot be adjusted so that it is side or rear-facing; and

(ii) The forwardmost point on its visible interior surface is rearward of the vertical transverse plane that passes through the shoulder reference point (as described in Figure 1 of Section 571.210 Seat belt assembly anchorages) of that rearmost seating position.

(b)(1) The initial maximum haze level shall not exceed 1.0 percent. The specimens are subjected to abrasion for 100 cycles and then carefully wiped with dry lens paper (or its equivalent). The light scattered by the abraded track is measured in accordance with Test 17. The arithmetic mean of the percentages of light scattered by the three specimens shall not exceed 4.0 percent after being subjected to abrasion for 100 cycles.

(2) The specimen is remounted on the specimen holder so that it rotates substantially in a plane and subjected to abrasion for an additional 400 cycles on the same track already abraded for 100

cycles. Specimens are carefully wiped after abrasion with dry lens paper (or its equivalent). The light scattered by the abraded track is then measured as specified in Test 17. The arithmetic mean of the percentages of light scattered by the three specimens shall not exceed 10.0 percent after being subjected to abrasion for 500 cycles.

S5.2 Edges. In vehicles except schoolbuses, exposed edges shall be treated in accordance with SAE Recommended Practice J673a (1967) (incorporated by reference, see §571.5). In schoolbuses, exposed edges shall be banded.

S6. Certification and Marking.

S6.1 Each prime glazing material manufacturer, except as specified below, shall mark the glazing materials it manufactures in accordance with section 6 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5). The materials specified in S5.1.2.1, S5.1.2.2, S5.1.2.3, S5.1.2.4, S5.1.2.5, S5.1.2.6, S5.1.2.7, S5.1.2.8, and S5.1.2.11 shall be identified by the marks ''AS 11C'', ''AS 12'', ''AS 13'', ''AS 14'', ''AS 15A'', ''AS 15B'', ''AS 16A'', ''AS 16B'', and ''AS 4'', respectively. A prime glazing material manufacturer is one which fabricates, laminates, or tempers the glazing material.

S6.2 Each prime glazing material manufacturer shall certify each piece of glazing material to which this standard applies that is designed as a component of any specific motor vehicle or camper, pursuant to section 114 of the National Traffic and Motor Vehicle Safety Act of 1966 (49 U.S.C. §30115), by adding to the mark required by S6.1 in letters and numerals of the size specified in section 6 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5), the symbol ''DOT'' and a manufacturer's code mark, which will be assigned by NHTSA on the written request of the manufacturer.

S6.3 Each prime glazing material manufacturer shall certify each piece of glazing material to which this standard applies that is designed to be cut into components for use in motor vehicles or items of motor vehicle equipment, pursuant to section 114 of the National Traffic and Motor Vehicle Safety Act (49 U.S.C. §30115).

S6.4 Each manufacturer or distributor who cuts a section of glazing material to which this standard applies, for use in a motor vehicle or camper, shall mark that material in accordance with section 6 of ANSI Z26.1–1977, as amended by ANSI Z26.1a–1980 (both incorporated by reference, see §571.5).

S6.5 Each manufacturer or distributor who cuts a section of glazing material to which this standard applies, for use in a motor vehicle or camper, shall certify that his product complies with this standard in accordance with section 114 of the National Traffic and Motor Vehicle Safety Act (49 U.S.C. 30115).

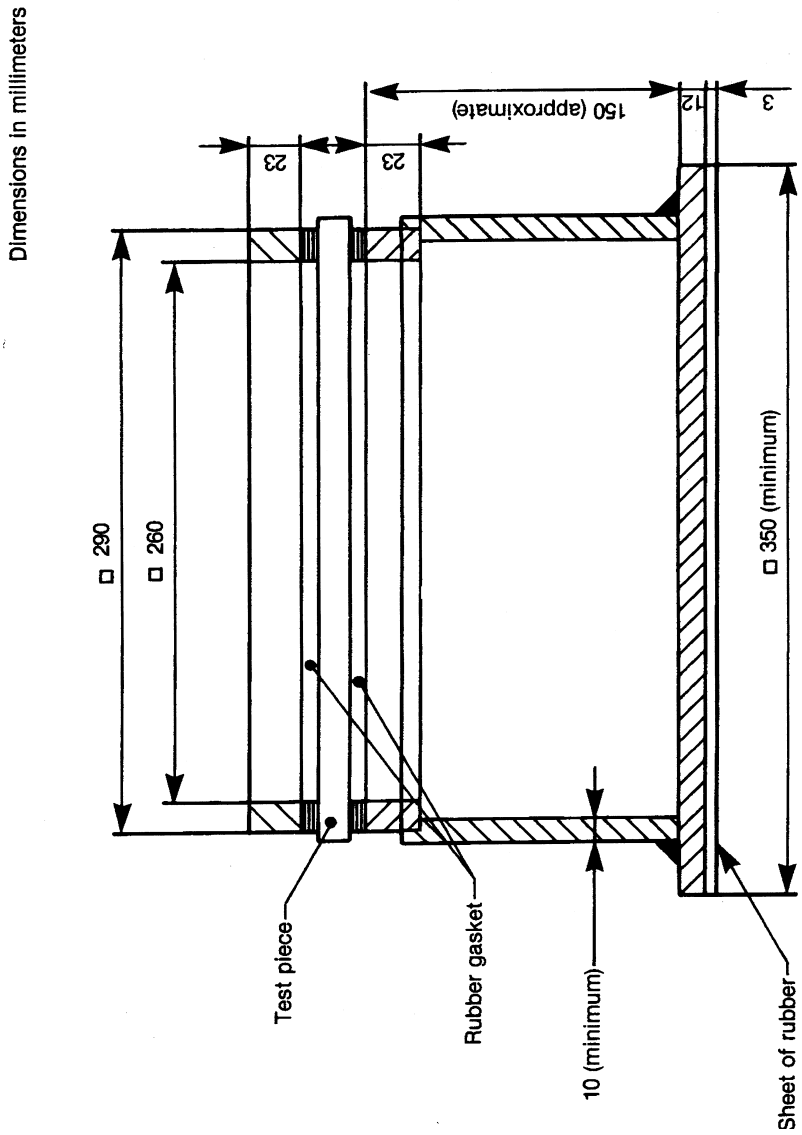


Figure 1 — Test Fixture For Clamped Specimens

[70 FR 39966, July 12, 2005, as amended at 77 FR 763, Jan. 6, 2012]

§571.206 Standard No. 206; Door locks and door retention components.

S1. *Scope and Purpose.* This standard specifies requirements for vehicle door locks and door retention components, including latches, hinges, and other supporting means, to minimize the likelihood of occupants being ejected from a vehicle as a result of impact.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks designed to carry at least one person, and buses with a gross vehicle weight rating (GVWR) of 4,536 kg or less.

S3. *Definitions.*

Auxiliary Door Latch is a latch equipped with a fully latched position, with or without a secondary latched position, and fitted to a door or door system equipped with a primary door latch system.

Auxiliary Door Latch System consists of door latches and strikers other than those associated with the primary door latch system.

Back Door is a door or door system on the back end of a motor vehicle through which passengers can enter or depart the vehicle or cargo can be loaded or unloaded. It does not include:

(a) A trunk lid; or

(b) A door or window composed entirely of glazing material and whose latches and/or hinge systems are attached directly to the glazing material.

Body Member is that portion of the hinge normally affixed to the body structure.

Door Closure Warning System is a system that will activate a visual signal when a door latch system is not in its fully latched position and the vehicle ignition is activated.

Door Hinge System is one or more hinges used to support a door.

Door Latch System consists of latches and strikers installed on a door system.

Door Member is that portion of the hinge normally affixed to the door structure and constituting the swinging member.

Door System is the door, latch, striker, hinges, sliding track combinations and other door retention components on a door and its surrounding doorframe. The door system of a double door includes both doors.

Double Door is a system of two doors where the front door or wing door opens first and connects to the rear door or bolted door, which opens second.

Folding Door is a movable barrier, which will close off an entranceway to a bus, multipurpose passenger vehicle or truck, consisting of two or more hinge panels that swing, slide, or rotate; does not have a striker and latch assembly.

Fork-bolt is the part of the latch that engages and retains the striker when in a latched position.

Fork-bolt Opening Direction is the direction opposite to that in which the striker enters the latch to engage the fork-bolt.

Fully Latched Position is the coupling condition of the latch that retains the door in a completely closed position.

Hinge is a device system used to position the door relative to the body structure and control the path of the door swing for passenger ingress and egress.

Hinge Pin is that portion of the hinge normally interconnecting the body and door members and establishing the swing axis.

Latch is a device employed to maintain the door in a closed position relative to the vehicle body with provisions for deliberate release (or operation).

Primary Door Latch is a latch equipped with both a fully latched position and a secondary latched position and is designated as a ''primary door latch'' by the manufacturer.

Primary Door Latch System consists of a primary door latch(s) and a striker(s).

Secondary Latched Position refers to the coupling condition of the latch that retains the door in a partially closed position.

Side Front Door is a door that, in a side view, has 50 percent or more of its opening area forward of the rearmost point on the driver's seat back, when the seat back is adjusted to its most vertical and rearward position. For vehicles without a driver's designated seating position it is a door that in a side view, has 50 percent or more of its opening area forward of the rearmost point on the most rearward passenger's seat back in the front row of seats, when the seat backs are adjusted to their most vertical and rearward position.

Side Rear Door is a door that, in a side view, has 50 percent or more of its opening area to the rear of the rearmost point on the driver's seat back, when the driver's seat is adjusted to its most vertical and rearward position. For vehicles without a driver's designated seating position it is a door that in a side view, has 50 percent or more of its opening area rear of the rearmost point on the most rearward

passenger's seat back in the front row of seats, when the seat backs are adjusted to their most vertical and rearward position.

Striker is a device with which the latch engages to maintain the door in the fully latched or secondary latched position.

Trunk Lid is a movable body panel that provides access from outside the vehicle to a space wholly partitioned from the occupant compartment by a permanently attached partition or fixed or fold-down seat back.

S4. *Requirements.* The requirements apply to all side and back doors, that lead directly into a compartment that contains one or more seating accommodations and the associated door components, except for those on folding doors, roll-up doors, detachable doors, bus doors used only for emergency egress purposes and labeled accordingly and on bus doors to accommodate a permanently attached wheelchair lift system that when the device is in the retracted position, the lift platform retracts to a vertical orientation parallel to and in close proximity with the interior surface of the lift door and in that position, the platform completely covers the doorway opening, has fixed attachments to the vehicle and provides a barricade to the doorway. The bus wheelchair lift door must be linked to an alarm system consisting of either a flashing visible signal located in the driver's compartment or an alarm audible to the driver that is activated when the door is not fully closed and the vehicle ignition is activated.

S4.1 *Hinged Doors*

S4.1.1 *Primary and Auxiliary Door Latch Systems.* Each hinged door system shall be equipped with at least one primary door latch system. By the time a vehicle is certified a manufacturer shall designate the door latch system(s) that is the ''primary door latch system(s).'' Upon certification, a manufacturer may not thereafter alter the designation of a primary door latch system. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding such designation.

S4.1.1.1 *Load Test One.*

(a) Each primary door latch system and auxiliary door latch system, when in the fully latched position, shall not separate when a load of 11,000 N is applied in the direction perpendicular to the face of the latch such that the latch and the striker anchorage are not compressed against each other, when tested in accordance with S5.1.1.1.

(b) When in the secondary latched position, the primary door latch system shall not separate when a load of 4,500 N is applied in the same direction specified in paragraph (a) of this section when tested in accordance with S5.1.1.1.

S4.1.1.2 *Load Test Two.*

(a) Each primary door latch system and auxiliary door latch system, when in the fully latched position, shall not separate when a load of 9,000 N is applied in the fork-bolt opening direction and parallel to the face of the latch, when tested in accordance with S5.1.1.2.

(b) When in the secondary latched position, the primary door latch system shall not separate when a load of 4,500 N is applied in the same direction specified in paragraph (a) of this section when tested in accordance with S5.1.1.2.

S4.1.1.3 *Load Test Three.* (Applicable only to back doors that open in a vertical direction). Each primary door latch system on back doors, when in the fully latched position, shall not separate when a load of 9,000 N is applied in a direction orthogonal to the directions specified in S4.1.1.1 and S4.1.1.2 when tested in accordance with S5.1.1.3.

S4.1.1.4 *Inertial Load.* Each primary door latch system and auxiliary door latch system shall meet either the dynamic requirements specified in paragraphs (a) and (b) of S4.1.1.4 or the calculation of inertial load resistance specified in paragraph (c) of S4.1.1.4.

(a) Each primary door latch and auxiliary door latch on each hinged door shall not disengage from the fully latched position when an inertia load is applied to the door latch system, including the latch and its activation device, in the directions parallel to the vehicle's longitudinal and transverse

axes with the locking device disengaged, when tested as specified in S5.1.1.4(b).

(b) Each primary door latch and auxiliary door latch on each hinged back door shall also not disengage from the fully latched position when an inertia load is applied to the door latch system, including the latch and its activation device, in the direction parallel to the vehicle's vertical axis with the locking device disengaged, when tested as specified in S5.1.1.4(b).

(c) Each component or subassembly is calculated for its minimum inertial load resistance in a particular direction. The combined resistance to the unlatching operation must assure that the door latch system, when properly assembled in the vehicle door, will remain latched when subjected to an inertial load of 30 g in the vehicle directions specified in paragraph (a) of this section or paragraph (b) of this section, as applicable, when calculated in accordance with S5.1.1.4 (a).

S4.1.2 *Door Hinges.*

S4.1.2.1 When tested in accordance with S5.1.2, each door hinge system shall:

(a) Support the door,

(b) Not separate when a longitudinal load of 11,000 N is applied,

(c) Not separate when a transverse load of 9,000 N is applied, and

(d) For back doors,

(1) Not separate when a load of 11,000 N is applied perpendicular to the hinge face plate (longitudinal load test) such that the hinge plates are not compressed against each other (Load Test One).

(2) Not separate when a load of 9,000 N is applied perpendicular to the axis of the hinge pin and parallel to the hinge face plate (transverse load test) such that the hinge plates are not compressed against each other (Load Test Two).

(3) Not separate when a load of 9,000 N is applied in the direction of the axis of the hinge pin (Load Test Three—only for back doors that open in a vertical direction).

S4.1.2.2 If a single hinge within the hinge system is tested instead of the entire hinge system, the hinge must bear a load proportional to the total number of hinges in the hinge system. (For example, an individual hinge in a two-hinge system must be capable of withstanding 50% of the load requirements of the total system.)

S4.1.2.3 On side doors with rear mounted hinges that can be operated independently of other doors,

(a) The interior door handle shall be inoperative when the speed of the vehicle is greater than or equal to 4 km/h, and

(b) A door closure warning system shall be provided for those doors. The door closure warning system shall be located where it can be clearly seen by the driver.

S4.1.3.2 *Side Rear Door Locks.* In passenger cars and multipurpose passenger vehicles, when the locking mechanism is engaged both the outside and inside door handles or other latch release controls shall be inoperative.

S4.2 *Sliding Side Doors.*

S4.2.1 *Latch System.* Each sliding door system shall be equipped with either:

(a) At least one primary door latch system, or

(b) A door latch system with a fully latched position and a door closure warning system. The door closure warning system shall be located where it can be clearly seen by the driver. Upon certification a manufacturer may not thereafter alter the designation of a primary latch. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding such designation.

S4.2.1.1 *Load Test One.*

(a) At least one door latch system, when in the fully latched position, shall not separate when a load of 11,000 N is applied in the direction perpendicular to the face of the latch such that the latch and the striker anchorage are not compressed against each other, when tested in accordance with S5.2.1.1.

(b) In the case of a primary door latch system, when in the secondary latched position, the door latch system shall not separate when a load of 4,500 N is applied in the same direction specified in paragraph (a) of this section when tested in accordance with S5.2.1.1.

S4.2.1.2 *Load Test Two.*

(a) At least one door latch system, when in the fully latched position, shall not separate when a load of 9,000 N is applied in the fork-bolt opening direction and parallel to the face of the latch when tested in accordance with S5.2.1.2.

(b) In the case of a primary door latch system, when in the secondary latched position, the door latch system shall not separate when a load of 4,500 N is applied in the same direction specified in paragraph (a) of this section when tested in accordance with S5.2.1.2.

S4.2.1.3 *Inertial Load.* Each door latch system certified as meeting the requirements of S4.2.1.1 and S4.2.1.2 shall meet either the dynamic requirements specified in paragraph (a) of this section or the calculation of inertial load resistance specified in paragraph (b) of this section.

(a) The door latch system shall not disengage from the fully latched position when an inertial load is applied to the door latch system, including the latch and its activation mechanism, in the directions parallel to the vehicle's longitudinal and transversal axes with the locking mechanism disengaged, and when tested in accordance with S5.1.1.4(b).

(b) The minimum inertial load resistance can be calculated for each component or subassembly. Their combined resistance to the unlatching operation must assure that the door latch system, when properly assembled in the vehicle door, will remain latched when subjected to an inertia load of 30 g in the vehicle directions specified in paragraph (a) of this section, when calculated in accordance with S5.1.1.4(a).

S4.2.2 *Door System.*

S4.2.2.1 The track and slide combination or other supporting means for each sliding door, while in the closed fully latched position, shall not separate from the door frame when a total force of 18,000 N along the vehicle transverse axis is applied to the door as specified in S5.2.2.

S4.2.2.2 When a sliding door system is tested in accordance with S5.2.2, the following conditions shall not occur:

(a) A separation which permits a sphere with a diameter of 100 mm to pass unobstructed between the exterior of the vehicle to the interior of the vehicle, while the required force is maintained as shown in Figure 1.

(b) Either force application device reaches a total displacement of 300 mm.

S4.2.2.3 This S4.2.2 applies to vehicles manufactured on or after September 1, 2010.

S4.3 *Door Locks.* Each door shall be equipped with at least one locking device which, when engaged, shall prevent operation of the exterior door handle or other exterior latch release control and which has an operating means and a lock release/engagement device located within the interior of the vehicle.

S4.3.1 *Rear side doors.* Each rear side door shall be equipped with at least one locking device which has a lock release/engagement mechanism located within the interior of the vehicle and readily accessible to the driver of the vehicle or an occupant seated adjacent to the door, and which, when engaged, prevents operation of the interior door handle or other interior latch release control and requires separate actions to unlock the door and operate the interior door handle or other interior latch release control.

S4.3.2 *Back doors.* Each back door equipped with an interior door handle or other interior latch release control, shall be equipped with at least one locking device that meets the requirements of S4.3.1.

S5 *Test Procedures.*

S5.1 *Hinged Doors.*

S5.1.1 *Primary and Auxiliary Door Latches.*

S5.1.1.1 *Load Test One Force Application.* The test procedures for S4.1.1.1 and S4.2.1.1 are as follows:

(a) *Fully latched position.*

(1) Attach the test fixture shown in Figure 2 to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount the fixture with latch and striker in the fully latched position in the test machine so as to apply a load perpendicular to the face of the latch.

(2) Locate weights so as to apply a 900 N load tending to separate the latch and striker in the direction of the latch opening.

(3) Apply the test load, in the direction specified in S4.1.1.1 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record the maximum load achieved.

(b) *Secondary Latched Position.*

(1) Attach the test fixture shown in Figure 2 to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount the fixture with latch and striker in the secondary position in the test machine so as to apply a load perpendicular to the face of the latch.

(2) Locate weights so as to apply a 900 N load tending to separate the latch and striker in the direction of the latch opening.

(3) Apply the test load, in the direction specified in S4.1.1.1 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record maximum load achieved.

(4) The test plate to which the door latch is mounted will have a striker cut-out configuration similar to the environment in which the door latch will be mounted on normal vehicle doors.

S5.1.1.2 *Load Test Two Force Application.* The test procedures for S4.1.1.2 and S4.2.1.2 are as follows:

(a) *Fully Latched Position.*

(1) Adapt the test fixture shown in Figure 3 to the mounting provisions of the latch and striker. Mount the fixture with latch and striker in the fully latched position in the test machine so to apply a load in the direction of latch opening.

(2) Apply the test load, in the direction specified in S4.1.1.2 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record the maximum load achieved.

(b) *Secondary Latched Position.*

(1) Adapt the test fixture shown in Figure 3 to the mounting provisions of the latch and striker. Mount the fixture with latch and striker in the secondary latched position in the test machine so as to apply a load in the direction of latch opening.

(2) Apply the test load, in the direction specified in S4.1.1.2 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record the maximum load achieved.

S5.1.1.3 *Load Test Three Force Application.* The test procedures for S4.1.1.3 are as follows:

(a) Adapt the test fixture shown in Figure 4 to the mounting provisions of the latch and striker. Mount the fixture with latch and striker in the fully latched position in the test machine so as to apply a load in the direction specified in S4.1.1.3 and Figure 5.

(b) Apply the test load, in the direction specified in S4.1.1.3 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record the maximum load required.

S5.1.1.4 *Inertial Force Application.* The test procedures for S4.1.1.4 and S4.2.1.3 are as follows:

(a) *Calculation.* The calculation is performed in accordance with paragraph 6 of SAE Recommended Practice J839 (1991) (incorporated by reference, see § 571.5).

(b) *Dynamic Test.* The dynamic inertial force application is tested according to the setup specified in paragraph (1) or (2) of this section.

(1) *Test Setup and Directions for Full Vehicle Test.*

(i) Test Setup.

(A) Rigidly secure the full vehicle to an acceleration device that, when accelerated together, will assure that all points on the crash pulse curve are within the corridor defined in Table 1 and Figure 6.

(B) Install the equipment used to record door opening (doors may be tethered to avoid damaging the recording equipment).

(C) Close the door(s) to be tested and ensure that the door latch(es) is in the fully-latched position, that the door(s) is unlocked, and that all windows, if provided, on the door(s) are closed.

(ii) Test Directions. (See Figure 7)

(A) Longitudinal Setup 1. Orient the vehicle so that its longitudinal axis is aligned with the axis of the acceleration device, simulating a frontal impact.

(B) Longitudinal Setup 2. Orient the vehicle so that its longitudinal axis is aligned with the axis of the acceleration device, simulating a rear impact.

(C) Transverse Setup 1. Orient the vehicle so that its transverse axis is

aligned with the axis of the acceleration device, simulating a left-side impact.

(D) Transverse Setup 2. (Only for vehicles having different door arrangements on each side.) Orient the vehicle so that its transverse axis is aligned with the axis of the acceleration device, simulating a side impact in the direction opposite to that described in b(1)(ii)(C) of this paragraph.

(2) *Test Setup and Directions for Door Test.*

(i) Test Setup.

(A) Mount the door assemblies, consisting of at least the door latch(es), exterior door handle(s) with mechanical latch operation, interior door opening lever(s), and locking device(s), either separately or combined to a test fixture. Each door and striker is mounted to the test fixture to correspond to its orientation on the vehicle and to the directions specified in b(1)(ii) of this paragraph.

(B) Mount the test fixture to the acceleration device, and install the equipment used to record door opening.

(C) Ensure that the door latch is in the fully-latched position, that the door is unlocked (doors may be tethered to avoid damaging the recording equipment), and that any windows, if provided, are closed.

(ii) Test Directions. (See Figure 7)

(A) Longitudinal Setup 1. Orient the door subsystem(s) on the acceleration device in the direction of a frontal impact.

(B) Longitudinal Setup 2. Orient the door subsystem(s) on the acceleration device in the direction of a rear impact.

(C) Transverse Setup 1. Orient the door subsystem(s) on the acceleration device in the direction of a driver-side impact.

(D) Transverse Setup 2. Orient the door subsystem(s) on the acceleration device in the direction opposite to that described in (b)(2)(ii)(C) of this paragraph.

(E) Vertical Setup 1 (applicable only to back doors that open in a vertical direction). Orient the door subsystem(s) on the acceleration device so that its vertical axis (when mounted in the vehicle) is aligned with the axis of the acceleration device, simulating a rollover impact where the force is applied in the direction from the top to the bottom of the door (when mounted in a vehicle).

(F) Vertical Setup 2 (applicable only to back doors that open in a vertical direction). Orient the door subsystem(s) on the acceleration device so that its vertical axis (when mounted in the vehicle) is aligned with the axis of the acceleration device, simulating a rollover impact where the force is applied in the direction opposite to that described in (b)(2)(ii)(E) of this paragraph.

(3) *Test Operation.*

(i) The acceleration device platform shall be instrumented with an accelerometer and data processing system that conforms to the requirements specified in SAE Recommended Practice J211–1 DEC2003 (incorporated by reference, see §571.5) Channel Class 60. The accelerometer sensitive axis is parallel to the direction of test platform travel.

(ii) Maintaining a minimum acceleration level of 30 g for a period of at least 30 ms, while keeping the recorded acceleration within the pulse corridor defined in Table 1 and Figure 6, accelerate the acceleration device in the following directions:

(A) For Full Vehicle Tests, in the directions specified in S5.1.1.4(b)(1)(ii)(A) through S5.1.1.4(b)(1)(ii)(D).

(B) For Door Tests, in the directions specified in S5.1.1.4(b)(2)(ii)(A) through S5.1.1.4(b)(2)(ii)(F).

(iii) Check recording device for door opening and/or closure during the test.

(iv) If at any point in time, the pulse exceeds 36 g and the test specifications are met, the test shall be considered valid.

S5.1.2 *Door Hinges.* The test procedures for S4.1.2 are as follows:

S5.1.2.1 Multiple Hinge Evaluation;

S5.1.2.1 Multiple Hinge Evaluation;

S5.1.2.1.1 *Longitudinal Load Test.*

(a) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge in the system to the extreme end of another hinge in the system is to be

set at 406 mm ±4 mm. The load is to be applied equidistant between the linear center of the engaged portions of the hinge pins and through the centerline of the hinge pin in the longitudinal vehicle direction (see Figure 8).

(b) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Record maximum load achieved.

S5.1.2.1.2 *Transverse Load Test*

(a) Attach the test fixture shown in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge in the system to the extreme opposite end of another hinge in the system is to be set at 406 mm ±4 mm. The load is to be applied equidistant between the linear center of the engaged portions of the hinge pins and through the centerline of the hinge pin in the transverse vehicle direction (see Figure 8).

(b) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Record maximum load achieved.

S5.1.2.2 *Back Door Hinge Load Test*

(a) Load Test One

(1) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge system in the system to the extreme opposite end of another hinge system is to be set at 406 ±4 mm. The load is to be applied equidistant between the linear center of the engaged portions of the hinge pins and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(1). (See Figure 9).

(2) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record the maximum load achieved.

(b) Load Test Two

(1) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge system in the system to the extreme opposite end of another hinge system is to be set at 406 ±4 mm. The load is to be applied equidistant between the linear center of the engaged portions of the hinge pins and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(2). (See Figure 9).

(2) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record the maximum load achieved.

(c) Load Test Three

(1) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge system in the system to the extreme opposite end of another hinge system is to be set at 406 ±4 mm. The load is to be applied through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(3). (See Figure 9).

(2) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record the maximum load achieved.

S5.1.2.3 *Single Hinge Evaluation.* Individual hinges of a hinge system are tested in accordance with the procedures below:

(a) *Longitudinal Load.* Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin in the longitudinal vehicle direction. Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(b) *Transverse Load.* Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge.

Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin in the transverse vehicle direction. Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(c) *Back Door Hinge Load Tests.*

(1) Load Test One. Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(1). (See Figure 9). Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(2) Load Test Two. Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(2). (See Figure 9). Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(3) Load Test Three. Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(3). (See Figure 9). Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

S5.1.2.4 For piano-type hinges, the hinge spacing requirements are not applicable and arrangement of the test fixture is altered so that the test forces are applied to the complete hinge.

S5.2 *Sliding Side Doors.*

S5.2.1 *Door Latches.*

S5.2.1.1 *Load Test One Force Application.* The requirements of S4.2.1.1 are tested in accordance with the procedures specified in S5.1.1.1.

S5.2.1.2 *Load Test Two Force Application.* The requirements of S4.2.1.2 are tested in accordance with the procedures specified in S5.1.1.2.

S5.2.1.3 [Reserved]

S5.2.1.4 [Reserved]

S5.2.2 *Door System.* The test procedures for S4.2.2 are as follows:

S5.2.2.1 Tests are conducted using a full vehicle with the sliding door and its retention components.

S5.2.2.1 Tests are conducted using a full vehicle with the sliding door and its retention components.

S5.2.2.2 The test is conducted using two force application devices capable of applying the outward transverse forces specified in S5.2.2.4. The test setup is shown in Figure 10. The force application system shall include the following:

(a) Two force application plates, (b) Two force application devices capable of applying the outward transverse load requirements for a minimum displacement of 300 mm.

(c) Two load cells of sufficient capacity to measure the applied loads specified in S5.2.2.4.

(d) Two linear displacement measurement devices required for measuring force application device displacement during the test.

(e) Equipment to measure for a 100 mm separation as specified in S4.2.2.2(a), while respecting all relevant safety and health requirements.

S5.2.2.3 *Test Setup.*

(a) Remove all interior trim and decorative components from the sliding door assembly.

(b) Remove seats and any interior components that may interfere with the mounting and operation of the test

equipment and all pillar trim and any non-structural components that overlap the door and cause improper placement of the force application plates.

(c) Each force application device and associated support structure is rigidly fixed on a horizontal surface on the vehicle floor, while applying the loads.

(d) Determine the forward and aft edge of the sliding door, or its adjoining vehicle structure, that contains a latch/striker.

(e) Close the sliding door, ensuring that all door retention components are fully engaged.

(f) For any tested door edge that contains one latch/striker, the following set-up procedures are used:

(1)(i) The force application plate is 150 mm in length, 50 mm in width, and at least 15 mm in thickness. The plate edges are rounded to a radius of 6 mm ±1 mm.

(ii) The plates are fixed perpendicular to the force application devices and move in the transverse direction. For alignment purposes, each plate is attached to the application device in a manner that allows for rotation about the vehicle's y-axis. In this manner, the face of each plate remains parallel to the vertical plane which passes through the vehicle's longitudinal centerline.

(2) Place the force application device and force application plate against the door so that the applied force is perpendicular to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline, and vertically centered on the door-mounted portion of the latch/striker.

(3) The force application plate is positioned such that the long edge of the plate is as close to the interior edge of the door as possible, but not such that the forward edge of forward plate and the rear edge of the rear plate are more than 12.5 mm from the respective interior edges.

(g) For any tested door edge that contains more than one latch/striker, the following setup procedures are used:

(1)(i) The force application plate is 300 mm in length, 50 mm in width, and at least 15 mm in thickness. The plate edges are rounded to a radius of 6 mm ±1 mm.

(ii) The plates are fixed perpendicular to the force application devices and move in the transverse direction. For alignment purposes, each plate is attached to the application device in a manner that allows for rotation about the vehicle's y-axis. In this manner, the face of each plate remains parallel to the vertical plane which passes through the vehicle's longitudinal centerline.

(2) Place the force application device and force application plate against the door so that the applied force is perpendicular to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline, and vertically centered on a point mid-way between the outermost edges of the latch/striker assemblies.

(3) The force application plate is positioned such that the long edge of the plate is as close to the interior edge of the door as possible, but not such that the forward edge of forward plate and the rear edge of the rear plate are more than 12.5 mm from the respective interior edges.

(h) For any tested door edge that does not contain at least one latch/striker, the following set-up procedures are used:

(1)(i) The force application plate is 300 mm in length, 50 mm in width, and at least 15 mm in thickness. The plate edges are rounded to a radius of 6 mm ±1 mm.

(ii) The plates are fixed perpendicular to the force application devices and move in the transverse direction. For alignment purposes, each plate is attached to the application device in a manner that allows for rotation about the vehicle's y-axis. In this manner, the face of each plate remains parallel to the vertical plane which passes through the vehicle's longitudinal centerline.

(2) Place the force application device and force application plate against the door so that the applied force is perpendicular to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline, and vertically centered on a point mid-way along the length of the door edge ensuring that the loading device avoids contact with the window glazing.

(3) The force application plate is positioned such that the long edge of the plate is as close to the interior edge of the door as possible, but not such that the forward edge of forward plate and the rear edge of the rear plate are more than 12.5 mm from the respective interior edges.

(i) The door is unlocked. No extra fixtures or components may be welded or affixed to the sliding door or any of its components.

(j) Place the load application structure so that the force application plates are in contact with the interior of the sliding door.

(k) Apply a preload of 500 N to each actuator and ''zero'' the displacement measuring device.

S5.2.2.4 *Test Procedure.*

(a) Increase the force on each force application device as linearly as practicable until a force of 9,000 N is achieved on each force application device in not less than 90 seconds and not more than 120 seconds, or until either force application device reaches a total displacement of 300 mm.

(b) If one of the force application devices reaches the target force of 9,000 N prior to the other, maintain the 9,000 N force with that force application device until the second force application device reaches the 9,000 N force.

(c) Once both force application devices have achieved 9,000 N each hold the resulting load.

(d) Maintain each force application device load as specified in paragraph (c) and within 30 seconds measure the separation between the exterior edge of the doorframe and the interior of the door along the perimeter of the door.

S5.3 *Sliding Side Doors.* Compliance with S4.3 shall be demonstrated by applying an outward transverse load of 8,900 Newtons (2,000 pounds) to the load-bearing members at the opposite edges of the door (17,800 Newtons (4,000 pounds) total). The demonstration may be performed either in the vehicle or with the door retention components in a bench test fixture.

FIGURE 1. EVALUATION OF SLIDING DOOR GAP SEPARATION

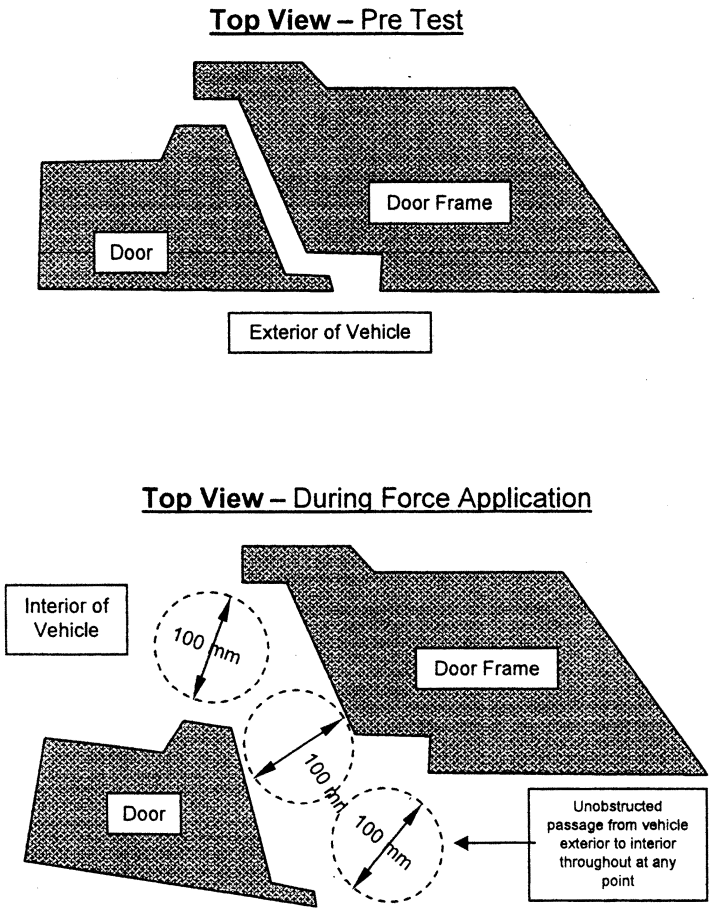


FIGURE 2 - DOOR LATCH – TENSILE TESTING FIXTURE FOR LOAD TEST 1

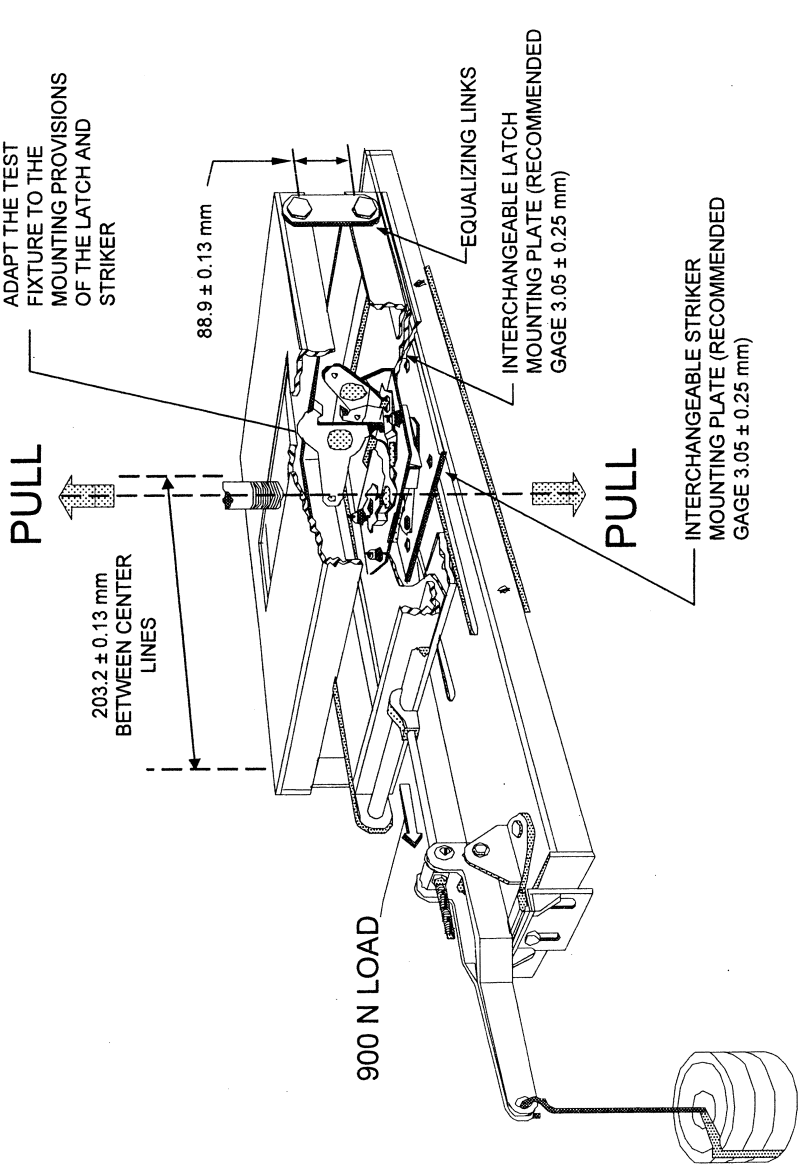


FIGURE 3 – DOOR LATCH – TENSILE TESTING FIXTURE FOR LOAD TEST 2

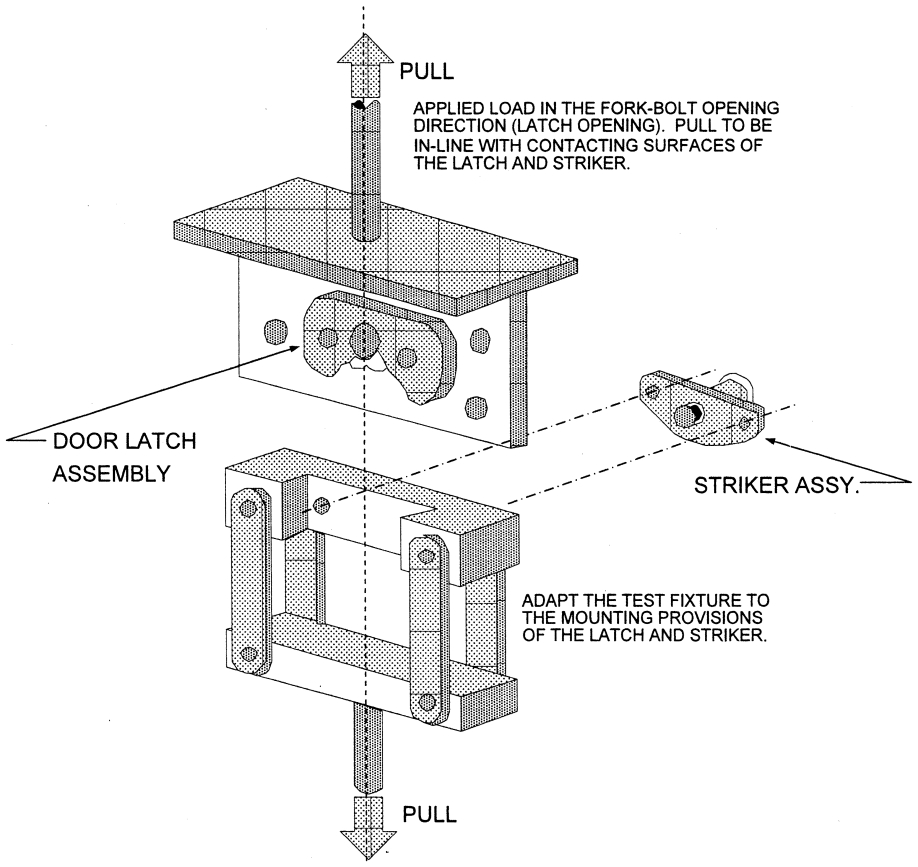
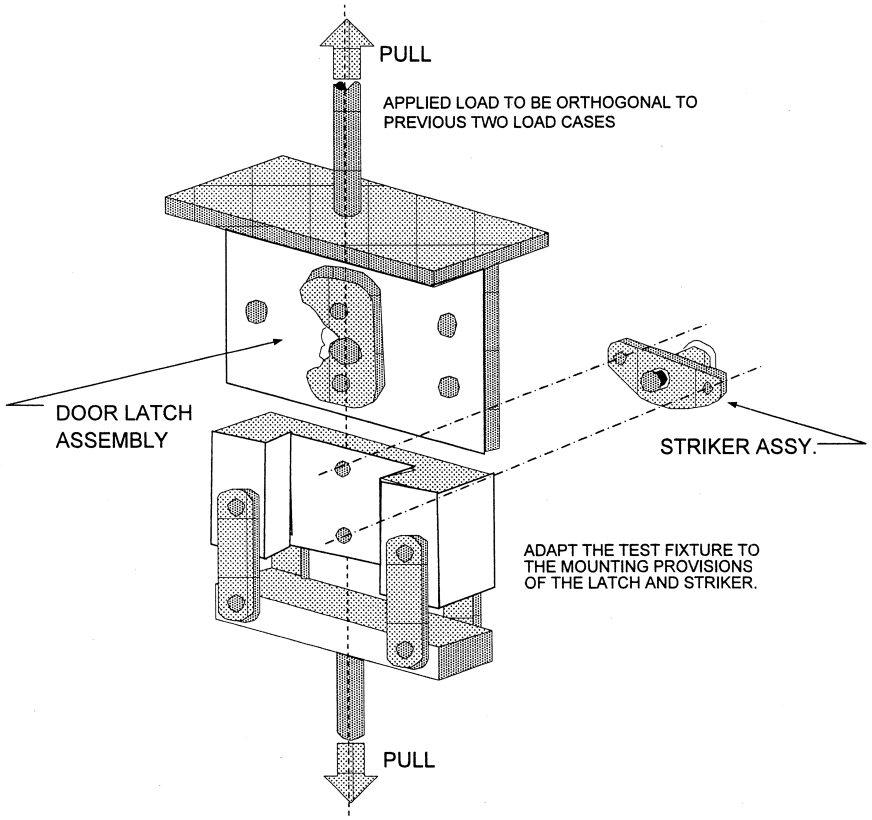


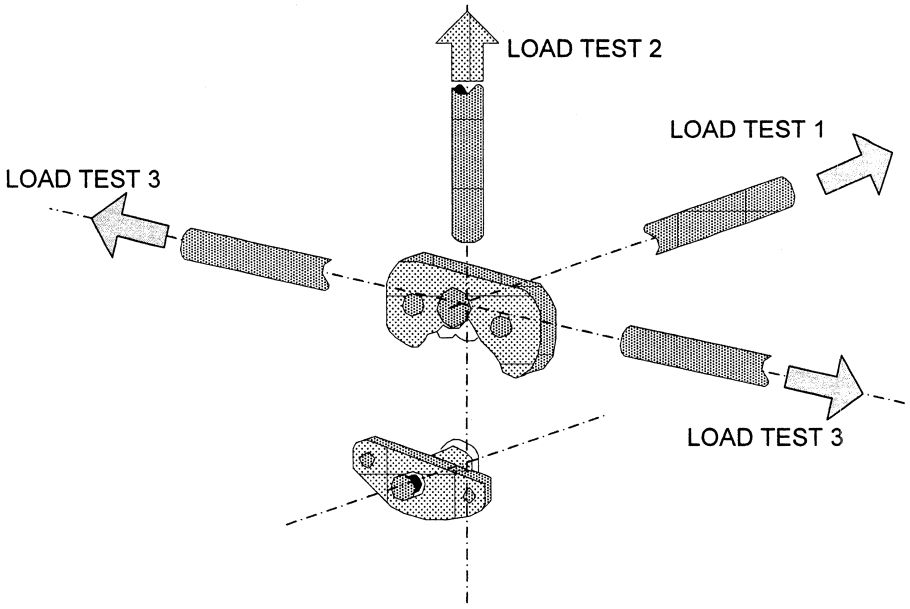
FIGURE 4 – DOOR LATCH – TENSILE TESTING FIXTURE FOR LOAD TEST 3 (BACK DOORS ONLY)



Upper Bound			Lower Bound		
Point	Time (ms)	Acceleration (g)	Point	Time (ms)	Acceleration (g)
A	0	6	E	5	0
B	20	36	F	25	30
C	60	36	G	55	30
D	100	0	H	70	0

ACCELERATION PULSE CORRIDOR TABLE 1

FIGURE 5 – DOOR LATCH STATIC LOAD TEST DIRECTIONS



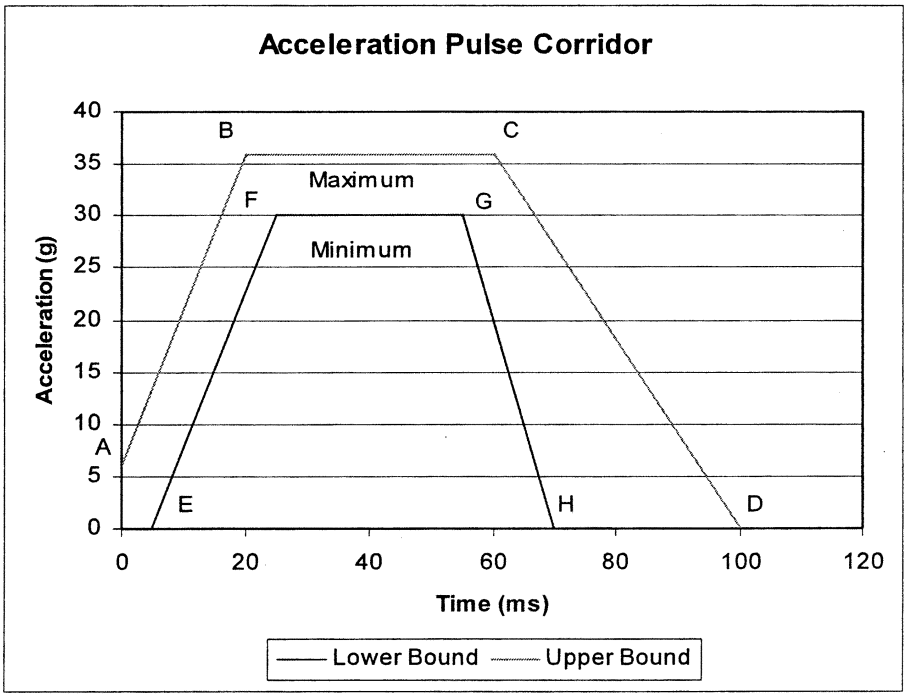
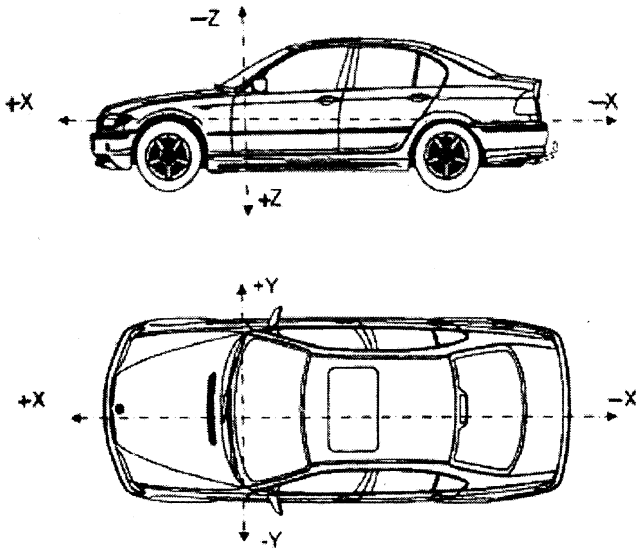


FIGURE 6 – ACCELERATION PULSE

FIGURE 7 - VEHICLE COORDINATE REFERENCE SYSTEM FOR INERTIAL TESTING



X = longitudinal direction
Y = transverse direction
Z = vertical direction

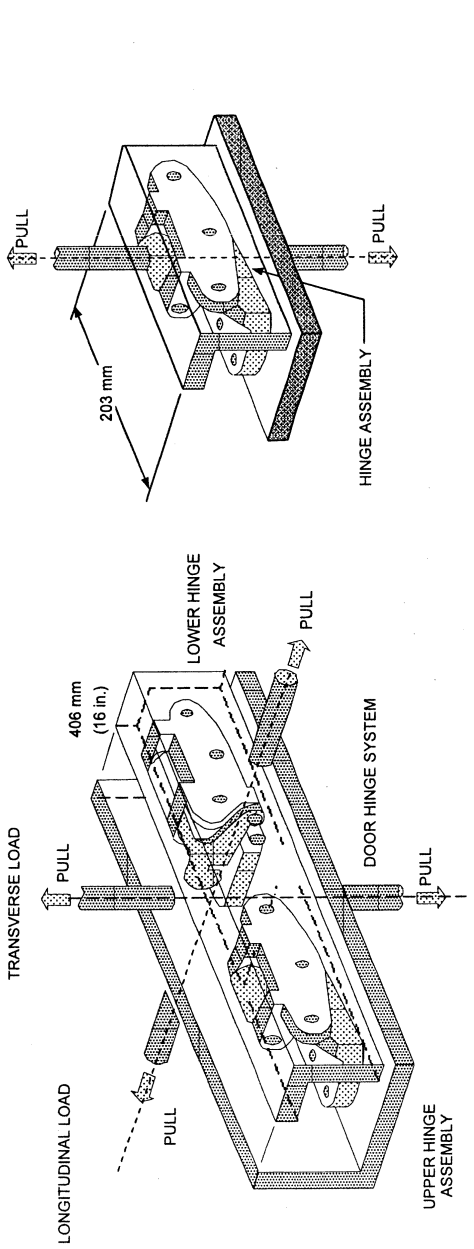


FIGURE 8 – HINGE STATIC TEST FIXTURES

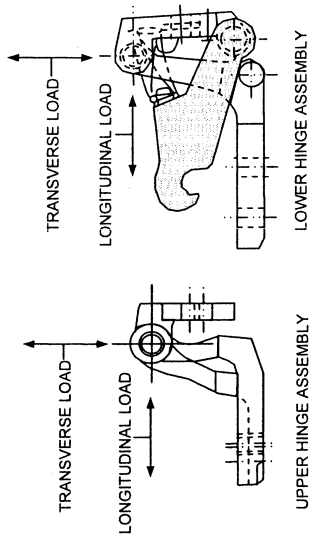
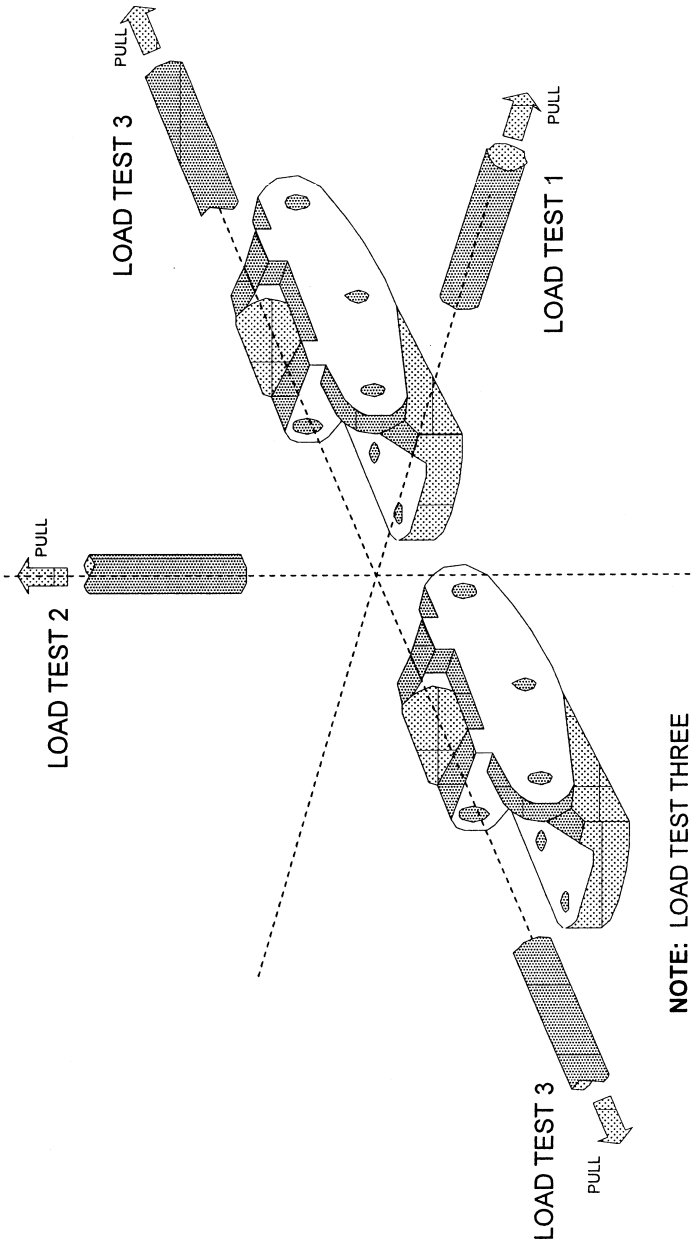


FIGURE 9 – HINGE STATIC TEST LOAD DIRECTIONS FOR BACK DOORS



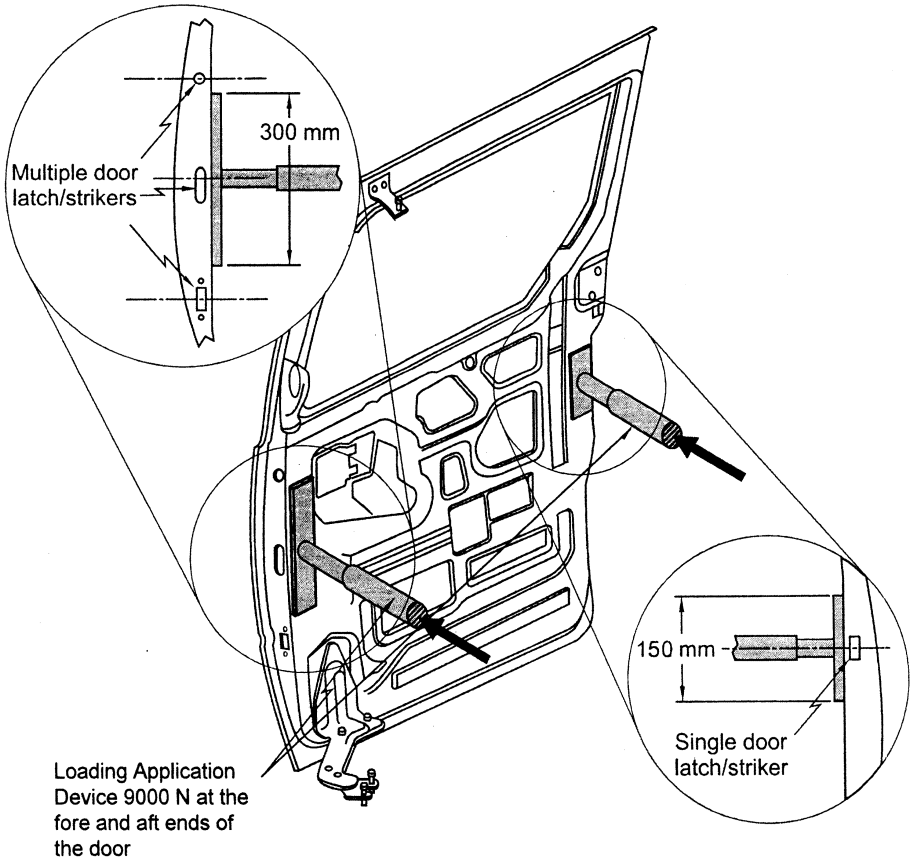


FIGURE 10 – Sliding Door Full Vehicle Test Procedure
(Note: Sliding door is shown separated from the vehicle)

[36 FR 22902, Dec. 2, 1971, as amended at 37 FR 284, Jan. 8, 1972; 50 FR 12031, Mar. 27, 1985; 60 FR 13646, Mar. 14, 1995; 60 FR 50134, Sept. 28, 1995; 61 FR 39907, July 31, 1996; 72 FR 5399, June 27, 2007; 74 FR 35135, July 20, 2009; 74 FR 37176, July 28, 2009; 75 FR 7382, Feb. 19, 2010; 77 FR 764, Jan. 6, 2012; 87 FR 18588, Mar. 30, 2022]

§571.207 Standard No. 207; Seating systems.

S1. *Purpose and scope.* This standard establishes requirements for seats, their attachment assemblies, and their installation to minimize the possibility of their failure by forces acting on them as a result of vehicle impact.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks designed to carry at least one person, and buses.

S3. *Definitions. Occupant seat* means a seat that provides at least one designated seating position.

Seat adjuster means the part of the seat that provides forward and rearward positioning of the seat bench and back, and/or rotation around a vertical axis, including any fixed portion, such as a seat track. In the case of a seat equipped with seat adjusters at different levels, the term means the uppermost seat adjuster.

S4. *Requirements.*

S4.1 *Driver's seat.* Each vehicle with manually operated driving controls shall have a driver's designated seating position.

S4.2. *General performance requirements.* When tested in accordance with S5, each occupant seat shall withstand the following forces, in newtons, except for: a side-facing seat; a passenger seat on a bus other than a school bus; a passenger seat on a school bus with a GVWR greater than 4,536 kilograms (10,000 pounds); and, a passenger seat on a school bus with a GVWR less than or equal to 4,536 kg manufactured before October 21, 2011.

(a) In any position to which it can be adjusted—20 times the mass of the seat in kilograms multiplied by 9.8 applied in a forward longitudinal direction;

(b) In any position to which it can be adjusted—20 times the mass of the seat in kilograms multiplied by 9.8 applied in a rearward longitudinal direction;

(c) For a seat belt assembly attached to the seat—the force specified in paragraph (a), if it is a forward facing seat, or paragraph (b), if it is a rearward facing seat, in each case applied simultaneously with the forces imposed on the seat by the seat belt assembly when it is loaded in accordance with S4.2 of § 571.210; and

(d) In its rearmost position—a force that produces a 373 newton meters moment about the seating reference point for each designated seating position that the seat provides, applied to the upper cross-member of the seat back or the upper seat back, in a rearward longitudinal direction for forward-facing seats and in a forward longitudinal direction for rearward-facing seats.

S4.2.1 *Seat adjustment.* Except for vertical movement of nonlocking suspension type occupant seats in trucks or buses, each seat shall remain in its adjusted position when tested in accordance with the test procedures specified in S5.

S4.3. *Restraining device for hinged or folding seats or seat backs.* Except for a passenger seat in a bus or a seat having a back that is adjustable only for the comfort of its occupants, a hinged or folding occupant seat or occupant seat back shall—

(a) Be equipped with a self-locking device for restraining the hinged or folding seat or seat back, and

(b) If there are any designated seating positions or auxiliary seating accommodations behind the seat, either immediately to the rear or to the sides, be equipped with a control for releasing that restraining device.

S4.3.1 *Accessibility of release control.* If there is a designated seating position immediately behind a seat equipped with a restraining device, the control for releasing the device shall be readily accessible to the occupant of the seat equipped with the device and, if access to the control is required in order to exit from the vehicle, to the occupant of the designated seating position immediately behind the seat.

S4.3.2 *Performance of restraining device.*

S4.3.2.1 *Static force.* (a) Once engaged, the restraining device for a forward-facing seat shall not release or fail when a forward longitudinal force, in newtons, equal to 20 times the mass of the hinged or folding portion of the seat in kilograms multiplied by 9.8 is applied through the center of gravity of that portion of the seat.

(b) Once engaged, the restraining device for a rearward-facing seat shall not release or fail when a rearward longitudinal force, in newtons, equal to 8 times the mass of the hinged or folding portion of the seat in kilograms multiplied by 9.8 is applied through the center of gravity of that portion of the seat.

S4.3.2.2 *Acceleration.* Once engaged, the restraining device shall not release or fail when the device is subjected to an acceleration of 20 g., in the longitudinal direction opposite to that in which the seat folds.

S4.4 *Labeling.* Seats not designated for occupancy while the vehicle is in motion shall be conspicuously labeled to that effect.

S5. *Test procedures.*

S5.1 Apply the forces specified in S4.2(a) and S4.2(b) as follows:

S5.1.1 *For a seat whose seat back and seat bench are attached to the vehicle by the same attachments.* (a) For a seat

whose seat back and seat bench are attached to the vehicle by the same attachments and whose height is adjustable, the loads are applied when the seat is in its highest adjustment position in accordance with the procedure or procedures specified in S5.1.1(a)(1), S5.1.1(a)(2), or S5.1.1(a)(3), as appropriate.

(1) For a seat whose center of gravity is in a horizontal plane that is above the seat adjuster or that passes through any part of the adjuster, use, at the manufacturer's option, either S5.1.1(b) or, if physically possible, S5.1.1(c).

(2) For a seat specified in S5.1.1(a)(1) for which it is not physically possible to follow the procedure in S5.1.1(c), use S5.1.1(b).

(3) For a seat whose center of gravity is in a horizontal plane that is below the seat adjuster, use S5.1.1(c).

(4) For all other seats whose seat back and seat bench are attached to the vehicle by the same attachments, use S5.1.1(b).

(b) Secure a strut on each side of the seat from a point on the outside of the seat frame in the horizontal plane of the seat's center of gravity to a point on the frame as far forward as possible of the seat anchorages. Between the upper ends of the struts attach a rigid cross-member, in front of the seat back frame for rearward loading and behind the seat back frame for forward loading. Apply the force specified by S4.2(a) or S4.2(b) horizontally through the rigid cross-member as shown in Figure 1.

(c) Find ''cg_1,'' the center of gravity of the portion of the seat that is above the lowest surface of the seat adjuster. On each side of the seat, secure a strut from a point on the outside of the seat frame in the horizontal plane of cg_1 to a point on the frame as far forward as possible of the seat adjusted position. Between the upper ends of the struts attach a rigid cross-member, in front of the seat back frame for rearward loading and behind the seat back frame for forward loading. Find ''cg_2,'' the center of gravity of the portion of the seat that is below the seat adjuster. Apply a force horizontally through cg_1 equal to 20 times the weight of the portion of the seat represented by cg_1, and simultaneously apply a force horizontally through cg_2 equal to 20 times the weight of the portion of the seat represented by cg_2.

S5.1.2 If the seat back and the seat bench are attached to the vehicle by different attachments, attach to each component a fixture capable of transmitting a force to that component. Apply forces, in newtons, equal to 20 times the mass of the seat back in kilograms multiplied by 9.8 m/s^2 horizontally through the center of gravity of the seat back, as shown in Figure 2 and apply forces, in newtons, equal to 20 times the mass of the seat bench in kilograms multiplied by 9.8 m/s^2 horizontally through the center of gravity of the seat bench, as shown in Figure 3.

S5.2 Develop the moment specified in S4.2(d) as shown in Figure 4.

S5.3 Apply the forces specified in S4.3.2.1(a) and (b) to a hinged or folding seat as shown in Figure 1 and to a hinged or folding seat back as shown in Figure 5.

S5.4 Determine the center of gravity of a seat or seat component with all cushions and upholstery in place and with the head restraint in its fully extended design position.

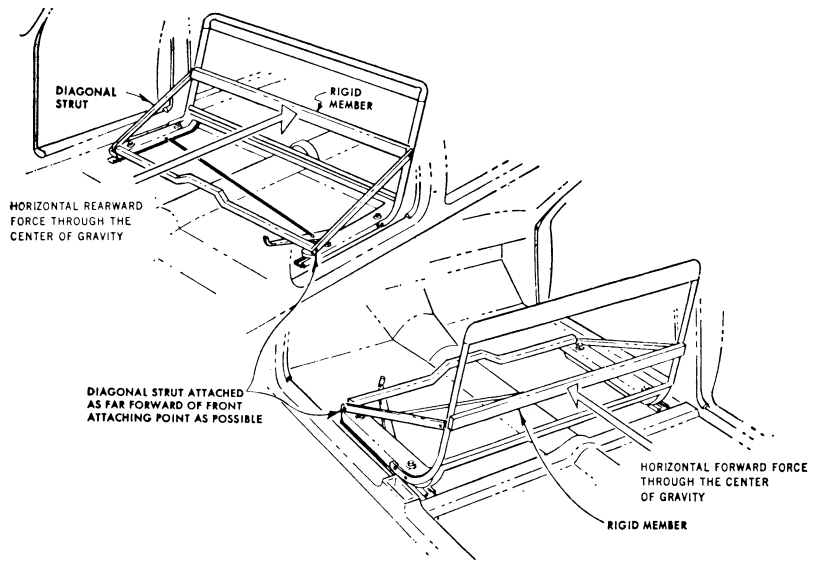


FIGURE 1

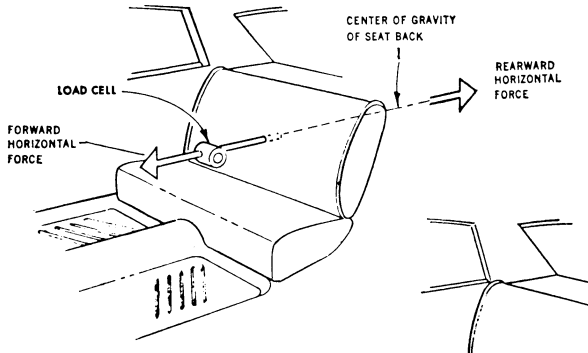


FIGURE 2

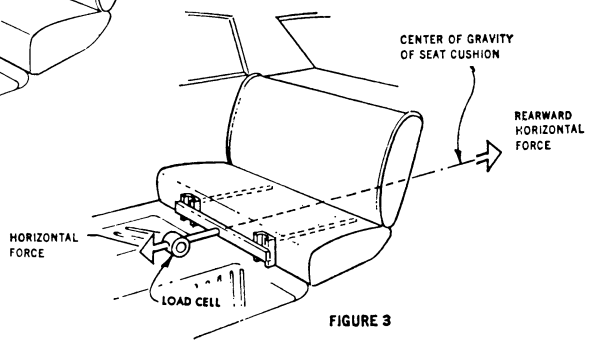


FIGURE 3

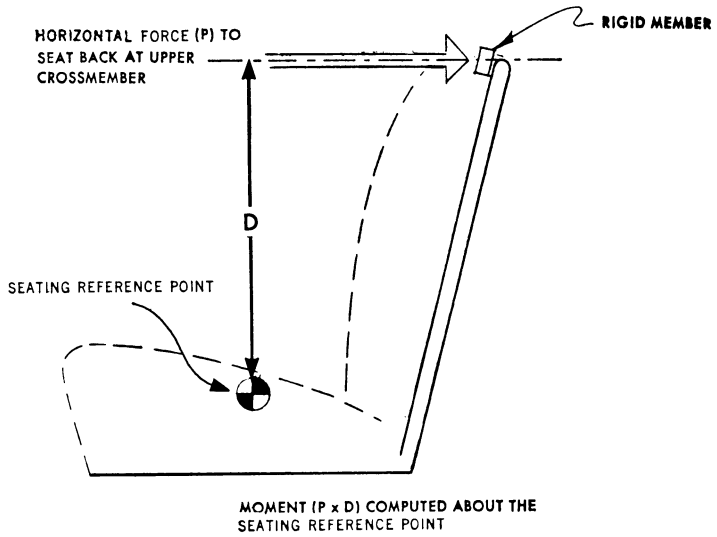


FIGURE 4

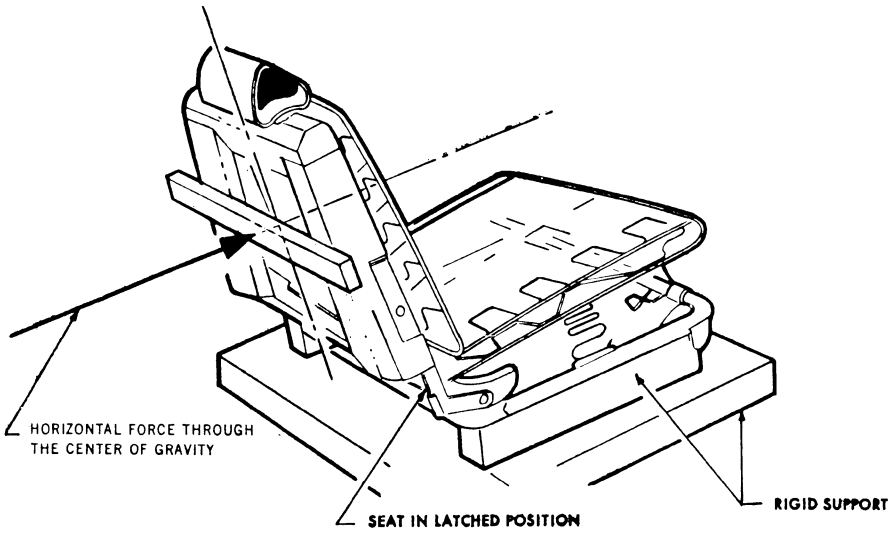


FIGURE 5

[36 FR 22902, Dec. 2, 1971, as amended at 52 FR 7868, Mar. 13, 1987; 53 FR 30434, Aug. 12, 1988; 59 FR 37167, July 21, 1994; 60 FR 13647, Mar. 14, 1995; 63 FR 28935, May 27, 1998; 73 FR 62779, Oct. 21, 2008; 87 FR 18588, Mar. 30, 2022]

§ 571.208 Standard No. 208; Occupant crash protection.

S1. *Scope.* This standard specifies performance requirements for the protection of vehicle occupants in crashes.

S2. *Purpose.* The purpose of this standard is to reduce the number of deaths of vehicle occupants, and the severity of injuries, by specifying vehicle crashworthiness requirements in terms of forces and accelerations measured on anthropomorphic dummies in test crashes, and by specifying equipment requirements for active and passive restraint systems.

S3. *Application.* (a) This standard applies to passenger cars, multipurpose passenger vehicles, trucks designed to carry at least one person, and buses. In addition, S9, *Pressure vessels and explosive devices,* applies to vessels designed to contain a pressurized fluid or gas, and to explosive devices, for use in the above types of motor vehicles as part of a system designed to provide protection to occupants in the event of a crash.

(b) Notwithstanding any language to the contrary, any vehicle manufactured after March 19, 1997, and before September 1, 2006, that is subject to a dynamic crash test requirement conducted with unbelted dummies may meet the requirements specified in S5.1.2(a)(1), S5.1.2(a)(2), or S13 instead of the applicable unbelted requirement, unless the vehicle is certified to meet the requirements specified in S14.5, S15, S17, S19, S21, S23, and S25.

(c) For vehicles which are certified to meet the requirements specified in S13 instead of the otherwise applicable dynamic crash test requirement conducted with unbelted dummies, compliance with S13 shall, for purposes of Standards No. 201, 203 and 209, be deemed as compliance with the unbelted frontal barrier requirements of S5.1.2.

S4. *General requirements.*

S4.1 *Passenger cars.*

S4.1.1 *Passenger cars manufactured from January 1, 1972, to August 31, 1973.* Each passenger car manufactured from January 1, 1972, to August 31, 1973, inclusive, shall meet the requirements of S4.1.1.1, S4.1.1.2, or S4.1.1.3. A protection system that meets the requirements of S4.1.1.1, or S4.1.1.2 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.1.1.3.

S4.1.1.1 *First option—complete passive protection system.* The vehicle shall meet the crash protection requirements of S5. by means that require no action by vehicle occupants.

S4.1.1.2 *Second option—lap belt protection system with belt warning.* The vehicle shall—

(a) At each designated seating position have a Type 1 seatbelt assembly or a Type 2 seatbelt assembly with a detachable upper torso portion that conforms to S7.1 and S7.2 of this standard;

(b) At each front outboard designated seating position, have a seat belt warning system that conforms to S7.3; and

(c) Meet the frontal crash protection requirements of S5.1, in a perpendicular impact, with respect to anthropomorphic test devices in each front outboard designated seating position restrained only by Type 1 seat belt assemblies.

S4.1.1.3 *Third option—lap and shoulder belt protection system with belt warning.*

S4.1.1.3.1 Except for convertibles and open-body vehicles, the vehicle shall—

(a) At each front outboard designated seating position have a Type 2 seatbelt assembly that conforms to § 571.209 and S7.1 and S7.2 of this standard, with either an integral or detachable upper torso portion, and a seatbelt warning system that conforms to S7.3;

(b) At each designated seating position other than the front outboard positions, have a Type 1 or Type 2 seat belt assembly that conforms to § 571.209 and to S7.1 and S7.2 of this standard; and

(c) When it perpendicularly impacts a fixed collision barrier, while moving longitudinally forward at any speed up to and including 30 m.p.h., under the test conditions of S8.1 with anthropomorphic test devices at each front outboard position restrained by Type 2 seatbelt assemblies, experience no complete separation of any load-bearing element of a seatbelt assembly or anchorage.

S4.1.1.3.2 Convertibles and open-body type vehicles shall at each designated seating position have a Type 1

or Type 2 seatbelt assembly that conforms to §571.209 and to S7.1 and S7.2 of this standard, and at each front outboard designated seating position have a seatbelt warning system that conforms to S7.3.

S4.1.2 *Passenger cars manufactured on or after September 1, 1973, and before September 1, 1986.* Each passenger car manufactured on or after September 1, 1973, and before September 1, 1986, shall meet the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A protection system that meets the requirements of S4.1.2.1 or S4.1.2.2 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.1.2.3.

S4.1.2.1 *First option—frontal/angular automatic protection system.* The vehicle shall:

(a) At each front outboard designated seating position meet the frontal crash protection requirements of S5.1 by means that require no action by vehicle occupants;

(b) At the front center designated seating position and at each rear designated seating position have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and to S7.1 and S7.2; and

(c) *Either.* (1) Meet the lateral crash protection requirements of S5.2 and the rollover crash protection requirements of S5.3 by means that require no action by vehicle occupants; or

(2) At each front outboard designated seating position have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 through S7.3, and that meets the requirements of S5.1 with front test dummies as required by S5.1, restrained by the Type 1 or Type 2 seat belt assembly (or the pelvic portion of any Type 2 seat belt assembly which has a detachable upper torso belt) in addition to the means that require no action by the vehicle occupant.

S4.1.2.2 *Second option—head-on automatic protection system.* The vehicle shall—

(a) At each designated seating position have a Type 1 seat belt assembly or Type 2 seat belt assembly with a detachable upper torso portion that conforms to S7.1 and S7.2 of this standard.

(b) At each front outboard designated seating position, meet the frontal crash protection requirements of S5.1, in a perpendicular impact, by means that require no action by vehicle occupants;

(c) At each front outboard designated seating position, meet the frontal crash protection requirements of S5.1, in a perpendicular impact, with a test device restrained by a Type 1 seat belt assembly; and

(d) At each front outboard designated seating position, have a seat belt warning system that conforms to S7.3.

S4.1.2.3 *Third option—lap and shoulder belt protection system with belt warning.*

S4.1.2.3.1 Except for convertibles and open-body vehicles, the vehicle shall—

(a) At each front outboard designated seating position have a seat belt assembly that conforms to S7.1 and S7.2 of this standard, and a seat belt warning system that conforms to S7.3. The belt assembly shall be either a Type 2 seat belt assembly with a nondetachable shoulder belt that conforms to Standard No. 209 (§571.209), or a Type 1 seat belt assembly such that with a test device restrained by the assembly the vehicle meets the frontal crash protection requirements of S5.1 in a perpendicular impact.

(b) At any center front designated seating position, have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 (§571.209) and to S7.1 and S7.2 of this standard, and a seat belt warning system that conforms to S7.3; and

(c) At each other designated seating position, have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 (§571.209) and S7.1 and S7.2 of this standard.

S4.1.2.3.2 Convertibles and open-body type vehicles shall at each designated seating position have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 (§571.209) and to S7.1 and S7.2 of this standard, and at each front designated seating position have a seat belt warning system that conforms to S7.3.

S4.1.3 *Passenger cars manufactured on or after September 1, 1986, and before September 1, 1989.*

S4.1.3.1 *Passenger cars manufactured on or after September 1, 1986, and before September 1, 1987.*

S4.1.3.1.1 Subject to S4.1.3.1.2 and S4.1.3.4, each passenger car manufactured on or after September 1, 1986, and before September 1, 1987, shall comply with the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.3.1.2 Subject to S4.1.3.4 and S4.1.5, the amount of passenger cars, specified in S4.1.3.1.1 complying with the requirements of S4.1.2.1 shall be not less than 10 percent of:

(a) The average annual production of passenger cars manufactured on or after September 1, 1983, and before September 1, 1986, by each manufacturer, or

(b) The manufacturer's annual production of passenger cars during the period specified in S4.1.3.1.1.

S4.1.3.1.3 A manufacturer may exclude convertibles which do not comply with the requirements of S4.1.2.1, when it is calculating its average annual production under S4.1.3.1.2(a) or its annual production under S4.1.3.1.2(b).

S4.1.3.2 *Passenger cars manufactured on or after September 1, 1987, and before September 1, 1988.*

S4.1.3.2.1 Subject to S4.1.3.2.2 and S4.1.3.4, each passenger car manufactured on or after September 1, 1987, and before September 1, 1988, shall comply with the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.3.2.2 Subject to S4.1.3.4 and S4.1.5, the amount of passenger cars specified in S4.1.3.2.1 complying with the requirements of S4.1.2.1. shall be not less than 25 percent of:

(a) The average annual production of passenger cars manufactured on or after September 1, 1984, and before September 1, 1987, by each manufacturer, or

(b) The manufacturer's annual production of passenger cars during the period specified in S4.1.3.2.1.

S4.1.3.2.3 A manufacturer may exclude convertibles which do not comply with the requirements of S4.1.2.1, when it is calculating its average annual production under S4.1.3.2.2(a) or its annual production under S4.1.3.2.2(b).

S4.1.3.3 *Passenger cars manufactured on or after September 1, 1988, and before September 1, 1989.*

S4.1.3.3.1 Subject to S4.1.3.3.2 and S4.1.3.4, each passenger car manufactured on or after September 1, 1988, and before September 1, 1989, shall comply with the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.3.3.2 Subject to S4.1.3.4 and S4.1.5, the amount of passenger cars specified in S4.1.3.3.1 complying with the requirements of S4.1.2.1 shall be not less than 40 percent of:

(a) The average annual production of passenger cars manufactured on or after September 1, 1985, and before September 1, 1988, by each manufacturer or

(b) The manufacturer's annual production of passenger cars during the period specified in S4.1.3.3.1.

S4.1.3.3.3 A manufacturer may exclude convertibles which do not comply with the requirements of S4.1.2.1, when it is calculating its average annual production under S4.1.3.3.2(a) or its annual production under S4.1.3.3.2(b).

S4.1.3.4 *Calculation of complying passenger cars.* (a) For the purposes of calculating the numbers of cars manufactured under S4.1.3.1.2, S4.1.3.2.2, or S4.1.3.3.2 to comply with S4.1.2.1:

(1) Each car whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose front right seating position will comply with the requirements of S4.1.2.1(a) by any means is counted as 1.5 vehicles, and

(2) Each car whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose

right front seat seating position is equipped with a manual Type 2 seat belt is counted as one vehicle.

(b) For the purposes of complying with S4.1.3.1.2, a passenger car may be counted if it:

(1) Is manufactured on or after September 1, 1985, but before September 1, 1986, and

(2) Complies with S4.1.2.1.

(c) For the purposes of complying with S4.1.3.2.2, a passenger car may be counted if it:

(1) Is manufactured on or after September 1, 1985, but before September 1, 1987,

(2) Complies with S4.1.2.1, and

(3) Is not counted toward compliance with S4.1.3.1.2

(d) For the purposes of complying with S4.1.3.3.2, a passenger car may be counted if it:

(1) Is manufactured on or after September 1, 1985, but before September 1, 1988,

(2) Complies with S4.1.2.1, and

(3) Is not counted toward compliance with S4.1.3.1.2 or S4.1.3.2.2.

S4.1.3.5 *Passenger cars produced by more than one manufacturer.*

S4.1.3.5.1 For the purposes of calculating average annual production of passenger cars for each manufacturer and the amount of passenger cars manufactured by each manufacturer under S4.1.3.1.2, S4.1.3.2.2 or S4.1.3.3.2, a passenger car produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.1.3.5.2:

(a) A passenger car which is imported shall be attributed to the importer.

(b) A passenger car manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer which markets the vehicle.

S4.1.3.5.2 A passenger car produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S4.1.3.5.1.

S4.1.4 Passenger cars manufactured on or after September 1, 1989, but before September 1, 1996.

S4.1.4.1 Except as provided in S4.1.4.2, each passenger car manufactured on or after September 1, 1989 shall comply with the requirements of S4.1.2.1. Any passenger car manufactured on or after September 1, 1989 and before September 1, 1993 whose driver's designated seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose right front designated seating position is equipped with a manual Type 2 seat belt so that the seating position complies with the occupant crash protection requirements of S5.1, with the Type 2 seat belt assembly adjusted in accordance with S7.4.2, shall be counted as a vehicle complying with S4.1.2.1. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not know in the exercise of due care that such vehicle is not in conformity with this standard.

S4.1.4.2 (a) Each passenger car, other than a convertible, manufactured before December 11, 1989 may be equipped with, and each passenger car, other than a convertible, manufactured on or after December 11, 1989 and before September 1, 1990 shall be equipped with a Type 2 seat belt assembly at every forward-facing rear outboard designated seating position. Type 2 seat belt assemblies installed pursuant to this provision shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1.1 of this standard.

(b) Except as provided in S4.1.4.2.1 and S4.1.4.2.2, each passenger car, other than a convertible, manufactured on or after September 1, 1990 and each convertible passenger car manufactured on or after September 1, 1991 shall be equipped with an integral Type 2 seat belt assembly at every forward-facing rear outboard designated seating position. Type 2 seat belt assemblies installed in compliance with this requirement shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 an S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include

the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

(c) As used in this section, ''rear outboard designated seating position'' means any ''outboard designated seating position'' (as that term is defined at 49 CFR 571.3) that is rearward of the front seat(s), except any designated seating position adjacent to a walkway that is located between the seat and the near side of the vehicle and is designed to allow access to more rearward seating positions.

S4.1.4.2.1 Any rear outboard designated seating position with a seat that can be adjusted to be forward-facing and to face some other direction shall either:

(i) Meet the requirements of S4.1.4.2 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(ii) When the seat is in its forward-facing position, have a Type 2 seat belt assembly with an upper torso restraint that conforms to S7.1 and S7.2 of this standard and that adjusts by means of an emergency locking retractor that conforms with Standard No. 209 (49 CFR 571.209), which upper torso restraint may be detachable at the buckle, and, when the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.1.4.2.2 Any rear outboard designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) in a vehicle manufactured on or after September 1, 1992 shall meet the requirements of S4.1.4.2 and may use an upper torso belt that detaches at either its upper or lower anchorage points, but *not* both anchorage points, to meet those requirements. The means for detaching the upper torso belt may use a pushbutton action.

S4.1.5 *Passenger cars manufactured on or after September 1, 1996.*

S4.1.5.1 *Frontal/angular automatic protection system.* (a) Each passenger car manufactured on or after September 1, 1996 shall:

(1) At each front outboard designated seating position meet the frontal crash protection requirements of S5.1 by means that require no action by vehicle occupants;

(2) At any front designated seating positions that are not ''outboard designated seating positions,'' as that term is defined at 49 CFR 571.3, and at any rear designated seating positions that are not ''rear outboard designated seating positions,'' as that term is defined at S4.1.4.2(c) of this standard, have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 and S7.2 of this standard; and

(3) At each front designated seating position that is an ''outboard designated seating position,'' as that term is defined at 49 CFR 571.3, and at each forward-facing rear designated seating position that is a ''rear outboard designated seating positions,'' as that term is defined at S4.1.4.2(c) of this standard, have a Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 through S7.3 of this standard, and, in the case of the Type 2 seat belt assemblies installed at the front outboard designated seating positions, meet the frontal crash protection requirements with the appropriate anthropomorphic test dummy restrained by the Type 2 seat belt assembly in addition to the means that requires no action by the vehicle occupant.

(b) For the purposes of sections S4.1.5 through S4.1.5.3 and S4.2.6 through S4.2.6.2 of this standard, an *inflatable restraint system* means an air bag that is activated in a crash.

S4.1.5.2 *Passenger cars manufactured on or after September 1, 1996 and before September 1, 1997.*

S4.1.5.2.1 The amount of passenger cars complying with the requirement of S4.1.5.1(a)(1) by means of an inflatable restraint system at the driver's and right front passenger's position shall be not less than 95 percent of the manufacturer's total production of passenger cars manufactured on or after September 1, 1996, and before September 1, 1997. A vehicle shall not be deemed to be in noncompliance with

this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.5.2.2 *Passenger cars produced by more than one manufacturer.*

S4.1.5.2.2.1 For the purpose of calculating the production of passenger cars by each manufacturer during the period specified in S4.1.5.2, a passenger car produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.1.5.2.2.2:

(a) A passenger car that is imported into the United States shall be attributed to the importer.

(b) A passenger car manufactured within the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S4.1.5.2.2.2 A passenger car produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers, as specified in an express written contract, reported to the National Highway Traffic Safety Administration pursuant to part 585 of this chapter, between the manufacturer so specified and the manufacturer to which the vehicle otherwise would be attributed, pursuant to S4.1.5.2.2.1.

S4.1.5.3 *Passenger cars manufactured on or after September 1, 1997.* Each passenger car manufactured on or after September 1, 1997 shall comply with the requirement of S4.1.5.1(a)(1) by means of an inflatable restraint system at the driver's and right front passenger's position. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.5.4 *Passenger cars certified to S14.* Each passenger car certified to S14 shall, at each front outboard designated seating position, meet the applicable frontal crash protection requirements of S5.1.2(b) by means of an inflatable restraint system that requires no action by vehicle occupants.

S4.1.5.5 *Passenger cars manufactured on or after September 1, 2007.*

S4.1.5.5.1 Except as provided in S4.1.5.5.2, each passenger car shall have a Type 2 seat belt assembly that conforms to Standard No. 209 and to S7.1 and S7.2 of this standard at each rear designated seating position, except that side-facing designated seating positions shall have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and to S7.1 and S7.2 of this standard.

S4.1.5.5.2 Any inboard designated seating position on a seat for which the entire seat back can be folded (including the head restraints and any other part of the vehicle attached to the seat back) such that no part of the seat back extends above a horizontal plane located 250 mm above the highest SRP located on the seat may meet the requirements of S4.1.5.5.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.1.5.6 *Inboard designated seating positions in passenger cars without manually operated driving controls.*

S4.1.5.6.1 *For vehicles specified in S4.1.5.6 with no outboard designated seating positions and with a single front inboard designated seating position, the vehicle shall at that position meet the requirements of S4.1.5.6.3 and S4.1.5.6.4.* The above specified vehicles with multiple front inboard designated seating position shall at one inboard position meet the requirements S4.1.5.6.3 and S4.1.5.6.4 and at all other inboard positions meet the requirements of S4.1.5.6.6.

S4.1.5.6.2 *For vehicles specified in S4.1.5.6 with only one outboard designated seating position and a single front inboard designated seating position, the vehicle shall at that position meet the requirements of S4.1.5.6.3 and S4.1.5.6.4.* The above specified vehicles with multiple front inboard designated seating position shall at one inboard position meet the requirements of S4.1.5.6.3 and S4.1.5.6.4 and at all other inboard positions meet the requirements of S4.1.5.6.5.

S4.1.5.6.3 As specified in S4.1.5.6.1 and S4.1.5.6.2, the vehicles shall meet

the frontal crash protection requirements of S5.1.2(b) as specified for front outboard passenger designated seating positions by means of an inflatable restraint system that requires no action by vehicle occupants and the requirements of S14, as specified for front outboard passenger designated seating positions.

S4.1.5.6.4 As specified in S4.1.5.6.1 and S4.1.5.6.2, the designated seating positions have a Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 through S7.3 of this standard, as specified for front outboard passenger designated seating positions.

S4.1.5.6.5 As specified in S4.1.5.6.1 and S4.1.5.6.2, as appropriate, have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 through S7.3 of this standard.

S4.1.5.6.6 As specified in S4.1.5.6.1 and S4.1.5.6.2, as appropriate, have a Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 through S7.3 of this standard, as specified for front outboard passenger designated seating positions.

S4.1.5.7. *Front seat belt warnings for passenger cars manufactured on or after September 1, 2026.*

S4.1.5.7.1 Any front outboard designated seating position and any inboard designated seating position for which a seat belt warning is required in S4.1.5.6 shall comply with S7.5 of this standard.

S4.1.5.8. *Rear seat belt warnings for passenger cars manufactured on or after September 1, 2027.*

S4.1.5.8.1. All rear designated seating positions, except in law enforcement vehicles, shall comply with S7.5 of this standard.

S4.2 *Trucks and multipurpose passenger vehicles with a GVWR of 10,000 pounds or less.* As used in this section, *vehicles manufactured for operation by persons with disabilities* means vehicles that incorporate a level change device (*e.g.*, a wheelchair lift or a ramp) for onloading or offloading an occupant in a wheelchair, an interior element of design intended to provide the vertical clearance necessary to permit a person in a wheelchair to move between the lift or ramp and the driver's position or to occupy that position, and either an adaptive control or special driver's seating accommodation to enable persons who have limited use of their arms or legs to operate a vehicle. For purposes of this definition, special driver's seating accommodations include a driver's seat easily removable with means installed for that purpose or with simple tools, or a driver's seat with extended adjustment capability to allow a person to easily transfer from a wheelchair to the driver's seat.

S4.2.1 *Trucks and multipurpose passenger vehicles with a GVWR of 10,000 pounds or less, manufactured on or after January 1, 1976 and before September 1, 1991.* Each truck and multipurpose passenger vehicle, with a gross vehicle weight rating of 10,000 pounds or less, manufactured before September 1, 1991, shall meet the requirements of S4.1.2.1, or at the option of the manufacturer, S4.1.2.2 or S4.1.2.3 (as specified for passenger cars), except that forward control vehicles manufactured prior to September 1, 1981, convertibles, open-body type vehicles, walk-in van-type trucks, motor homes, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles carrying chassis-mount campers may instead meet the requirements of S4.2.1.1 or S4.2.1.2.

S4.2.1.1 *First option—complete automatic protection system.* The vehicle shall meet the crash protection requirements of S5 by means that require no action by vehicle occupants.

S4.2.1.2 *Second option—belt system.* The vehicle shall have seat belt assemblies that conform to Standard 209 (49 CFR 571.209) installed as follows:

(a) A Type 1 or Type 2 seat belt assembly shall be installed for each designated seating position in convertibles, open-body type vehicles, and walk-in van-type trucks.

(b) In vehicles manufactured for operation by persons with disabilities, a Type 2 or Type 2A seat belt assembly shall be installed for the driver's seating position, a Type 2 seat belt assembly shall be installed for each other outboard designated seating position that includes the windshield header within the head impact area, and a Type 1 or Type 2 seat belt assembly shall be installed for each other designated seating position.

(c) In all vehicles except those for which requirements are specified in

S4.2.1.2 (a) or (b), a Type 2 seat belt assembly shall be installed for each outboard designated seating position that includes the windshield header within the head impact area, and a Type 1 or Type 2 seat belt assembly shall be installed for each other designated seating position.

S4.2.2 *Trucks and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less, manufactured on or after September 1, 1991 and before September 1, 1997.* Except as provided in S4.2.4, each truck and multipurpose passenger vehicle, with a gross vehicle weight rating of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less, manufactured on or after September 1, 1991 and before September 1, 1997, shall meet the requirements of S4.1.2.1, or at the option of the manufacturer, S4.1.2.2 or S4.1.2.3 (as specified for passenger cars), except that convertibles, open-body type vehicles, walk-in van-type trucks, motor homes, vehicles designed to be exclusively sold to the U.S. Postal Service, vehicles carrying chassis-mount campers, and vehicles manufactured for operation by persons with disabilities may instead meet the requirements of S4.2.1.1 or S4.2.1.2. Each Type 2 seat belt assembly installed in a front outboard designated seating position in accordance with S4.1.2.3 shall meet the requirements of S4.6.

S4.2.3 *Trucks and multipurpose passenger vehicles manufactured on or after September 1, 1991 with either a GVWR or more than 8,500 pounds but not greater than 10,000 pounds or with an unloaded vehicle weight greater than 5,500 pounds and a GVWR of 10,000 pounds or less.* Except as provided in S4.2.4, each truck and multipurpose passenger vehicle manufactured on or after September 1, 1991, that has either a gross vehicle weight rating which is greater than 8,500 pounds, but not greater than 10,000 pounds, or has an unloaded vehicle weight greater than 5,500 pounds and a GVWR of 10,000 pounds or less, shall meet the requirements of S4.1.2.1, or at the option of the manufacturer, S4.1.2.2 or S4.1.2.3 (as specified for passenger cars), except that convertibles, open-body type vehicles, walk-in van-type trucks, motor homes, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles carrying chassis-mount campers may instead meet the requirements of S4.2.1.1 or S4.2.1.2.

S4.2.4 *Rear outboard seating positions in trucks and multipurpose passenger vehicles manufactured on or after September 1, 1991 with a GVWR of 10,000 pounds or less.* Except as provided in S4.2.4.2 and S4.2.4.3, each truck and each multipurpose passenger vehicle, other than a motor home, manufactured on or after September 1, 1991 that has a gross vehicle weight rating of 10,000 pounds or less shall be equipped with an integral Type 2 seat belt assembly at every forward-facing rear outboard designated seating position. Type 2 seat belt assemblies installed in compliance with this requirement shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.2.4.1 As used in this section—

(a) [Reserved]

(b) *Rear outboard designated seating position* means any ''outboard designated seating position'' (as that term is defined at 49 CFR 571.3) that is rearward of the front seat(s), except any designated seating positions adjacent to a walkway located between the seat and the side of the vehicle, which walkway is designed to allow access to more rearward seating positions.

S4.2.4.2 Any rear outboard designated seating position with a seat that can be adjusted to be forward-facing and to face some other direction shall either:

(i) Meet the requirements of S4.2.4 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(ii) When the seat is in its forward-facing position, have a Type 2 seat belt assembly with an upper torso restraint that conforms to S7.1 and S7.2 of this standard and that adjusts by means of an emergency locking retractor that

conforms with Standard No. 209 (49 CFR 571.209), which upper torso restraint may be detachable at the buckle, and, when the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.2.4.3 Any rear outboard designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) in a vehicle manufactured on or after September 1, 1992 shall meet the requirements of S4.2.4 and may use an upper torso belt that detaches at either its upper or lower anchorage point, but not both anchorage points, to meet those requirements. The means for detaching the upper torso belt may use a pushbutton action.

S4.2.5 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1994, and before September 1, 1997.*

S4.2.5.1 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1994, and before September 1, 1995.*

S4.2.5.1.1 Subject to S4.2.5.1.2 and S4.2.5.5 and except as provided in S4.2.4, each truck, bus and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1994 and before September 1, 1995, shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars). A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of standard.

S4.2.5.1.2 Subject to S4.2.5.5, the amount of trucks, buses, and multipurpose passenger vehicles specified in S4.2.5.1.1 complying with S4.1.2.1 (as specified for passenger cars) shall be not less than 20 percent of:

(a) The average annual production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1991, and before September 1, 1994, by each manufacturer that produced such vehicles during each of those annual production periods, or

(b) The manufacturer's total production of trucks, buses, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less during the period specified in S4.2.5.1.1.

S4.2.5.2 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1995 and before September 1, 1996.*

S4.2.5.2.1 Subject to S4.2.5.2.2 and S4.2.5.5 and except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1995 and before September 1, 1996, shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars). A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.2.5.2.2 Subject to S4.2.5.5, the amount of trucks, buses, and multipurpose passenger vehicles specified in S4.2.5.2.1 complying with S4.1.2.1 (as specified for passenger cars) shall be not less than 50 percent of:

(a) The average annual production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle

weight of 5,500 pounds or less manufactured on or after September 1, 1992, and before September 1, 1995, by each manufacturer that produced such vehicles during each of those annual production periods, or

(b) The manufacturer's total production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less during the period specified in S4.2.5.2.1.

S4.2.5.3 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1996 and before September 1, 1997.*

S4.2.5.3.1 Subject to S4.2.5.3.2 and S4.2.5.5 and except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1996 and before September 1, 1997, shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars). A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.2.5.3.2 Subject to S4.2.5.5, the amount of trucks, buses, and multipurpose passenger vehicles specified in S4.2.5.3.1 complying with S4.1.2.1 (as specified for passenger cars) shall be not less than 90 percent of:

(a) The average annual production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1993, and before September 1, 1996, by each manufacturer that produced such vehicles during each of those annual production periods, or

(b) The manufacturer's total production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less during the period specified in S4.2.5.3.1.

S4.2.5.4 *Alternative phase-in schedule.* A manufacturer may, at its option, comply with the requirements of this section instead of complying with the requirements set forth in S4.2.5.1, S4.2.5.2, and S4.2.5.3.

(a) Except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1994 and before September 1, 1995 shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars).

(b) Except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-tape trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1995 shall comply with the requirements of S4.1.2.1 (as specified for passenger cars) of this standard. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

(c) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1995, but before September 1, 1998, whose driver's seating position complies with the requirements of S4.1.2.1(a) of this standard by means not including any type of seat belt and whose right front passenger seating position is equipped with a manual Type 2 seat belt that complies with S5.1 of this standard, with the seat belt assembly adjusted in accordance with S7.4.2, shall be counted as a vehicle complying with S4.1.2.1.

S4.2.5.5 *Calculation of complying trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less.*

(a) For the purposes of the calculations required in S4.2.5.1.2, S4.2.5.2.2, and S4.2.5.3.2 of the number of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that comply with S4.1.2.1 (as specified for passenger cars):

(1) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose front right seating position complies with the requirements of S4.1.2.1(a) by any means is counted as 1.5 vehicles, and

(2) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose right front passenger seating position is equipped with a manual Type 2 seat belt that complies with S5.1 of this standard, with the seat belt assembly adjusted in accordance with S7.4.2, is counted as one vehicle.

(3) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured in two or more stages or that is altered (within the meaning of § 567.7 of this chapter) after having previously been certified in accordance with part 567 of this chapter is not subject to the requirements of S4.2.5.1.2, S4.2.5.2.2, and S4.2.5.3.2. Such vehicles may be excluded from all calculations of compliance with S4.2.5.1.2, S4.2.5.2.2, and S4.2.5.3.2.

(b) For the purposes of complying with S4.2.5.1.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less may be counted if it:

(1) Is manufactured on or after September 1, 1992, but before September 1, 1994, and

(2) Is certified as complying with S4.1.2.1 (as specified for passenger cars).

(c) For the purposes of complying with S4.2.5.2.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less may be counted if it:

(1) Is manufactured on or after September 1, 1992, but before September 1, 1995,

(2) Is certified as complying with S4.1.2.1 (as specified for passenger cars), and

(3) Is not counted toward compliance with S4.2.5.1.2.

(d) For the purposes of complying with S4.2.5.3.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less may be counted if it:

(1) Is manufactured on or after September 1, 1992, but before September 1, 1996,

(2) Is certified as complying with S4.1.2.1 (as specified for passenger cars), and

(3) Is not counted toward compliance with S4.2.5.1.2 or S4.2.5.2.2.

S4.2.5.6 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer.*

S4.2.5.6.1 For the purposes of calculating average annual production for each manufacturer and the amount of vehicles manufactured by each manufacturer under S4.2.5.1.2, S4.2.5.2.2, or S4.2.5.3.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.2.5.6.2:

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle that is manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S4.2.5.6.2 A truck, bus, or multipurpose passenger vehicle with, GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified in an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S4.2.5.6.1 of this standard.

S4.2.6 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1997.* Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less, which is manufactured on or after September 1, 1997, shall comply with the requirements of S4.1.5.1 of this standard (as specified for passenger cars), except that walk-in van-type trucks and vehicles designed to be sold exclusively to the U.S. Postal Service may meet the requirements of S4.2.1.1 or S4.2.1.2 of this standard instead of the requirements of S4.1.5.1.

S4.2.6.1 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1997 and before September 1, 1998.*

S4.2.6.1.1 The amount of trucks, buses, and multipurpose passenger vehicles complying with the requirements of S4.1.5.1(a)(1) of this standard by means of an inflatable restraint system shall be not less than 80 percent of the manufacturer's total combined production of subject vehicles manufactured on or after September 1, 1997 and before September 1, 1998. Each truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1997 and before September 1, 1998, whose driver's seating position complies with S4.1.5.1(a)(1) by means of an inflatable restraint system and whose right front passenger seating position is equipped with a manual Type 2 seat belt assembly that complies with S5.1 of this standard, with the seat belt assembly adjusted in accordance with S7.4.2 of this standard, shall be counted as a vehicle complying with S4.1.5.1(a)(1) by means of an inflatable restraint system. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.2.6.1.2 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer.*

S4.2.6.1.2.1 For the purpose of calculating the production by each manufacturer during the period specified in S4.2.6.1.1, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.2.6.1.2.2:

(a) A vehicle that is imported into the United States shall be attributed to the importer.

(b) A vehicle manufactured within the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S4.2.6.1.2.2 A truck, bus, or multipurpose passenger vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers, as specified in an express written contract, reported to the National Highway Traffic Safety Administration pursuant to part 585 of this chapter, between the manufacturer so specified and the manufacturer to which the vehicle otherwise would be attributed, pursuant to S4.2.6.1.2.1.

S4.2.6.2 *Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1998.* Each truck, bus, or multipurpose vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1998 shall comply

with the requirement of S4.1.5.1(a)(1) by means of an inflatable restraint system at the driver's and right front passenger's position. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.2.6.3 *Trucks, buses, and multipurpose passenger vehicles certified to S14.* Each truck, bus, or multipurpose passenger vehicle with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less certified to S14 shall, at each front outboard designated seating position, meet the applicable frontal crash protection requirements of S5.1.2(b) by means of an inflatable restraint system that requires no action by vehicle occupants.

S4.2.6.4 *Inboard designated seating positions in trucks, buses, and multipurpose passenger vehicles without manually operated driving controls and with a single or multiple front inboard designated seating position and no outboard seating positions and with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less.* The above specified vehicles shall meet the requirements of S4.1.5.6 as specified for passenger cars.

S4.2.7 *Rear seating positions in trucks, and multipurpose passenger vehicles manufactured on or after September 1, 2007 with a GVWR of 10,000 lbs. (4,536 kg) or less.*

S4.2.7.1 Except as provided in S4.2.7.2, S4.2.7.3, S4.2.7.4, S4.2.7.5, and S4.2.7.6, each truck and each multipurpose passenger vehicle, other than a motor home, a walk-in van-type truck, or a vehicle designed to be sold exclusively to the U.S. Postal Service with a GVWR of 10,000 lbs. (4,536 kg) or less, or a vehicle carrying chassis-mount camper with a gross vehicle weight rating of 8,500–10,000 lbs. (3,855–4,536 kg), shall be equipped with a Type 2 seat belt assembly at every rear designated seating position other than a side-facing position, except that Type 2 seat belt assemblies installed in compliance with this requirement shall conform to Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in conformity to this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall conform to S7.4.2(c) of this standard. Side-facing designated seating positions shall be equipped, at the manufacturer's option, with a Type 1 or Type 2 seat belt assembly that conforms with S7.1 and S7.2 of this standard.

S4.2.7.2 Any rear designated seating position with a seat that can be adjusted to be forward-or rear-facing and to face some other direction shall either:

(a) Meet the requirements of S4.2.7.1 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(b) When the seat is in its forward-facing and/or rear-facing position or within ±30 degrees of either position, have a Type 2 seat belt assembly with an upper torso restraint that conforms to S7.1 and S7.2 of this standard and that adjusts by means of an emergency locking retractor that conforms to Standard No. 209 (49 CFR 571.209), which upper torso restraint may be detachable at either the buckle or the upper anchorage, but not both, and, when the seat is in any other position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.2.7.3 Any rear designated seating position on a readily removable seat (i.e., a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) may meet the requirements of S4.2.7.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.2.7.4 Any inboard designated seating position on a seat for which the entire seat back can be folded such that no part of the seat back extends above a horizontal plane located 250 mm above the highest SRP located on

the seat may meet the requirements of S4.2.7.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.2.7.5 Any rear designated seating position adjacent to a walkway located between the seat and the side of the vehicle, which walkway is designed to allow access to more rearward designated seating positions may meet the requirements of S4.2.7.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.2.7.6 Any rear side-facing designated seating position shall have a Type 1 or Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.2.8 *Front seat belt warnings for trucks and multipurpose passenger vehicles manufactured on or after September 1, 2026 with a GVWR of 4,536 kg (10,000 lb) or less.*

S4.2.8.1. Any front outboard designated seating position certified to a compliance option requiring a seat belt and any inboard designated seating position for which a seat belt warning is required by S4.2.6.4 shall comply with S7.5 of this standard.

S4.2.9 *Rear seat belt warnings for trucks and multipurpose passenger vehicles manufactured on or after September 1, 2027 with a GVWR of 4,536 kg (10,000 lb) or less.*

S4.2.9.1. All rear designated seating positions certified to a compliance option requiring a seat belt, except ambulances, as defined by FMVSS No. 201 (§571.201), and law enforcement vehicles, shall comply with S7.5 of this standard.

S4.3 *Trucks and multipurpose passenger vehicles, with GVWR of more than 10,000 pounds.*

S4.3.1 *Trucks and multipurpose passenger vehicles with a GVWR of more than 10,000 pounds, manufactured in or after January 1, 1972 and before September 1, 1990.* Each truck and multipurpose passenger vehicle with a gross vehicle weight rating of more than 10,000 pounds, manufactured on or after January 1, 1972 and before September 1, 1990, shall meet the requirements of S4.3.1.1 or S4.3.1.2. A protection system that meets the requirements of S4.3.1.1 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.3.1.2.

S4.3.1.1 *First option—complete passenger protection system.* The vehicle shall meet the crash protection requirements of S5 by means that require no action by vehicle occupants.

S4.3.1.2 *Second option—belt system.* The vehicle shall, at each designated seating position, have either a Type 1 or a Type 2 seat belt assembly that conforms to S571.209.

S4.3.2 *Trucks and multipurpose passenger vehicles with a GVWR of more than 10,000 pounds, manufactured on or after September 1, 1990.* Each truck and multipurpose passenger vehicle with a gross vehicle weight rating of more than 10,000 pounds, manufactured on or after September 1, 1990, shall meet the requirements of S4.3.2.1 or S4.3.2.2. A protection system that meets the requirements of S4.3.2.1 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.3.2.2.

S4.3.2.1 *First option—complete passenger protection system.* The vehicle shall meet the crash protection requirements of S5 by means that require no action by vehicle occupants.

S4.3.2.2 *Second option—belt system.* The vehicle shall, at each designated seating position, have either a Type 1 or a Type 2 seat belt assembly that conforms to §571.209 of this part and S7.2 of this Standard. A Type 1 belt assembly or the pelvic portion of a dual retractor Type 2 belt assembly installed at a front outboard seating position shall include either an emergency locking retractor or an automatic locking retractor. If a seat belt assembly installed at a front outboard seating position includes an automatic locking retractor for the lap belt or the lap belt portion, that seat belt assembly shall comply with the following:

(a) An automatic locking retractor used at a front outboard seating position that has some type of suspension system for the seat shall be attached to

the seat structure that moves as the suspension system functions.

(b) The lap belt or lap belt portion of a seat belt assembly equipped with an automatic locking retractor that is installed at a front outboard seating position must allow at least ¾ inch, but less than 3 inches, of webbing movement before retracting webbing to the next locking position.

(c) Compliance with S4.3.2.2(b) of this standard is determined as follows:

(1) The seat belt assembly is buckled and the retractor end of the seat belt assembly is anchored to a horizontal surface. The webbing for the lap belt or lap belt portion of the seat belt assembly is extended to 75 percent of its length and the retractor is locked after the initial adjustment.

(2) A load of 20 pounds is applied to the free end of the lap belt or the lap belt portion of the belt assembly (i.e., the end that is not anchored to the horizontal surface) in the direction away from the retractor. The position of the free end of the belt assembly is recorded.

(3) Within a 30 second period, the 20 pound load is slowly decreased, until the retractor moves to the next locking position. The position of the free end of the belt assembly is recorded again.

(4) The difference between the two positions recorded for the free end of the belt assembly shall be at least ¾ inch but less than 3 inches.

S4.4 Buses manufactured on or after November 28, 2016.

S4.4.1 *Definitions.* For purposes of S4.4, the following definitions apply:

Over-the-road bus means a bus characterized by an elevated passenger deck located over a baggage compartment, except a school bus.

Perimeter-seating bus means a bus, which is not an over-the-road bus, that has 7 or fewer designated seating positions that are forward-facing or can convert to forward-facing without the use of tools, and are rearward of the driver's designated seating position or rearward of the outboard designated seating position(s) in the front row of seats, if there is no driver's designated seating position.

Prison bus means a bus manufactured for the purpose of transporting persons subject to involuntary restraint or confinement and has design features consistent with that purpose.

Stop-request system means a vehicle-integrated system for passenger use to signal to a vehicle operator that they are requesting a stop.

Transit bus means a bus that is equipped with a stop-request system sold for public transportation provided by, or on behalf of, a State or local government and that is not an over-the-road bus.

S4.4.2 *Buses with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less.*

S4.4.2.1 Each bus with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less, except a school bus, shall comply with the requirements of S4.2.6 of this standard for front seating positions and with the requirements of S4.4.3.1 of this standard for all rear seating positions.

S4.4.2.2 Each school bus with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less shall comply with the requirements of S4.2.6 of this standard for front seating positions and with the requirements of S4.4.3.2 of this standard for all rear seating positions.

S4.4.3 *Buses with a GVWR of 4,536 kg (10,000 lb) or less.*

S4.4.3.1 Except as provided in S4.4.3.1.1, S4.4.3.1.2, S4.4.3.1.3, S4.4.3.1.4 and S4.4.3.1.5, each bus with a gross vehicle weight rating of 4,536 kg (10,000 lb) or less, except a school bus or an over-the-road bus, shall be equipped with a Type 2 seat belt assembly at every designated seating position other than a side-facing position. Type 2 seat belt assemblies installed in compliance with this requirement shall conform to Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates a webbing tension relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle

shall conform to S7.4.2(c) of this standard. Side-facing designated seating positions shall be equipped, at the manufacturer's option, with a Type 1 or Type 2 seat belt assembly.

S4.4.3.1.1 Any rear designated seating position with a seat that can be adjusted to be forward- or rear-facing and to face some other direction shall either:

(a) Meet the requirements of S4.4.3.1 with the seat in any position in which it can be occupied while the vehicle is in motion, or meet S4.4.3.1.1(b)(1) and S4.4.3.1.1(b)(2).

(b)(1) When the seat is in its forward-facing and/or rear-facing position, or within ±30 degrees of either position, have a Type 2 seat belt assembly with an upper torso restraint that

(i) Conforms to S7.1 and S7.2 of this standard,

(ii) Adjusts by means of an emergency locking retractor conforming to Standard No. 209 (49 CFR 571.209), and

(iii) May be detachable at the buckle or upper anchorage, but not both.

(2) When the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.4.3.1.2 Any rear designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) may meet the requirements of S4.4.3.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.3.1.3 Any inboard designated seating position on a seat for which the entire seat back can be folded such that no part of the seat back extends above a horizontal plane located 250 mm above the highest SRP located on the seat may meet the requirements of S4.4.3.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.3.1.4 Any rear designated seating position adjacent to a walkway located between the seat, which walkway is designed to allow access to more rearward designated seating positions, and not adjacent to the side of the vehicle may meet the requirements of S4.4.3.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.3.1.5 Any rear side-facing designated seating position shall be equipped with a Type 1 or Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.4.3.2 Each school bus with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or less shall comply with the requirements of S4.4.3.2.1 and S4.4.3.2.2.

S4.4.3.2.1 The driver's designated seating position and any outboard designated seating position not rearward of the driver's seating position shall be equipped with a Type 2 seat belt assembly. For a school bus without a driver's designated seating position, the outboard designated seating positions in the front row of seats shall be equipped with Type 2 seat belt assemblies. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. The lap belt portion of the seat belt assembly shall include either an emergency locking retractor or an automatic locking retractor. An automatic locking retractor shall not retract webbing to the next locking position until at least ¾ inch of webbing has moved into the retractor. In determining whether an automatic locking retractor complies with this requirement, the webbing is extended to 75 percent of its length and the retractor is locked after the initial adjustment. If the seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.3.2.2 Passenger seating positions, other than those specified in S4.4.3.2.1, shall be equipped with Type 2

seat belt assemblies that comply with the requirements of S7.1.1.5, S7.1.5 and S7.2 of this standard.

S4.4.3.3 Each over-the-road-bus with a GVWR of 4,536 kg (10,000 lb) or less shall meet the requirements of S4.4.5.1 (as specified for buses with a GVWR or more than 11,793 kg (26,000 lb)).

S4.4.3.4 *Front seat belt warnings for buses manufactured on or after September 1, 2026 with a GVWR of 4,536 kg (10,000 lb) or less.*

S4.4.3.4.1 All front outboard designated seating positions and any inboard designated seating position for which a seat belt warning is required by S4.2.6.4 shall comply with S7.5 of this standard.

S4.4.3.5 *Rear seat belt warnings for buses manufactured on or after September 1, 2027 with a GVWR of 4,536 kg (10,000 lb) or less.*

S4.4.3.5.1 All rear designated seating positions certified to a compliance option requiring a seat belt, except for school buses and law enforcement vehicles, shall comply with S7.5 of this standard.

S4.4.4 *Buses with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb).*

S4.4.4.1 Each bus with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb), except a school bus or an over-the-road bus, shall meet the requirements of S4.4.4.1.1 or S4.4.4.1.2.

S4.4.4.1.1 *First option—complete passenger protection system—driver only.* The vehicle shall meet the crash protection requirements of S5, with respect to an anthropomorphic test dummy in the driver's designated seating position, by means that require no action by vehicle occupants.

S4.4.4.1.2 *Second option—belt system.* The vehicle shall, at the driver's designated seating position and all designated seating positions in the front row of seats, if there is no driver's designated seating position, be equipped with either a Type 1 or a Type 2 seat belt assembly that conforms to § 571.209 of this part and S7.2 of this Standard. A Type 1 belt assembly or the pelvic portion of a dual retractor Type 2 belt assembly installed at these seating positions shall include either an emergency locking retractor or an automatic locking retractor. If a seat belt assembly includes an automatic locking retractor for the lap belt or the lap belt portion, that seat belt assembly shall comply with the following:

(a) An automatic locking retractor used at a driver's seating position that has some type of suspension system for the seat shall be attached to the seat structure that moves as the suspension system functions.

(b) The lap belt or lap belt portion of a seat belt assembly equipped with an automatic locking retractor that is installed at the driver's seating position must allow at least ¾; inch, but less than 3 inches, of webbing movement before retracting webbing to the next locking position.

(c) Compliance with S4.4.4.2.1(b) of this standard is determined as follows:

(1) The seat belt assembly is buckled and the retractor end of the seat belt assembly is anchored to a horizontal surface. The webbing for the lap belt or lap belt portion of the seat belt assembly is extended to 75 percent of its length and the retractor is locked after the initial adjustment.

(2) A load of 20 pounds is applied to the free end of the lap belt or the lap belt portion of the belt assembly (i.e., the end that is not anchored to the horizontal surface) in the direction away from the retractor. The position of the free end of the belt assembly is recorded.

(3) Within a 30 second period, the 20 pound load is slowly decreased, until the retractor moves to the next locking position. The position of the free end of the belt assembly is recorded again.

(4) The difference between the two positions recorded for the free end of the belt assembly shall be at least ¾; inch but less than 3 inches.

S4.4.4.2 Each school bus with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb) shall be equipped with a Type 2 seat belt assembly at the driver's designated seating position. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a seat belt assembly installed in compliance with this requirement includes an automatic locking retractor for the lap belt

portion, that seat belt assembly shall comply with paragraphs (a) through (c) of S4.4.4.1.2 of this standard. If a seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.4.3 Each over-the-road-bus with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb) shall meet the requirements of S4.4.5.1 (as specified for buses with a GVWR or more than 11,793 kg (26,000 lb)).

S4.4.5 *Buses with a GVWR of more than 11,793 kg (26,000 lb).*

S4.4.5.1 Each bus with a GVWR of more than 11,793 kg (26,000 lb), except a perimeter-seating bus, transit bus, or school bus, shall comply with the requirements of S4.4.5.1.1 and S4.4.5.1.2.

S4.4.5.1.1 The driver's designated seating position and any outboard designated seating position not rearward of the driver's seating position shall be equipped with a Type 2 seat belt assembly. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. For a bus without a driver's designated seating position, any outboard designated seating position in the front row of seats, shall be equipped with Type 2 seat belt assemblies. If a seat belt assembly installed in compliance with this requirement includes an automatic locking retractor for the lap belt portion, that seat belt assembly shall comply with paragraphs (a) through (c) of S4.4.4.1.2 of this standard. If a seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.5.1.2 Passenger seating positions, other than those specified in S4.4.5.1.1 and seating positions on prison buses rearward of the driver's seating position, shall:

(a) Other than for over-the-road buses:

(i) Be equipped with a Type 2 seat belt assembly at any seating position that is not a side-facing position;

(ii) Be equipped with a Type 1 or Type 2 seat belt assembly at any seating position that is a side-facing position;

(c) For over-the-road buses, be equipped with a Type 2 seat belt assembly;

(d) Have the seat belt assembly attached to the seat structure at any seating position that has another seating position, wheelchair position, or side emergency door behind it; and

(e) Comply with the requirements of S7.1.1.5, S7.1.1.6, S7.1.3, and S7.2 of this standard.

S4.4.5.2 Each perimeter-seating bus and transit bus with a GVWR of more than 11,793 kg (26,000 lb) shall meet the requirements of S4.4.4.1.1 or S4.4.4.1.2 (as specified for buses with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb)).

S4.4.5.3 Each school bus with a GVWR of more than 11,793 kg (26,000 lb) shall be equipped with a Type 2 seat belt assembly at the driver's designated seating position. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a seat belt assembly installed in compliance with this requirement includes an automatic locking retractor for the lap belt portion, that seat belt assembly shall comply with paragraphs (a) through (c) of S4.4.4.1.2 of this standard. If a seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.5 *Other general requirements.*

S4.5.1 *Labeling and owner's manual information.*

(a) *Air bag maintenance or replacement information.* If the vehicle manufacturer recommends periodic maintenance or replacement of an inflatable restraint system, as that term is defined in S4.1.5.1(b) of this standard, installed in a vehicle, that vehicle shall

be labeled with the recommended schedule for maintenance or replacement. The schedule shall be specified by month and year, or in terms of vehicle mileage, or by intervals measured from the date appearing on the vehicle certification label provided pursuant to 49 CFR part 567. The label shall be permanently affixed to the vehicle within the passenger compartment and lettered in English in block capital and numerals not less than three thirty-seconds of an inch high. This label may be combined with the label required by S4.5.1(b) of this standard to appear on the sun visor. If some regular maintenance or replacement of the inflatable restraint system(s) in a vehicle is recommended by the vehicle manufacturer, the owner's manual shall also set forth the recommended schedule for maintenance or replacement.

(b) *Sun visor air bag warning label.* (1) Except as provided in S4.5.1(b)(2), each vehicle shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown in either Figure 6a or 6b of this standard, as appropriate, and shall comply with the requirements of S4.5.1(b)(1)(i) through S4.5.1(b)(1)(iv).

(i) The heading area shall be yellow with the word ''WARNING'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 30 mm (1.2 in) in diameter.

(iv) If the vehicle does not have a back seat, the label shown in Figure 6a or 6b may be modified by omitting the statements: ''The BACK SEAT is the SAFEST place for children.''

(2) Vehicles certified to meet the requirements specified in S19, S21, or S23 before September 1, 2003 shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown either in Figure 8 or Figure 11 of this standard, at the manufacturer's option, and shall comply with the requirements of S4.5.1(b)(2)(i) through S4.5.1(b)(2)(iv).

(i) The heading area shall be yellow with the word ''WARNING'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) The pictogram shall be black on a white background. The pictogram shall be no less than 30 mm (1.2 in) in length.

(iv) If the vehicle does not have a back seat, the label shown in the figure may be modified by omitting the statement: ''The BACK SEAT is the SAFEST place for CHILDREN.''

(v) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the label shown in the figure may be modified by omitting the statement: ''Never put a rear-facing child seat in the front.''

(3) Vehicles certified to meet the requirements specified in S19, S21, or S23 on or after September 1, 2003 shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown in Figure 11 of this standard and shall comply with the requirements of S4.5.1(b)(3)(i) through S4.5.1(b)(3)(iv).

(i) The heading area shall be yellow with the word ''WARNING'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) The pictogram shall be black on a white background. The pictogram shall be no less than 30 mm (1.2 in) in length.

(iv) If the vehicle does not have a back seat, the label shown in the figure may be modified by omitting the statement: ''The BACK SEAT is the SAFEST place for CHILDREN.''

(v) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the

label shown in the figure may be modified by omitting the statement: ''Never put a rear-facing child seat in the front.''

(4) Design-specific information.

(i) A manufacturer may request in writing that the Administrator authorize additional design-specific information to be placed on the air bag sun visor label for vehicles certified to meet the requirements specified in S19, S21, or S23. The label shall conform in content to the label shown in Figure 11 of this standard and shall comply with the requirements of S4.5.1(b)(3)(i) through S4.5.1(b)(3)(iv), except that the label may contain additional, design-specific information, if authorized by the Administrator.

(ii) The request must meet the following criteria:

(A) The request must provide a mock-up of the label with the specific language or pictogram the manufacturer requests permission to add to the label.

(B) The additional information conveyed by the requested label must be specific to the design or technology of the air bag system in the vehicle and not applicable to all or most air bag systems.

(C) The additional information conveyed by the requested label must address a situation in which foreseeable occupant behavior can affect air bag performance.

(iii) The Administrator shall authorize or reject a request by a manufacturer submitted under S4.5.1(b)(4)(i) on the basis of whether the additional information could result in information overload or would otherwise make the label confusing or misleading. No determination will be made as to whether, in light of the above criteria, the particular information best prevents information overload or whether the information best addresses a particular air bag risk. Moreover, the Administrator will not verify or vouch for the accuracy of the information.

(5) Limitations on additional labels.

(i) Except for the information on an air bag maintenance label placed on the sun visor pursuant to S4.5.1(a) of this standard, or on a utility vehicle warning label placed on the sun visor that conforms in content, form, and sequence to the label shown in Figure 1 of 49 CFR 575.105, no other information shall appear on the same side of the sun visor to which the sun visor air bag warning label is affixed.

(ii) Except for the information in an air bag alert label placed on the sun visor pursuant to S4.5.1(c) of this standard, or on a utility vehicle warning label placed on the sun visor that conforms in content, form, and sequence to the label shown in Figure 1 of 49 CFR 575.105, no other information about air bags or the need to wear seat belts shall appear anywhere on the sun visor.

(c) *Air bag alert label.* If the label required by S4.5.1(b) is not visible when the sun visor is in the stowed position, an air bag alert label shall be permanently affixed to that visor so that the label is visible when the visor is in that position. The label shall conform in content to the sun visor label shown in Figure 6(c) of this standard, and shall comply with the requirements of S4.5.1(c)(1) through S4.5.1(c)(3).

(1) The message area shall be black with yellow text. The message area shall be no less than 20 square cm.

(2) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 20 mm in diameter.

(3) If a vehicle does not have an inflatable restraint at any front seating position other than that for the driver's designated seating position, the pictogram may be omitted from the label shown in Figure 6c.

(d) At the option of the manufacturer, the requirements in S4.5.1(b) and S4.5.1(c) for labels that are permanently affixed to specified parts of the vehicle may instead be met by permanent marking or molding of the required information.

(e) *Label on the dashboard.* (1) Except as provided in S4.5.1(e)(2) or S4.5.1(e)(3), each vehicle that is equipped with an inflatable restraint for the passenger position shall have a label attached to a location on the dashboard or the steering control hub that is clearly visible from all front seating positions. The label need not be permanently affixed to the vehicle. This label shall conform in content to the label shown in Figure 7 of this standard, and shall

comply with the requirements of S4.5.1(e)(1)(i) through S4.5.1(e)(1)(iii).

(i) The heading area shall be yellow with the word ''WARNING'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) If the vehicle does not have a back seat, the label shown in Figure 7 may be modified by omitting the statement: ''The back seat is the safest place for children 12 and under.''

(2) Vehicles certified to meet the requirements specified in S19, S21, and S23 before December 1, 2003, that are equipped with an inflatable restraint for the passenger position shall have a label attached to a location on the dashboard or the steering control hub that is clearly visible from all front seating positions. The label need not be permanently affixed to the vehicle. This label shall conform in content to the label shown in either Figure 9 or Figure 12 of this standard, at manufacturer's option, and shall comply with the requirements of S4.5.1(e)(2)(i) through S4.5.1(e)(2)(iv).

(i) The heading area shall be yellow with black text.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) If the vehicle does not have a back seat, the labels shown in Figures 9 and 12 may be modified by omitting the statement: ''The back seat is the safest place for children.''

(iv) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the label shown in Figure 12 may be modified by omitting the statement: ''Never put a rear-facing child seat in the front.''

(3) Vehicles certified to meet the requirements specified in S19, S21, and S23 on or after December 1, 2003, that are equipped with an inflatable restraint for the passenger position shall have a label attached to a location on the dashboard or the steering control hub that is clearly visible from all front seating positions. The label need not be permanently affixed to the vehicle. This label shall conform in content to the label shown in Figure 12 of this standard and shall comply with the requirements of S4.5.1(e)(3)(i) through S4.5.1(e)(3)(iv).

(i) The heading area shall be yellow with black text.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) If the vehicle does not have a back seat, the label shown in Figure 12 may be modified by omitting the statement: ''The back seat is the safest place for children.''

(iv) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the label shown in Figure 12 may be modified by omitting the statement: ''Never put a rear-facing child seat in the front.''

(f) *Information to appear in owner's manual.* (1) The owner's manual for any vehicle equipped with an inflatable restraint system shall include an accurate description of the vehicle's air bag system in an easily understandable format. The owner's manual shall include a statement to the effect that the vehicle is equipped with an air bag and lap/shoulder belt at both front outboard seating positions, and that the air bag is a supplemental restraint at those seating positions. The information shall emphasize that all occupants should always wear their seat belts whether or not an air bag is also provided at their seating position to minimize the risk of severe injury or death in the event of a crash. The owner's manual shall also provide any necessary precautions regarding the proper positioning of occupants, including children, at seating positions equipped with air bags to ensure maximum safety protection for those occupants. The owner's manual shall also explain that no objects should be placed over or near the air bag on the instrument panel, because any such objects could cause harm if the vehicle is in a crash severe enough to cause the air bag to inflate.

(2) For any vehicle certified to meet the requirements specified in S14.5, S15, S17, S19, S21, S23, and S25, the manufacturer shall also include in the vehicle owner's manual a discussion of the advanced passenger air bag system

installed in the vehicle. The discussion shall explain the proper functioning of the advanced air bag system and shall provide a summary of the actions that may affect the proper functioning of the system. The discussion shall include, at a minimum, accurate information on the following topics:

(i) A presentation and explanation of the main components of the advanced passenger air bag system.

(ii) An explanation of how the components function together as part of the advanced passenger air bag system.

(iii) The basic requirements for proper operation, including an explanation of the actions that may affect the proper functioning of the system.

(iv) For vehicles certified to meet the requirements of S19.2, S21.2 or S23.2, a complete description of the passenger air bag suppression system installed in the vehicle, including a discussion of any suppression zone.

(v) An explanation of the interaction of the advanced passenger air bag system with other vehicle components, such as seat belts, seats or other components.

(vi) A summary of the expected outcomes when child restraint systems, children and small teenagers or adults are both properly and improperly positioned in the passenger seat, including cautionary advice against improper placement of child restraint systems.

(vii) For vehicles certified to meet the requirements of S19.2, S21.2 or S23.2, a discussion of the telltale light, specifying its location in the vehicle and explaining when the light is illuminated.

(viii) Information on how to contact the vehicle manufacturer concerning modifications for persons with disabilities that may affect the advanced air bag system.

(3) The owner's manual (which includes information provided by the vehicle manufacturer to the consumer, whether in digital or printed form) for any vehicle equipped with a seat belt warning system must include an accurate description of the system features and warning signals, including the location and format of the visual warnings, in an easily understandable format. The description shall include information on when the different features of the warning system will activate and how to interpret the visual warnings. For vehicles with any rear designated seating position that is a readily-removable seat (a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) equipped with manual electrical connections that are utilized by the rear seat belt warning system, the owner's manual must include a description of the purpose of the connection, instructions on how to achieve a proper connection, and a description of how not achieving a proper connection may affect the proper functioning of the system.

(g) *Additional labels placed elsewhere in the vehicle interior*. The language on additional air bag warning labels placed elsewhere in the vehicle interior shall not cause confusion or contradiction of any of the statements required in the air bag sun visor label, and shall be expressed in symbols, words and abbreviations required by this standard.

S4.5.2 *Readiness indicator*. An occupant protection system that deploys in the event of a crash shall have a monitoring system with a readiness indicator. The indicator shall monitor its own readiness and shall be clearly visible from the driver's designated seating position. If the vehicle is equipped with a single readiness indicator for both a driver and passenger air bag, and if the vehicle is equipped with an on-off switch permitted by S4.5.4 of this standard, the readiness indicator shall monitor the readiness of the driver air bag when the passenger air bag has been deactivated by means of the on-off switch, and shall not illuminate solely because the passenger air bag has been deactivated by the manual on-off switch. A list of the elements of the system being monitored by the indicator shall be included with the information furnished in accordance with S4.5.1 but need not be included on the label.

S4.5.3 *Automatic belts*. Except as provided in S4.5.3.1, a seat belt assembly that requires no action by vehicle occupants (hereinafter referred to as an ''automatic belt'') may be used to meet the crash protection requirements of any option under S4. and in place of

any seat belt assembly otherwise required by that option.

S4.5.3.1. An automatic belt that provides only pelvic restraint may not be used pursuant to S4.5.3 to meet the requirements of an option that requires a Type 2 seat belt assembly. An automatic belt may not be used pursuant to S4.5.3 to meet the requirements of S4.1.5.1(a)(3) for a Type 2 seat belt assembly at any seating position equipped with an inflatable restraint system pursuant to S4.1.5.2, S4.1.5.3, S4.2.6.1, or S4.2.6.2 of this standard.

S4.5.3.2 An automatic belt, furnished pursuant to S4.5.3, that provides both pelvic and upper torso restraint may have either a detachable or nondetachable upper torso portion, notwithstanding provisions of the option under which it is furnished.

S4.5.3.3 An automatic belt furnished pursuant to S4.5.3 shall:

(a) Conform to S7.1 and have a single emergency release mechanism whose components are readily accessible to a seated occupant.

(b) Conform to the seat belt warning system requirements of S7.3 or S7.5 of this standard, as applicable.

S4.5.3.4 An automatic belt furnished pursuant to S4.5.3 that is not required to meet the perpendicular frontal crash protection requirements of S5.1 shall conform to the webbing, attachment hardware, and assembly performance requirements of Standard No. 209.

S4.5.3.5 A replacement automatic belt shall meet the requirements of S4.1(k) of Standard No. 209.

S4.5.4 *Passenger air bag manual cut-off device.* Passenger cars, trucks, buses, and multipurpose passenger vehicles manufactured before September 1, 2012 may be equipped with a device that deactivates the air bag installed at the right front outboard seating position in the vehicle, if all the conditions in S4.5.4.1 through S4.5.4.4 are satisfied.

S4.5.4.1 The vehicle complies with either S4.5.4.1(a) or S4.5.4.1(b).

(a) The vehicle has no forward-facing designated seating positions to the rear of the front seating positions.

(b) With the seats and seat backs adjusted as specified in S8.1.2 and S8.1.3, the distance, measured along a longitudinal horizontal line tangent to the highest point of the rear seat bottom in the longitudinal vertical plane described in either S4.5.4.1(b)(1) or S4.5.4.1(b)(2), between the rearward surface of the front seat back and the forward surface of the rear seat back is less than 720 millimeters.

(1) In a vehicle equipped with front bucket seats, the vertical plane at the centerline of the driver's seat cushion.

(2) In a vehicle equipped with front bench seating, the vertical plane which passes through the center of the steering wheel rim.

S4.5.4.2 The device is operable by means of the ignition key for the vehicle. The device shall be separate from the ignition switch for the vehicle, so that the driver must take some action with the ignition key other than inserting it or turning it in the ignition switch to deactivate the passenger air bag. Once deactivated, the passenger air bag shall remain deactivated until it is reactivated by means of the device.

S4.5.4.3 A telltale light in the interior of the vehicle shall be illuminated whenever the passenger air bag is turned off by means of the on-off switch. The telltale shall be clearly visible to occupants of all front seating positions. ''Clearly visible'' means within the normal range of vision throughout normal driving operations. The telltale:

(a) Shall be yellow;

(b) Shall have the identifying words ''PASSENGER AIR BAG OFF'' or ''PASS AIR BAG OFF'' on the telltale or within 25 millimeters of the telltale;

(c) Shall remain illuminated for the entire time that the air bag is ''off'';

(d) Shall not be illuminated at any time when the air bag is ''on''; and,

(e) Shall not be combined with the readiness indicator required by S4.5.2 of this standard.

S4.5.4.4 The vehicle owner's manual shall provide, in a readily understandable format:

(a) Complete instructions on the operation of the on-off switch;

(b) A statement that the on-off switch should only be used when a member of a passenger risk group identified in the request form in appendix B to part 595 of this chapter is occupying the right front passenger seating position; and,

(c) A warning about the safety consequences of using the on-off switch at other times.

S4.5.5 *Rear seat belt requirements for passenger cars and for trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lbs.) or less.*

S4.5.5.1 *Vehicles manufactured on or after September 1, 2005 and before September 1, 2007.*

(a) For vehicles manufactured for sale in the United States on or after September 1, 2005, and before September 1, 2007, a percentage of the manufacturer's production as specified in S4.5.5.2, shall meet the requirements specified in either S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.3.1 for complying buses.

(b) A manufacturer that sells two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph, instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2006, and before September 1, 2007, shall meet the requirements specified in S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks & multipurpose passenger vehicles, and S4.4.3.1 for complying buses. Credits for vehicles manufactured before September 1, 2006 are not to be applied to the requirements of this paragraph.

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S4.5.5.1.

(d) Vehicles that are manufactured by a manufacturer that produces fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S4.5.5.1.

S4.5.5.2 *Phase-in schedule.*

(a) Vehicles manufactured on or after September 1, 2005, and before September 1, 2006. Subject to S4.5.5.3(a), for vehicles manufactured on or after September 1, 2005, and before September 1, 2006, the amount of vehicles complying with S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.3.1 for complying buses shall be not less than 50 percent of:

(1) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years immediately prior to September 1, 2005, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2003, and before September 1, 2006, or

(2) The manufacturer's production on or after September 1, 2005, and before September 1, 2006.

(b) Vehicles manufactured on or after September 1, 2006, and before September 1, 2007. Subject to S4.5.5.3(b), for vehicles manufactured on or after September 1, 2006, and before September 1, 2007, the amount of vehicles complying with S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.3.1 for complying buses shall be not less than 80 percent of:

(1) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years immediately prior to September 1, 2006, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2004, and before September 1, 2007, or

(2) The manufacturer's production on or after September 1, 2006, and before September 1, 2007.

S4.5.5.3 *Calculation of complying vehicles.*

(a) For the purposes of complying with S4.5.5.2(a), a manufacturer may count a vehicle if it is manufactured on or after February 7, 2005, but before September 1, 2006.

(b) For the purposes of complying with S4.5.5.2(b), a manufacturer may count a vehicle if it:

(1) Is manufactured on or after February 7, 2005, but before September 1, 2007, and

(2) Is not counted toward compliance with S4.5.5.2(a).

S4.5.5.4 *Vehicles produced by more than one manufacturer.*

(a) For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S4.5.5.2, a vehicle produced by more than one manufacturer

shall be attributed to a single manufacturer as follows, subject to paragraph (b) of this section.

(1) A vehicle that is imported shall be attributed to the importer.

(2) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

(b) A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under paragraph (a) of this section.

S4.6 *Dynamic testing of manual belt systems.*

S4.6.1 Each truck and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded weight of less than 5,500 pounds that is manufactured on or after September 1, 1991, and is equipped with a Type 2 seat belt assembly at a front outboard designated seating position pursuant to S4.1.2.3 shall meet the frontal crash protection requirements of S5.1 at those designated seating positions with a test dummy restrained by a Type 2 seat belt assembly that has been adjusted in accordance with S7.4.2. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.6.2 Any manual seat belt assembly subject to the requirements of S5.1 of this standard by virtue of any provision of this standard other than S4.1.2.1(c)(2) does not have to meet the requirements of S4.2(a)–(f) and S4.4 of Standard No. 209 (§ 571.209).

S4.6.3 Any manual seat belt assembly subject to the requirements of S5.1 of this standard by virtue of S4.1.2.1(c)(2) does not have to meet the elongation requirements of S4.2(c), S4.4(a)(2), S4.4(b)(4), and S4.4(b)(5) of Standard No. 209 (§ 571.209).

S4.7 [Reserved]

S4.8 *Selection of compliance options.* Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S4.9 *Values and tolerances.* Wherever a range of values or tolerances are specified, requirements shall be met at all values within the range of values or tolerances. With respect to the positioning of anthropomorphic dummies, torso and spine angle tolerances shall be ±2 degrees unless otherwise stated, and leg, thigh, foot, and arm angle tolerances shall be ±5 degrees unless otherwise stated.

S4.10 *Metric values.* Specifications and requirements are given in metric units with English units provided for reference. The metric values are controlling.

S4.11 *Test duration for purpose of measuring injury criteria.*

(a) For all barrier crashes, the injury criteria specified in this standard shall be met when calculated based on data recorded for 300 milliseconds after the vehicle strikes the barrier.

(b) For the 3-year-old and 6-year-old child dummy low risk deployment tests, the injury criteria specified in this standard shall be met when calculated on data recorded for 100 milliseconds after the initial deployment of the air bag.

(c) For 12-month-old infant dummy low risk deployment tests, the injury criteria specified in the standard shall be met when calculated on data recorded for 125 milliseconds after the initiation of the final stage of air bag deployment designed to deploy in any full frontal rigid barrier crash up to 64 km/h (40 mph).

(d) For driver dummy low risk deployment tests, the injury criteria shall be met when calculated based on data recorded for 125 milliseconds after the initiation of the final stage of air bag deployment designed to deploy in any full frontal rigid barrier crash up to 26 km/h (16 mph).

(e) The requirements for dummy containment shall continue until both the vehicle and the dummies have ceased moving.

S4.12 *Suppression systems that do not detect dummies.* For vehicles with occupant sensing systems that recognize humans and not dummies, such that the air bag or bags would not function in crash tests, the manufacturer shall provide NHTSA with information and equipment necessary to circumvent the suppression system for the crash test such that the restraint system operates as if 5th percentile adult female humans and 50th percentile adult male humans are seated in the vehicle.

S4.13 *Data channels.* For vehicles manufactured on or after September 1, 2001, all data channels used in injury criteria calculations shall be filtered using a phaseless digital filter, such as the Butterworth four-pole phaseless digital filter specified in appendix C of SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see § 571.5).

S5 *Occupant crash protection requirements for the 50th percentile adult male dummy.*

S5.1 *Frontal barrier crash test.*

S5.1.1 *Belted test.* (a) *Vehicles not certified to S14.* Impact a vehicle traveling longitudinally forward at any speed, up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(a), S6.3, S6.4(a), and S6.5 of this standard.

(b) *Vehicles certified to S14*—(1) *Vehicles certified to S14.1 or S14.2.* Impact a vehicle traveling longitudinally forward at any speed, up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle under the applicable conditions of S8 and S10. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

(2) *Vehicles certified to S14.3 or S14.4.* Impact a vehicle traveling longitudinally forward at any speed, up to and including 56 km/h (35 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle under the applicable conditions of S8 and S10. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

S5.1.2 *Unbelted test.* (a) *Vehicles not certified to the requirements of S13 or S14.* At the manufacturer's option, either one of the following unbelted tests shall be met:

(1) Impact a vehicle traveling longitudinally forward at any speed up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10, excluding S10.7, S10.8, and S10.9. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(a), S6.3, S6.4(a), and S6.5 of this standard.

(2) Impact a vehicle traveling longitudinally forward at any speed between 32 km/h (20 mph) and 40 km/h (25 mph), inclusive, into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10, excluding S10.7, S10.8, and S10.9. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

(b) *Vehicles certified to the requirements of S14.* Impact a vehicle traveling longitudinally forward at any speed between 32 km/h (20 mph) and 40 km/h (25 mph), inclusive, into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10, excluding S10.7,

S10.8, and S10.9. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

S5.2 *Lateral moving barrier crash test.* Impact a vehicle laterally on either side by a barrier moving at 20 mph under the applicable conditions of S8. The test dummy specified in S8.1.8 positioned in the front outboard designated seating position adjacent to the impacted side shall meet the injury criteria of S6.2 and S6.3 of this standard.

S5.3 *Rollover.* Subject a vehicle to a rollover test in either lateral direction at 30 mph under the applicable conditions of S8 of this standard with a test dummy specified in S8.1.8 placed in the front outboard designated seating position on the vehicle's lower side as mounted on the test platform. The test dummy shall meet the injury criteria of S6.1 of this standard.

S6 *Injury criteria for the part 572, subpart E, Hybrid III test dummy.*

S6.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S6.2 *Head injury criteria.* (a)(1) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 36 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{36}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5}(t_2 - t_1)$$

(2) The maximum calculated HIC_{36} value shall not exceed 1,000.

(b)(1) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5}(t_2 - t_1)$$

(2) The maximum calculated HIC_{15} value shall not exceed 700.

S6.3 The resultant acceleration calculated from the output of the thoracic instrumentation shown in drawing 78051.218, revision R incorporated by reference in part 572, subpart E of this chapter shall not exceed 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S6.4 *Chest deflection.* (a) Compressive deflection of the sternum relative to the spine shall not exceed 76 mm (3.0 in).

(b) Compressive deflection of the sternum relative to the spine shall not exceed 63 mm (2.5 in).

S6.5 The force transmitted axially through each upper leg shall not exceed 2250 pounds.

S6.6 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S6.6(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 6806 N (1530 lbf) when Fz is in tension

(ii) Fzc = 6160 N (1385 lbf) when Fz is in compression

(iii) Myc = 310 Nm (229 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 135 Nm (100 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij = (Fz/Fzc) + (Mocy/Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 4170 N (937 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 4000 N (899 lbf) at any time.

S6.7 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR Part 572, Subpart E Hybrid III test dummy.

S7. *Seat belt assembly requirements.* As used in this section, a law enforcement vehicle means any vehicle manufactured primarily for use by the United States or by a State or local government for police or other law enforcement purposes.

S7.1 *Adjustment.*

S7.1.1 Except as specified in S7.1.1.1 and S7.1.1.2, the lap belt of any seat belt assembly furnished in accordance with S4.1.2 shall adjust by means of any emergency-locking or automatic-locking retractor that conforms to §571.209 to fit persons whose dimensions range from those of a 50th percentile 6-year-old child to those of a 95th percentile adult male and the upper torso restraint shall adjust by means of an emergency-locking retractor or a manual adjusting device that conforms to §571.209 to fit persons whose dimensions range from those of a 5th percentile adult female to those of a 95th percentile adult male, with the seat in any position, the seat back in the manufacturer's nominal design riding position, and any adjustable anchorages adjusted to the manufacturer's nominal design position for a 50th percentile adult male occupant. However, an upper torso restraint furnished in accordance with S4.1.2.3.1(a) shall adjust by means of an emergency-locking retractor that conforms to §571.209.

S7.1.1.1 A seat belt assembly installed at the driver's seating position shall adjust to fit persons whose dimensions range from those of a 5th-percentile adult female to those of a 95th-percentile adult male.

S7.1.1.2 (a) A seat belt assembly installed in a motor vehicle other than a forward control vehicle at any designated seating position other than the outboard positions of the front and second seats shall adjust either by a retractor as specified in S7.1.1 or by a manual adjusting device that conforms to §571.209.

(b) A seat belt assembly installed in a forward control vehicle at any designated seating position other than the front outboard seating positions shall adjust either by a retractor as specified in S7.1.1 or by a manual adjusting device that conforms to §571.209.

(c) A seat belt assembly installed in a forward-facing rear outboard seating position in a law enforcement vehicle shall adjust either by a retractor as specified in S7.1.1 or by a manual adjusting device that conforms to §571.209.

S7.1.1.3 A Type 1 lap belt or the lap belt portion of any Type 2 seat belt assembly installed at any forward-facing outboard designated seating position of a vehicle with a gross vehicle weight rating of 10,000 pounds or less to comply with a requirement of this standard, except walk-in van-type vehicles and school buses, and except in rear seating positions in law enforcement vehicles, shall meet the requirements of S7.1 by means of an emergency locking retractor that conforms to Standard No. 209 (49 CFR 571.209).

S7.1.1.4 Notwithstanding the other provisions of S7.1—S7.1.1.3, emergency-locking retractors on belt assemblies located in positions other than front outboard designated seating postions may be equipped with a manual webbing adjustment device capable of causing the retractor that adjusts the lap belt to lock when the belt is buckled.

S7.1.1.5 Passenger cars, and trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lb) or less manufactured on or after September 1, 1995 and buses with a GVWR of more than 11,793 kg (26,000 pounds) manufactured on or after November 28, 2016, except a perimeter-seating bus, prison bus, school bus, or transit bus, shall meet the requirements of S7.1.1.5(a), S7.1.1.5(b) and S7.1.1.5(c).

(a) Each designated seating position, except the driver's designated seating position, and except any right front seating position that is equipped with an automatic belt, that is in any motor vehicle, except walk-in van-type vehicles and vehicles manufactured to be sold exclusively to the U.S. Postal Service, and that is forward-facing or can be adjusted to be forward-facing, shall have a seat belt assembly whose lap belt portion is lockable so that the seat belt assembly can be used to tightly secure a child restraint system. The means provided to lock the lap belt or lap belt portion of the seat belt assembly shall not consist of any device that must be attached by the vehicle user to the seat belt webbing, retractor, or any other part of the vehicle. Additionally, the means provided to lock the lap belt or lap belt portion of the seat belt assembly shall not require any inverting, twisting or otherwise deforming of the belt webbing.

(b) If the means provided pursuant to S7.1.1.5(a) to lock the lap belt or lap belt portion of any seat belt assembly makes it necessary for the vehicle user to take some action to activate the locking feature, the vehicle owner's manual shall include a description in words and/or diagrams describing how to activate the locking feature so that the seat belt assembly can tightly secure a child restraint system and how to deactivate the locking feature to remove the child restraint system.

(c) Except for seat belt assemblies that have no retractor or that are equipped with an automatic locking retractor, compliance with S7.1.1.5(a) is demonstrated by the following procedure:

(1) With the seat in any adjustment position, buckle the seat belt assembly. Complete any procedures recommended in the vehicle owner's manual, pursuant to S7.1.1.5(b), to activate any locking feature for the seat belt assembly.

(2) Locate a reference point A on the safety belt buckle. Locate a reference point B on the attachment hardware or retractor assembly at the other end of the lap belt or lap belt portion of the seat belt assembly. Adjust the lap belt or lap belt portion of the seat belt assembly pursuant to S7.1.1.5(c)(1) as necessary so that the webbing between points A and B is at the maximum length allowed by the belt system. Measure and record the distance between points A and B along the longitudinal centerline of the webbing for the lap belt or lap belt portion of the seat belt assembly.

(3) Readjust the belt system so that the webbing between points A and B is at any length that is 5 inches or more shorter than the maximum length of the webbing.

(4) Apply a pre-load of 10 pounds, using the webbing tension pull device described in Figure 5 of this standard, to the lap belt or lap belt portion of the seat belt assembly in a vertical plane parallel to the longitudinal axis of the vehicle and passing through the seating reference point of the designated seating position whose belt system is being tested. Apply the pre-load in a horizontal direction toward the front of the vehicle with a force application angle of not less than 5 degrees nor more than 15 degrees above the horizontal. Measure and record the length of belt between points A and B along the longitudinal centerline of the webbing for the lap belt or lap belt portion of the seat belt assembly while the pre-load is being applied.

(5) Apply a load of 50 pounds, using the webbing tension pull device described in Figure 5 of this standard, to the lap belt or lap belt portion of the seat belt assembly in a vertical plane parallel to the longitudinal axis of the vehicle and passing through the seating reference point of the designated seating position whose belt system is being tested. The load is applied in a horizontal direction toward the front of the vehicle with a force application angle of not less than 5 degrees nor more than 15 degrees above the horizontal at an onset rate of not more

than 50 pounds per second. Attain the 50 pound load in not more than 5 seconds. If webbing sensitive emergency locking retroactive are installed as part of the lap belt assembly or lap belt portion of the seat belt assembly, apply the load at a rate less than the threshold value for lock-up specified by the manufacturer. Maintain the 50 pound load for at least 5 seconds before the measurements specified in S7.1.1.5(c)(6) are obtained and recorded.

(6) Measure and record the length of belt between points A and B along the longitudinal centerline of the webbing for the lap belt or lap belt portion of the seat belt assembly.

(7) The difference between the measurements recorded under S7.1.1.5(c) (6) and (4) shall not exceed 2 inches.

(8) The difference between the measurements recorded under S7.1.1.5(c) (6) and (2) shall be 3 inches or more.

S7.1.1.6 *Passenger seats, other than any outboard designated seating position not rearward of the driver's seating position, in buses with a GVWR of more than 11,793 kg (26,000 lb) manufactured on or after* November 28, 2016. The lap belt of any seat belt assembly on any passenger seat in each bus with a GVWR of more than 11,793 kg (26,000 lb), except a perimeter-seating bus, prison bus, school bus, or transit bus, shall adjust by means of any emergency-locking retractor that conforms to 49 CFR 571.209 to fit persons whose dimensions range from those of a 50th percentile 6-year-old child to those of a 95th percentile adult male and the upper torso restraint shall adjust by means of an emergency-locking retractor that conforms to 49 CFR 571.209 to fit persons whose dimensions range from those of a 5th percentile adult female to those of a 95th percentile adult male, with the seat in any position, the seat back in the manufacturer's nominal design riding position, and any adjustable anchorages adjusted to the manufacturer's nominal design position for a 50th percentile adult male occupant.

S7.1.2 Except as provided in S7.1.2.1, S7.1.2.2, and S7.1.2.3, for each Type 2 seat belt assembly which is required by Standard No. 208 (49 CFR 571.208), the upper anchorage, or the lower anchorage nearest the intersection of the torso belt and the lap belt, shall include a movable component which has a minimum of two adjustment positions. The distance between the geometric center of the movable component at the two extreme adjustment positions shall be not less than five centimeters, measured linearly. If the component required by this paragraph must be manually moved between adjustment positions, information shall be provided in the owner's manual to explain how to adjust the seat belt and warn that misadjustment could reduce the effectiveness of the safety belt in a crash.

S7.1.2.1 As an alternative to meeting the requirement of S7.1.2, a Type 2 seat belt assembly shall provide a means of automatically moving the webbing in relation to either the upper anchorage, or the lower anchorage nearest the intersection of the torso belt and the lap belt. The distance between the midpoint of the webbing at the contact point of the webbing and the anchorage at the extreme adjustment positions shall be not less than five centimeters, measured linearly.

S7.1.2.2 The requirements of S7.1.2 do not apply the anchorages of a Type 2 seat belt assembly installed:

(a) At a seat which is adjustable fore and aft while the vehicle is in motion and whose seat frame above the fore-and-aft adjuster is part of each of the assembly's seat belt anchorages, as defined in S3 of Standard No. 210 (49 CFR 571.210).

(b) At a seat that is not adjustable fore and aft while the vehicle is in motion.

S7.1.2.3 The requirements of S7.1.2 do not apply to any truck with a gross vehicle weight rating of more than 8,500 pounds manufactured before January 1, 1998.

S7.1.3 The intersection of the upper torso belt with the lap belt in any Type 2 seat belt assembly furnished in accordance with S4.1.1 or S4.1.2, with the upper torso manual adjusting device, if provided, adjusted in accordance with the manufacturer's instructions, shall be at least 6 inches from the front vertical centerline of a 50th-percentile adult male occupant, measured along the centerline of the lap belt, with the seat in its rearmost and lowest adjustable position and with the seat back in

the manufacturer's nominal design riding position.

S7.1.4 The weights and dimensions of the vehicle occupants referred to in this standard are as follows:

	50th-percentile 6-year-old child	50th-percentile 10-year-old child	5th-percentile adult female	50th-percentile adult male	95th-percentile adult male
Weight	47.3 pounds	82.1 pounds	102 pounds	164 pounds ±3	215 pounds.
Erect sitting height	25.4 inches	28.9 inches	30.9 inches	35.7 inches ±.1	38 inches.
Hip breadth (sitting)	8.4 inches	10.1 inches	12.8 inches	14.7 inches ±.7	16.5 inches.
Hip circumference (sitting).	23.9 inches	27.4 inches (standing).	36.4 inches	42 inches	47.2 inches.
Waist circumference (sitting).	20.8 inches	25.7 inches (standing).	23.6 inches	32 inches ±.6	42.5 inches.
Chest depth	6.0 inches	7.5 inches	9.3 inches ±.2	10.5 inches.	
Chest circumference:					
(nipple)	30.5 inches.				
(upper)	26.3 inches	29.8 inches	37.4 inches ±.6	44.5 inches.	
(lower)	26.6 inches.				

S7.1.5 *School bus bench seats.* The seat belt assemblies on school bus bench seats will operate by means of any emergency-locking retractor that conforms to 49 CFR 571.209 to restrain persons whose dimensions range from those of a 50th percentile 6-year-old child to those of a 50th percentile 10-year-old, for small occupant seating positions, as defined in 49 CFR 571.222, and to those of a 50th percentile adult male for all other seating positions. The seat back may be in any position.

S7.2 *Latch mechanism.* Except as provided in S7.2(e), each seat belt assembly installed in any vehicle shall have a latch mechanism that complies with the requirements specified in S7.2(a) through (d).

(a) The components of the latch mechanism shall be accessible to a seated occupant in both the stowed and operational positions;

(b) The latch mechanism shall release both the upper torso restraint and the lap belt simultaneously, if the assembly has a lap belt and an upper torso restraint that require unlatching for release of the occupant;

(c) The latch mechanism shall release at a single point; and;

(d) The latch mechanism shall release by a pushbutton action.

(e) The requirements of S7.2 do not apply to any automatic belt assembly. The requirements specified in S7.2(a) through (c) do not apply to any safety belt assembly installed at a forward-facing rear outboard seating position in a law enforcement vehicle.

S7.3 (a) A seat belt assembly provided at the driver's seating position shall be equipped with a warning system that, at the option of the manufacturer, either—

(1) Activates a continuous or intermittent audible signal for a period of not less than 4 seconds and not more than 8 seconds and that activates a continuous or flashing warning light visible to the driver displaying the identifying symbol for the seat belt telltale shown in Table 2 of FMVSS 101 or, at the option of the manufacturer if permitted by FMVSS 101, displaying the words ''Fasten Seat Belts'' or ''Fasten Belts'', for not less than 60 seconds (beginning when the vehicle ignition switch is moved to the ''on'' or the ''start'' position) when condition (b) exists simultaneously with condition (c), or that

(2) Activates, for a period of not less than 4 seconds and not more than 8 seconds (beginning when the vehicle ignition switch is moved to the ''on'' or the ''start'' position), a continuous or flashing warning light visible to the driver, displaying the identifying symbol of the seat belt telltale shown in Table 2 of FMVSS 101 or, at the option of the manufacturer if permitted by FMVSS 101, displaying the words ''Fasten Seat Belts'' or ''Fasten Belts'', when condition (b) exists, and a continuous or intermittent audible signal when condition (b) exists simultaneously with condition (c).

(b) The vehicle's ignition switch is moved to the ''on'' position or to the ''start'' position.

(c) The driver's lap belt is not in use, as determined, at the option of the manufacturer, either by the belt latch mechanism not being fastened, or by the belt not being extended at least 4 inches from its stowed position.

S7.4 *Seat belt comfort and convenience.*

(a) *Automatic seat belts.* Automatic seat belts installed in any vehicle, other than walk-in van-type vehicles, which has a gross vehicle weight rating of 10,000 pounds or less, and which is manufactured on or after September 1, 1986, shall meet the requirements of S7.4.1, S7.4.2, and S7.4.3.

(b) *Manual seat belts.*

(1) *Vehicles manufactured after September 1, 1986.* Manual seat belts installed in any vehicle, other than manual Type 2 belt systems installed in the front outboard seating positions in passenger cars or manual belts in walk-in van-type vehicles, which have a gross vehicle weight rating of 10,000 pounds or less, shall meet the requirements of S7.4.3, S7.4.4, S7.4.5, and S7.4.6.

(2) *Vehicles manufactured after September 1, 1989.*

(i) If the automatic restraint requirement of S4.1.4 is rescinded pursuant to S4.1.5, then manual seat belts installed in a passenger car shall meet the requirements of S7.1.1.3(a), S7.4.2, S7.4.3, S7.4.4, S7.4.5, and S7.4.6.

(ii) Manual seat belts installed in a bus, multipurpose passenger vehicle and truck with a gross vehicle weight rating of 10,000 pounds or less, except for walk-in van-type vehicles, shall meet the requirements of S7.4.3, S7.4.4, S7.4.5, and S7.4.6.

S7.4.1 *Convenience hooks.* Any manual convenience hook or other device that is provided to stow seat belt webbing to facilitate entering or exiting the vehicle shall automatically release the webbing when the automatic belt system is otherwise operational and shall remain in the released mode for as long as (a) exists simultaneously with (b), or, at the manufacturer's option, for as long as (a) exists simultaneously with (c)—

(a) The vehicle ignition switch is moved to the ''on'' or ''start'' position;

(b) The vehicle's drive train is engaged;

(c) The vehicle's parking brake is in the released mode (nonengaged).

S7.4.2 *Webbing tension-relieving device.* Each vehicle with an automatic seat belt assembly or with a Type 2 manual seat belt assembly that must meet the occupant crash protection requirements of S5.1 of this standard installed at a front outboard designated seating position, and each vehicle with a Type 2 manual seat belt assembly installed at a rear outboard designated seating position in compliance with a requirement of this standard, that has either automatic or manual tension-relieving devices permitting the introduction of slack in the webbing of the shoulder belt (e.g., ''comfort clips'' or ''window-shade'' devices) shall:

(a) Comply with the requirements of S5.1 with the shoulder belt webbing adjusted to introduce the maximum amount of slack recommended by the vehicle manufacturer pursuant to S7.4.2(b).

(b) Have a section in the vehicle owner's manual that explains how the tension-relieving device works and specifies the maximum amount of slack (in inches) recommended by the vehicle manufacturer to be introduced into the shoulder belt under normal use conditions. The explanation shall also warn that introducing slack beyond the amount specified by the manufacturer could significantly reduce the effectiveness of the shoulder belt in a crash; and

(c) Have, except for open-body vehicles with no doors, an automatic means to cancel any shoulder belt slack introduced into the belt system by a tension-relieving device. In the case of an automatic safety belt system, cancellation of the tension-relieving device shall occur each time the adjacent vehicle door is opened. In the case of a manual seat belt required to meet S5.1, cancellation of the tension-relieving device shall occur, at the manufacturer's option, either each time the adjacent door is opened or each time the latchplate is released from the buckle. In the case of a Type 2 manual seat belt assembly installed at a rear outboard designated seating position, cancellation of the tension-relieving device shall occur, at the manufacturer's

option either each time the door designed to allow the occupant of that seating position entry and egress of the vehicle is opened or each time the latchplate is released from the buckle. In the case of open-body vehicles with no doors, cancellation of the tension-relieving device may be done by a manual means.

S7.4.3 *Belt contact force.* Except for manual or automatic seat belt assemblies that incorporate a webbing tension-relieving device, the upper torso webbing of any seat belt assembly shall not exert more than 0.7 pounds of contact force when measured normal to and one inch from the chest of an anthropomorphic test dummy, positioned in accordance with S10 of this standard in the seating position for which that seat belt assembly is provided, at the point where the centerline of the torso belt crosses the midsagittal line on the dummy's chest.

S7.4.4 *Latchplate access.* Any seat belt assembly latchplate that is located outboard of a front outboard seating position in accordance with S4.1.2 shall also be located within the outboard reach envelope of either the outboard arm or the inboard arm described in S10.7 and Figure 3 of this standard, when the latchplate is in its normal stowed position and any adjustable anchorages are adjusted to the manufacturer's nominal design position for a 50th percentile adult male occupant. There shall be sufficient clearance between the vehicle seat and the side of the vehicle interior to allow the test block defined in Figure 4 of this standard unhindered transit to the latchplate or buckle.

S7.4.5 *Retraction.* When tested under the conditions of S8.1.2 and S8.1.3, with anthropomorphic dummies whose arms have been removed and which are positioned in accordance with S10 of this standard in the front outboard seating positions and restrained by the belt systems for those positions, the torso and lap belt webbing of any of those seat belt systems shall automatically retract to a stowed position either when the adjacent vehicle door is in the open position and the seat belt latchplate is released, or, at the option of the manufacturer, when the latchplate is released. That stowed position shall prevent any part of the webbing or hardware from being pinched when the adjacent vehicle door is closed. A belt system with a tension-relieving device in an open-bodied vehicle with no doors shall fully retract when the tension-relieving device is deactivated. For the purposes of these retraction requirements, outboard armrests, which are capable of being stowed, on vehicle seats shall be placed in their stowed position.

S7.4.6 *Seat belt guides and hardware.*

S7.4.6.1 (a) Any manual seat belt assembly whose webbing is designed to pass through the seat cushion or between the seat cushion and seat back shall be designed to maintain one of the following three seat belt parts (the seat belt latchplate, the buckle, or the seat belt webbing) on top of or above the seat cushion under normal conditions (i.e., conditions other than when belt hardware is intentionally pushed behind the seat by a vehicle occupant). In addition, the remaining two seat belt parts must be accessible under normal conditions.

(b) The requirements of S7.4.6.1(a) do not apply to: (1) seats whose seat cushions are movable so that the seat back serves a function other than seating, (2) seats which are removable, or (3) seats which are movable so that the space formerly occupied by the seat can be used for a secondary function.

S7.4.6.2 The buckle and latchplate of a manual seat belt assembly subject to S7.4.6.1 shall not pass through the guides or conduits provided for in S7.4.6.1 and fall behind the seat when the events listed below occur in the order specified: (a) The belt is completely retracted or, if the belt is nonretractable, the belt is unlatched; (b) the seat is moved to any position to which it is designed to be adjusted; and (c) the seat back, if foldable, is folded forward as far as possible and then moved backward into position. The inboard receptacle end of a seat belt assembly installed at a front outboard designated seating position shall be accessible with the center arm rest in any position to which it can be adjusted (without having to move the armrest).

S7.5 *Seat belt warning systems for front outboard seat belt assemblies in vehicles manufactured on or after September 1, 2026 provided in accordance with the requirements of S4.1.5.7, S4.2.8, S4.4.3.4, and S4.5.3.3 of this standard, and rear seat belt assemblies in vehicles manufactured on or after September 1, 2027 provided in accordance with the requirements of S4.1.5.8, S4.2.9, S4.4.3.5, and S4.5.3.3 of this standard.*

(a) *Definitions for S7.5.* (1) A manual seat belt is *not in use* when the seat belt latch mechanism is not fastened. A seat belt is *in use* when the seat belt latch mechanism is fastened. An automatic seat belt is *not in use* when the seat belt latch mechanism is not fastened or, if the automatic belt is nondetachable, the emergency release mechanism is in the released position. If the automatic seat belt is motorized, whether the seat belt is in use is determined when the seat belt webbing is in its locked protective mode at the anchorage point.

(2) A *warning cycle for an intermittent audible warning* consists of period(s) when the warning is active at the chime frequency or continuously, and of inactive period(s). A warning cycle begins with an active period and is 30 seconds in duration.

(3) *Chime frequency* means the repetition rate for an intermittent audible warning when the warning is active.

(4) *Duty cycle* means the total amount of time an intermittent audible warning is active during a warning cycle at the chime frequency or continuously, divided by the total warning cycle duration (30 seconds).

(5) A *readily-removable seat* means a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose.

(6) *Seat centerline* means the line formed by the intersection of the seating surface and the vertical plane that passes through the ''seating reference point'' (as defined at 49 CFR 571.3) and is parallel to the direction that the seat faces.

(b) *Front seat belt warning system.* A driver's designated seating position and any front outboard passenger designating seating position must be equipped with an audio-visual seat belt warning meeting the requirements of S7.5(b)(1) through (4) when tested in accordance with S7.5(d).

(1) *Visual warning.* (i) A visual warning must activate and remain active whenever the ignition switch is in the ''on'' or ''start'' position (or the propulsion system is activated), the seat is occupied, and the seat belt is not in use.

(ii) *Vehicles with a driver's designated seating position.* The visual warning for the driver's seat belt and the visual warning for the front outboard passenger seat belt must be visible from the driver's seat. If the vehicle has a mode of driverless operation, the visual warning for the front outboard passenger seat belt must also be visible from the front outboard passenger seat.

(iii) *Vehicles without a driver's designated seating position.* The visual warning for each outboard passenger designated seating position must be visible from each outboard passenger designated seating position.

(iv) The visual warning may be continuous or intermittent and must display the identifying symbol or the words specified in table 2 of FMVSS No. 101 (§571.101).

(v) For a visual warning associated with multiple front outboard seats, the visual warning must clearly identify the seating positions for which the warnings are intended.

(vi) The visual warning must not be overridden by other warnings.

(2) *Audible warning—first phase.* (i) An audible warning must activate when the ignition switch is placed in the ''on'' or ''start'' position (or upon manual activation of the propulsion system, but prior to the vehicle being placed in ''possible active driving mode'' as defined by FMVSS No. 305 (§571.305)), the seat is occupied, and the seat belt is not in use.

(ii) The audible warning must continue for 30 seconds, until the seat belt that triggered the warning is in use, until the seat is no longer occupied, or until the second-phase warning activates, whichever comes first. The audible warning may be paused during the activation of another audible safety warning that is designed to alert the driver to take immediate action, but the seat belt audible warning must be

resumed for the remainder of the required duration after the other audible warning deactivates.

(iii) The audible warning may be continuous or intermittent. If intermittent, inactive periods longer than 3 seconds will not be counted toward the total duration of the audible warning, and there must be no inactive periods greater than 10 seconds. The same audible warning may be used for all front and rear seats.

(3) *Audible warning—second phase.* (i) The audible warning must activate and remain active when the vehicle speed is equal to or greater than 10 km/h (6.2 mph), the seat is occupied, and the seat belt is not in use. The audible warning may be paused during the activation of another audible safety warning that is designed to alert the driver to take immediate action, but the seat belt audible warning must be resumed after the other audible warning deactivates.

(ii) The audible warning may be continuous or intermittent. If intermittent, the audible warning when active must be continuous or have a chime frequency of at least 0.5 Hz and a duty cycle of at least 0.2. The same audible warning may be used for all front and rear seats.

(4) *Cancellation.* The warning must not be able to be canceled or deactivated.

(c) *Rear passenger seat belt warning system.* All rear designated seating positions must be equipped with a warning system meeting the requirements of S7.5(c)(1) through (7) when tested in accordance with S7.5(d).

(1) *Start-of-trip warning.* A visual warning indicating how many or which rear seat belts are in use and/or not in use must activate when the ignition switch is placed in the ''on'' or ''start'' position (or upon manual activation of the propulsion system, but prior to the vehicle being placed in ''possible active driving mode'' as defined by FMVSS No. 305 (§ 571.305)) and continue for at least 60 seconds.

(i) No visual warning is required for:

(A) an unoccupied seat if the system is able to determine whether or not a seat is occupied;

(B) a seat belt that is in use in a system designed to indicate to the driver how many or which rear seat belts are not in use; and

(C) a seat belt that is not in use in a system designed to indicate to the driver how many or which rear seat belts are in use.

(2) *Change-of-status warning.* An audio-visual warning indicating how many or which rear seat belts have undergone a change of status from in use to not in use must activate when the status of any rear seat belt changes from in use to not in use and the vehicle is in forward or reverse drive mode, unless any rear door is open. The warning must continue for at least 30 seconds or until the seat belt that triggered the warning is in use. The warning may deactivate if the system is able to determine that the number of seat belts in use is restored and all the doors remained closed.

(3) *Additional visual warning requirements.* (i) The warning may be continuous or intermittent and may consist of text, symbols, and/or numbers.

(ii) The warning must be visible from the driver's seat.

(iii) If the warning is designed to indicate how many or which rear seat belts are in use, the color of the symbols or numbers indicating seat belts in use must be green. If the warning is designed to indicate to the driver how many or which rear seat belts are not in use, the color of the symbols or numbers indicating seat belts not in use must be red.

(iv) The change-of-status visual warning may use the same telltale as the start of trip warning, provided that the color of an illuminated symbol or number used to indicate to the driver how many or which rear seat belts have undergone a change of status from in use to not in use is red.

(v) The warning must not be overridden by other visual warnings for the required duration.

(4) *Audible warning requirements.* (i) The audible warning may be continuous or intermittent. If intermittent, inactive periods longer than 3 seconds will not be counted toward the total duration of the warning, and there must be no inactive periods greater than 10 seconds.

(ii) The audible warning may be paused during the activation of another audible safety warning that is designed to alert the driver to take immediate action, but the seat belt audible warning must be resumed for the remainder of the required duration after the other audible warning deactivates.

(iii) The same audible warning may be used for all front and rear seats.

(5) *Cancellation.* The warning must not be able to be canceled or deactivated.

(6) *Seat electrical connection requirements.* Any rear designated seating position consisting of a readily-removable seat that is equipped with electrical connections utilized by the rear seat belt warning system must either—

(i) Automatically connect the electrical connections when the seat is put in place; or

(ii) If a manual electrical connection is required, the connectors must be readily accessible.

(7) *Electrical connection warning signal.* Vehicles that provide a visual warning designed to indicate to the driver how many or which rear seat belts are not in use and are equipped with any readily removable rear seats must, when the ignition switch is placed in the ''on'' or ''start'' position (or upon manual activation of the propulsion system, but prior to the vehicle being placed in ''possible active driving mode'' as defined by FMVSS No. 305 (§571.305)) provide a visual warning visible from the driver's seat if a seat has been installed and a proper electrical connection has not been made. The visual warning may be intermittent but must remain active until all rear seat electrical connections are properly made.

(d) *Test procedures.* (1) *Occupied designated seating positions.* If testing with a designated seating position occupied, the following apply, at the option of the manufacturer:

(i) *Front outboard seating positions.* (A) Seat the 5th percentile female test dummy described in part 572, subpart O of this chapter, as well as any larger dummy described in part 572 of this chapter; or

(B) Seat any human occupant that weighs 46.7 kg (103 lb) or more and is 139.7 cm (55 inches) tall or taller.

(ii) *Driver's seating position.* (A) Seat the 5th percentile female test dummy described in part 572, subpart O of this chapter, as well as any larger dummy described in part 572 of this chapter;

(B) Seat any human occupant that weighs 46.7 kg (103 lb) or more and is 139.7 cm (55 inches) tall or taller; or

(C) The seat may be considered occupied when the ignition switch is in the ''on'' or ''start'' position (or the propulsion system is activated).

(iii) *Rear seating positions.* (A) Seat the 6-year-old child dummy described in part 572, subpart N of this chapter, as well as any larger dummy described in part 572 of this chapter; or

(B) Seat any human occupant that weighs 21 kg (46.5 lb) or more and is 114 cm (45 inches) tall or taller.

(iv) *Compliance option selection.* The manufacturer shall select a compliance option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall provide information to NHTSA regarding which of the compliance options it has selected for a particular vehicle or make/model upon request.

(2) *Seating procedures*—(i) *Seat adjustment.* If adjustable, the seat back shall be placed in the manufacturer's nominal design riding position, with any other seat adjustments in any position, and any adjustable seat belt anchorages in any position.

(ii) *Test dummy.* Seat the test dummy such that the midsagittal plane of the dummy is vertical and within ±10 mm of the seat centerline, with the torso and pelvis in contact with the seat back. The dummy may be clothed in any manner.

(iii) *Human occupant.* The occupant shall assume, to the extent possible, the final physical position specified for the test dummy. The occupant may be clothed in any manner.

(3) Verify that the seat belt warnings function as specified in S7.5(b) and (c) for any combination of seat belt use (at any seating position), seat occupancy (at any seating position), removable

seat electrical connection status (connected or not connected, for any removable seat), vehicle speed, and door status (open or closed, for any door), except that the door shall not be opened when the vehicle is in motion.

S8. *Test conditions.*

S8.1 *General conditions.* The following conditions apply to the frontal, lateral, and rollover tests. Except for S8.1.1(d), the following conditions apply to the alternative unbelted sled test set forth in S13 from March 19, 1997 until September 1, 2001.

S8.1.1 Except as provided in paragraph (c) of S8.1.1, the vehicle, including test devices and instrumentation, is loaded as follows:

(a) *Passenger cars.* A passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the weight of the necessary anthropomorphic test devices.

(b) *Multipurpose passenger vehicles, trucks, and buses.* A multipurpose passenger vehicle, truck, or bus is loaded to its unloaded vehicle weight plus 300 pounds or its rated cargo and luggage capacity weight, whichever is less, secured in the load carrying area and distributed as nearly as possible in proportion to its gross axle weight ratings, plus the weight of the necessary anthropomorphic test devices. For the purposes of §8.1.1, unloaded vehicle weight does not include the weight of work-performing accessories. Vehicles are tested to a maximum unloaded vehicle weight of 5,500 pounds.

(c) *Fuel system capacity.* With the test vehicle on a level surface, pump the fuel from the vehicle's fuel tank and then operate the engine until it stops. Then, add Stoddard solvent to the test vehicle's fuel tank in an amount which is equal to not less than 92 and not more than 94 percent of the fuel tank's usable capacity stated by the vehicle's manufacturer. In addition, add the amount of Stoddard solvent needed to fill the entire fuel system from the fuel tank through the engine's induction system.

(d) *Vehicle test attitude.* Determine the distance between a level surface and a standard reference point on the test vehicle's body, directly above each wheel opening, when the vehicle is in its ''as delivered'' condition. The ''as delivered'' condition is the vehicle as received at the test site, with 100 percent of all fluid capacities and all tires inflated to the manufacturer's specifications as listed on the vehicle's tire placard. Determine the distance between the same level surface and the same standard reference points in the vehicle's ''fully loaded condition.'' The ''fully loaded condition'' is the test vehicle loaded in accordance with S8.1.1 (a) or (b), as applicable. The load placed in the cargo area shall be center over the longitudinal centerline of the vehicle. The pretest vehicle attitude shall be equal to either the as delivered or fully loaded attitude or between the as delivered attitude and the fully loaded attitude.

S8.1.2 Adjustable seats are in the adjustment position midway between the forwardmost and rearmost positions, and if separately adjustable in a vertical direction, are at the lowest position. If an adjustment position does not exist midway between the forwardmost and rearmost positions, the closest adjustment position to the rear of the midpoint is used.

S8.1.3 Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer. Place any adjustable anchorages at the manufacturer's nominal design position for a 50th percentile adult male occupant. Place each adjustable head restraint in its highest adjustment position. Adjustable lumbar supports are positioned so that the lumbar support is in its lowest adjustment position.

S8.1.4 Adjustable steering controls are adjusted so that the steering control hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions.

S8.1.5 Movable vehicle windows and vents are placed in the fully closed position, unless the vehicle manufacturer chooses to specify a different adjustment position prior to the time it certifies the vehicle.

S8.1.6 Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S8.1.7 Doors are fully closed and latched but not locked.

S8.1.8 *Anthropomorphic test dummies.*

S8.1.8.1 The anthropomorphic test dummies used for evaluation of occupant protection systems manufactured pursuant to applicable portions of S4.1.2, S4.1.3, and S4.1.4 of this standard shall conform to the requirements of subpart E of part 572 of this chapter.

S8.1.8.2 Each test dummy is clothed in a form fitting cotton stretch short sleeve shirt with above-the-elbow sleeves and above-the-knee length pants. The weight of the shirt or pants shall not exceed 0.25 pounds each. Each foot of the test dummy is equipped with a size 11XW shoe which meets the configuration size, sole, and heel thickness specifications of MIL–S–13192P (incorporated by reference, see §571.5) change ''P'' and whose weight is 1.25 ±0.2 pounds.

S8.1.8.3 Limb joints are set at 1g, barely restraining the weight of the limb when extended horizontally. Leg joints are adjusted with the torso in the supine position.

S8.1.8.4 Instrumentation does not affect the motion of the dummies during impact or rollover.

S8.1.8.5 The stabilized test temperature of the test dummy is at any temperature level between 69 degrees F and 72 degrees F, inclusive.

S8.2 *Lateral moving barrier crash test conditions.* The following conditions apply to the lateral moving barrier crash test.

S8.2.1 The moving barrier, including the impact surface, supporting structure, and carriage, weighs 4,000 pounds.

S8.2.2 The impact surface of the barrier is a vertical, rigid, flat rectangle, 78 inches wide and 60 inches high, perpendicular to its direction of movement, with its lower edge horizontal and 5 inches above the ground surface.

S8.2.3 During the entire impact sequence the barrier undergoes no significant amount of dynamic or static deformation, and absorbs no significant portion of the energy resulting from the impact, except for energy that results in translational rebound movement of the barrier.

S8.2.4 During the entire impact sequence the barrier is guided so that it travels in a straight line, with no significant lateral, vertical or rotational movement.

S8.2.5 The concrete surface upon which the vehicle is tested is level, rigid and of uniform construction, with a skid number of 75 when measured in accordance with ASTM E274–65T (incorporated by reference, see §571.5) at 40 m.p.h., omitting water delivery as specified in paragraph 7.1 of that method.

S8.2.6 The tested vehicle's brakes are disengaged and the transmission is in neutral.

S8.2.7 The barrier and the test vehicle are positioned so that at impact—

(a) The vehicle is at rest in its normal attitude;

(b) The barrier is traveling in a direction perpendicular to the longitudinal axis of the vehicle at 20 m.p.h.; and

(c) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface passes through the driver's seating position seating reference point in the tested vehicle.

S8.3 *Rollover test conditions.* The following conditions apply to the rollover test.

S8.3.1 The tested vehicle's brakes are disengaged and the transmission is in neutral.

S8.3.2 The concrete surface on which the test is conducted is level, rigid, of uniform construction, and of a sufficient size that the vehicle remains on it throughout the entire rollover cycle. It has a skid number of 75 when measured in accordance with ASTM E274–65T (incorporated by reference, see §571.5) at 40 m.p.h. omitting water delivery as specified in paragraph 7.1 of that method.

S8.3.3 The vehicle is placed on a device, similar to that illustrated in Figure 2, having a platform in the form of a flat, rigid plane at an angle of 23° from the horizontal. At the lower edge of the platform is an unyielding flange, perpendicular to the platform with a height of 4 inches and a length sufficient to hold in place the tires that rest against it. The intersection of the inner face of the flange with the upper face of the platform is 9 inches above the rollover surface. No other restraints are used to hold the vehicle in position during the deceleration of the

platform and the departure of the vehicle.

S8.3.4 With the vehicle on the test platform, the test devices remain as nearly as possible in the posture specified in S8.1.

S8.3.5 Before the deceleration pulse, the platform is moving horizontally, and perpendicularly to the longitudinal axis of the vehicle, at a constant speed of 30 m.p.h. for a sufficient period of time for the vehicle to become motionless relative to the platform.

S8.3.6 The platform is decelerated from 30 to 0 m.p.h. in a distance of not more than 3 feet, without change of direction and without transverse or rotational movement during the deceleration of the platform and the departure of the vehicle. The deceleration rate is at least 20g for a minimum of 0.04 seconds.

S8.4 *Frontal test condition.* If the vehicle is equipped with a cutoff device permitted by S4.5.4 of this standard, the device is deactivated.

S9. *Pressure vessels and explosive devices.*

S9.1 *Pressure vessels.* A pressure vessel that is continuously pressurized shall conform to the requirements of §§ 178.65(a), 178.65(c)(2), 178.65(d), 178.65(e)(1), and 178.65(e)(2) of this title; and to the pressure relief device requirements of §§ 173.301(a)(2), 173.301(a)(3) and 173.301(f) of this title. It shall not leak or evidence visible distortion when tested in accordance with § 178.65(f)(1) of this title and shall not fail in any of the ways enumerated in § 178.65(f)(2) of this title when hydrostatically tested to destruction. It shall not crack when flattened in accordance with § 178.65(g) of this title to the limit specified in § 178.65(g)(4) of this title.

S9.2 *Explosive devices.* An explosive device shall not exhibit any of the characteristics prohibited by § 173.54 of this title. All explosive material shall be enclosed in a structure that is capable of containing the explosive energy without sudden release of pressure except through overpressure relief devices or parts designed to release the pressure during actuation.

S10. *Test dummy positioning procedures.*

S10.1 *Head.* The transverse instrumentation platform of the head shall be level within ½ degree. To level the head of the test dummy, the following sequences must be followed. First, adjust the position of the H point within the limits set forth in S10.4.2.1 to level the transverse instrumentation platform of the head of the test dummy. If the transverse instrumentation platform of the head is still not level, then adjust the pelvic angle of the test dummy within the limits specified in S10.4.2.2 of this standard. If the transverse instrumentation platform of the head is still not level, then adjust the neck bracket of the dummy the minimum amount necessary from the non-adjusted ''0'' setting to ensure that the transverse instrumentation platform of the head is horizontal within ½ degree. The test dummy shall remain within the limits specified in S10.4.2.1 and S10.4.2.2. after any adjustment of the neck bracket.

S10.2 *Upper Arms.*

S10.2.1 The driver dummy's upper arms shall be adjacent to the torso with the centerlines as close to a vertical plane as possible.

S10.2.2 Any front outboard passenger dummy's upper arms shall be in contact with the seat back and the sides of the torso.

S10.3 *Hands.*

S10.3.1 The palms of the driver dummy shall be in contact with the outer part of the steering control rim at the rim's horizontal centerline. The thumbs shall be over the steering control rim and shall be lightly taped to the steering control rim so that if the hand of the test dummy is pushed upward by a force of not less than 2 pounds and not more than 5 pounds, the tape shall release the hand from the steering control rim.

S10.3.2 The palms of any passenger test dummy shall be in contact with the outside of the thigh. The little finger shall be in contact with the seat cushion.

S10.4 *Torso.*

S10.4.1 *Upper Torso.*

S10.4.1.1 In vehicles equipped with bench seats, the upper torso of the driver and front outboard passenger dummies shall rest against the seat back. The midsagittal plane of the

driver dummy shall be vertical and parallel to the vehicle's longitudinal centerline, and pass through the center of rotation of the steering control. The midsagittal plane of any passenger dummy shall be vertical and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the midsagittal plane of the driver dummy, if there is a driver's seating position. If there is no driver's seating position, the midsagittal plane of any front outboard passenger dummy shall be vertical and parallel to the vehicle's longitudinal centerline, and pass through the seating reference point of the seat that it occupies.

S10.4.1.2 In vehicles equipped with bucket seats, the upper torso of the driver and passenger dummies shall rest against the seat back. The midsagittal plane of the driver and any front outboard passenger dummy shall be vertical and shall coincide with the longitudinal centerline of the bucket seat.

S10.4.2 *Lower Torso.*

S10.4.2.1 *H-point.* The H-points of the driver and any front outboard passenger test dummies shall coincide within ½ inch in the vertical dimension and ½ inch in the horizontal dimension of a point ¼ inch below the position of the H-point determined by using the equipment and procedures specified in SAE Standard J826–1980 (incorporated by reference, see §571.5), except that the length of the lower leg and thigh segments of the H-point machine shall be adjusted to 16.3 and 15.8 inches, respectively, instead of the 50th percentile values specified in Table 1 of SAE Standard J826–1980.

S10.4.2.2 *Pelvic angle.* As determined using the pelvic angle gage (GM drawing 78051–532, incorporated by reference in part 572, subpart E of this chapter) which is inserted into the H-point gaging hole of the dummy, the angle measured from the horizontal on the three inch flat surface of the gage shall be 22½ degrees plus or minus 2½ degrees.

S10.5 *Legs.* The upper legs of the driver and any front outboard passenger test dummies shall rest against the seat cushion to the extent permitted by placement of the feet. The initial distance between the outboard knee clevis flange surfaces shall be 10.6 inches. To the extent practicable, the left leg of the driver dummy and both legs of any front outboard passenger dummy shall be in vertical longitudinal planes. To the extent practicable, the right leg of the driver dummy shall be in a vertical plane. Final adjustment to accommodate the placement of feet in accordance with S10.6 for various passenger compartment configurations is permitted.

S10.6 *Feet.*

S10.6.1 *Driver dummy position.*

S10.6.1.1 If the vehicle has an adjustable accelerator pedal, adjust it to the full forward position. Rest the right foot of the test dummy on the undepressed accelerator pedal with the rearmost point of the heel on the floor pan in the plane of the pedal. If the foot cannot be placed on the accelerator pedal, set it initially perpendicular to the lower leg and then place it as far forward as possible in the direction of the pedal centerline with the rearmost point of the heel resting on the floor pan. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot. If the accelerator pedal still does not touch the foot in the full rearward position, leave the pedal in that position.

S10.6.1.2 Place the left foot on the toeboard with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toeboard and the floor pan and not on the wheelwell projection. If the foot cannot be positioned on the toeboard, set it initially perpendicular to the lower leg and place it as far forward as possible with the heel resting on the floor pan. If necessary to avoid contact with the vehicle's brake or clutch pedal, rotate the test dummy's left foot about the lower leg. If there is still pedal interference, rotate the left leg outboard about the hip the minimum distance necessary to avoid the pedal interference. For vehicles with a foot rest that does not elevate the left foot above the level of the right foot, place the left foot on the foot rest so that

the upper and lower leg centerlines fall in a vertical plane.

S10.6.2 Front outboard *passenger dummy position*.

S10.6.2.1 *Vehicles with a flat floor pan/toeboard*. Place the right and left feet on the vehicle's toeboard with the heels resting on the floor pan as close as possible to the intersection point with the toeboard. If the feet cannot be placed flat on the toeboard, set them perpendicular to the lower leg centerlines and place them as far forward as possible with the heels resting on the floor pan.

S10.6.2.2 *Vehicles with wheelhouse projections in passenger compartment*. Place the right and left feet in the well of the floor pan/toeboard and not on the wheelhouse projection. If the feet cannot be placed flat on the toeboard, initially set them perpendicular to the lower leg centerlines and then place them as far forward as possible with the heels resting on the floor pan.

S10.7 *Test dummy positioning for latchplate access*. The reach envelopes specified in S7.4.4 of this standard are obtained by positioning a test dummy in the driver's or front outboard passenger seating position and adjusting that seating position to its forwardmost adjustment position. Attach the lines for the inboard and outboard arms to the test dummy as described in Figure 3 of this standard. Extend each line backward and outboard to generate the compliance arcs of the outboard reach envelope of the test dummy's arms.

S10.8 *Test dummy positioning for belt contact force*. To determine compliance with S7.4.3 of this standard, position the test dummy in the vehicle in accordance with S10.1 through S10.6 of this standard and adjust the seating position in accordance with S8.1.2 and S8.1.3 of this standard. Pull the belt webbing three inches from the test dummy's chest and release until the webbing is within one inch of the test dummy's chest and measure the belt contact force.

S10.9 *Manual belt adjustment for dynamic testing*. With the test dummy positioned in accordance with S10.1 through S10.6 of this standard and the seating position adjusted in accordance with S8.1.2 and S8.1.3 of this standard, place the Type 2 manual belt around the test dummy and fasten the latch. Remove all slack from the lap belt portion. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this four times. Apply a 2 to 4 pound tension load to the lap belt. If the belt system is equipped with a tension-relieving device, introduce the maximum amount of slack into the upper torso belt that is recommended by the vehicle manufacturer in the vehicle's owner's manual. If the belt system is not equipped with a tension-relieving device, allow the excess webbing in the upper torso belt to be retracted by the retractive force of the retractor.

S11. [Reserved]

S12. *Temporary Exemption from Requirement for Inflatable Restraint System*.

S12.1 *Scope*. This section establishes procedures for filing and processing applications for temporary exemption from the requirements in this standard that vehicles be equipped with inflatable restraint systems.

S12.2 *Definitions*.

Line means a name that a manufacturer applies to a group of motor vehicles of the same make which have the same body or chassis, or otherwise are similar in construction or design. A *line* may, for example, include 2-door, 4-door, station wagon, and hatchback vehicles of the same make.

S12.3 *Standard of review*. In order to receive a temporary exemption from the inflatable restraint requirement, a vehicle manufacturer must demonstrate in its application that there has been a disruption in the supply of one or more inflatable restraint system components, or a disruption in the use and installation by the manufacturer of any such component due to unavoidable events not under the control of the manufacturer, which will prevent a manufacturer from meeting its anticipated production volume of vehicles with inflatable restraint systems.

S12.4 *Exemption applications—General requirements*. Each application for a temporary exemption from the inflatable restraint requirements must—

(a) Be written in the English language;

(b) Be submitted in three copies to: Administrator, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590;

(c) State the full name and address of the manufacturer, the nature of its organization (individual, partnership, corporation, etc.), and the name of the State or country under the laws of which it is organized;

(d) Identify the motor vehicle line or lines for which the temporary exemption is being sought;

(e) Set forth in full the data, views, and arguments of the manufacturer that would support granting the temporary exemption, including the specific information required by S12.5; and

(f) Specify and segregate any part of the information and data submitted in the application that should be withheld from public disclosure in accordance with part 512 of this chapter.

S12.5 *Exemption applications—Specific content requirements.* Each application for a temporary exemption from the inflatable restraint requirement must include:

(a) A clear and specific identification of any component in the inflatable restraint system that has become unavailable due to circumstances beyond the manufacturer's control, and a diagram showing the location of such component within the restraint system and within the vehicle;

(b) A clear and specific explanation of the cause or causes of the disruption in the supply of the component, and a showing that such disruption is beyond the control of the manufacturer;

(c) An estimate of the length of time that will be needed to correct the disruption and again incorporate the subject components into current production, or an explanation of why it is not possible to provide such an estimate;

(d) A complete statement of the bases for the manufacturer's belief that NHTSA should grant a temporary exemption in response to this application;

(e) An unconditional statement by the manufacturer that it will recall every vehicle for which a temporary exemption is requested in the application, to install all missing inflatable restraint systems;

(f) A plan setting forth steps the manufacturer will take to ensure that as many exempted vehicles as possible will be returned for installation of missing inflatable restraint systems;

(g) A proposed reasonable period of time after the disruption in the supply of inflatable restraint system components is corrected that the manufacturer estimates will ensure a sufficient quantity of components for both anticipated production and retrofit of those vehicles for which a temporary exemption is requested in the application, so that the vehicle manufacturer can recall those vehicles for which a temporary exemption is requested and install inflatable restraint systems in them, together with a demonstration of why the manufacturer believes this proposed period of time is reasonable for completing this recall, or an explanation of why it is not possible to provide such an estimate;

(h) A proposed date for termination of the exemption;

(i) A proposed date by which all exempted vehicles will have been recalled and had inflatable restraints installed (assuming owners returned their vehicles in a timely matter in response to a first notice by the manufacturer), or an explanation of why it is not possible to provide such an estimate.

S12.6 *Processing an application for a temporary exemption.* (a) NHTSA will process any application for temporary exemption that contains the information specified in S12.4 and S12.5. If an application fails to provide the information specified in S12.4 and S12.5, NHTSA will not process the application, but will advise the manufacturer of the information that must be provided if the agency is to process the application.

(b) Notice of each application for temporary exemption shall be published in the FEDERAL REGISTER.

(c) NHTSA will issue its decision to grant or deny the requested temporary exemption not later than 15 days after the agency receives a complete petition, as defined in paragraph (a). However, a failure to issue a decision within this time does not result in a grant of the petition.

(d) Notice of each decision to grant or deny a temporary exemption, and

the reasons for granting or denying it, will be published in the FEDERAL REGISTER.

(e) The Administrator may attach such conditions as he or she deems appropriate to a temporary exemption, including but not limited to requiring manufacturers to provide progress reports at specified times (including, as appropriate and to the extent possible, estimate of dates and times concerning when a supply disruption will be corrected and when recall will take place) and requiring manufacturers to take specific steps to ensure that as many exempted vehicles as possible will be returned for installation of missing inflatable restraint systems.

(f) Unless a later effective date is specified in a notice announcing an agency decision to grant a temporary exemption, a temporary exemption from the inflatable restraint requirement will become effective upon the date the decision is issued.

S12.7 *Labels and written notice announcing temporary exemption.*

S12.7.1 It shall be a condition of every temporary exemption from the inflatable restraint requirement that the manufacturer of exempted vehicles comply with the provisions of S12.7.2 and S12.7.3.

S12.7.2 (a) The manufacturer of any vehicle granted a temporary exemption from the inflatable restraint requirement shall affix a label within the passenger compartment of such vehicle. The label shall set forth the following information in block capital letters and numerals not less than three thirty-seconds of an inch high:

THIS VEHICLE DOES NOT CONTAIN AN AIR BAG IN CONFORMANCE WITH THE FEDERAL MOTOR VEHICLE SAFETY STANDARD FOR OCCUPANT CRASH PROTECTION. IT WAS EXEMPTED PURSUANT TO NHTSA EXEMPTION NO. (insert number assigned by NHTSA).

(b) This label shall not be removed until after the vehicle manufacturer has recalled the vehicle and installed an inflatable restraint system at those seating positions for which it was granted an exemption.

S12.7.3 The manufacturer of any vehicle that is delivered without an inflatable restraint system, pursuant to a temporary exemption granted under this section, shall, at the time of delivery of the vehicle, provide a written notice to the dealer to whom the vehicle is delivered. The manufacturer shall also provide a written notice by registered mail to the first purchaser of the vehicle for purposes other than resale, within two weeks after purchase. Unless otherwise provided for by the Administrator in the exemption, such notice shall provide the following information:

(a) This vehicle does not conform to Federal Motor Vehicle Safety Standard No. 208, because it is not equipped with an inflatable restraint at (insert the affected seating positions).

(b) The vehicle was allowed to be sold pursuant to NHTSA Exemption No. (insert appropriate exemption number).

(c) The reason this vehicle was exempted from the requirement for an inflatable restraint was because of factors beyond the manufacturer's control.

(d) The manufacturer will recall this vehicle not later than (insert the time set forth in the exemption) and install the missing inflatable restraint at no charge.

(e) If the reader has any questions or would like some further information, he or she may contact the manufacturer at (insert an address and telephone number).

S13 *Alternative unbelted test available, under S3(b) of this standard, for certain vehicles manufactured before September 1, 2006.*

S13.1 *Instrumentation for Impact Test—Part 1—Electronic Instrumentation.* Under the applicable conditions of S8, mount the vehicle on a dynamic test platform at the vehicle attitude set forth in S13.3, so that the longitudinal center line of the vehicle is parallel to the direction of the test platform travel and so that movement between the base of the vehicle and the test platform is prevented. The test platform is instrumented with an accelerometer and data processing system having a frequency response of 60 channel class as specified in SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see § 571.5). The accelerometer sensitive axis is parallel to the direction of test platform travel. The test is conducted at a velocity change

approximating 48 km/h (30 mph) with acceleration of the test platform such that all points on the crash pulse curve within the corridor identified in Figure 6 are covered. An inflatable restraint is to be activated at 20 ms ±2 ms from the time that 0.5 g is measured on the dynamic test platform. The test dummy specified in S8.1.8, placed in each front outboard designated seating position as specified in S10, excluding S10.7, S10.8, and S10.9, shall meet the injury criteria of S6.1, S6.2(a), S6.3, S6.4(a), S6.5, and S13.2 of this standard.

S13.2 *Neck injury criteria.* A vehicle certified to this alternative test requirement shall, in addition to meeting the criteria specified in S13.1, meet the following injury criteria for the neck, measured with the six axis load cell (ref. Denton drawing C–1709) that is mounted between the bottom of the skull and the top of the neck as shown in Drawing 78051–218, in the unbelted sled test:

(a) Flexion Bending Moment (calculated at the occipital condyle)—190 Nm. SAE Class 600.

(b) Extension Bending Moment (calculated at the occipital condyle)—57 Nm. SAE Class 600.

(c) Axial Tension—3300 peak N. SAE Class 1000.

(d) Axial Compression—4000 peak N. SAE Class 1000.

(e) Fore-and-Aft Shear—3100 peak N. SAE Class 1000.

S13.3 *Vehicle test attitude.* When the vehicle is in its ''as delivered'' condition, measure the angle between the left side door sill and the horizontal. Mark where the angle is taken on the door sill. The ''as delivered'' condition is the vehicle as received at the test site, with 100 percent of all fluid capacities and all tires inflated to the manufacturer's specifications as listed on the vehicle's tire placard. When the vehicle is in its ''fully loaded'' condition, measure the angle between the left side door sill and the horizontal, at the same place the ''as delivered'' angle was measured. The ''fully loaded'' condition is the test vehicle loaded in accordance with S8.1.1(a) or (b) of Standard No. 208, as applicable. The load placed in the cargo area shall be centered over the longitudinal centerline of the vehicle. The pretest door sill angle, when the vehicle is on the sled, (measured at the same location as the as delivered and fully loaded condition) shall be equal to or between the as delivered and fully loaded door sill angle measurements.

S13.4 *Tires and wheels.* Remove the tires and wheels.

S13.5. *Vehicle Securing.* The engine, transmissions, axles, exhaust, vehicle frame, and vehicle body may be rigidly secured to the vehicle and/or the sled, and fluids, batteries and unsecured components may be removed, in order to assure that all points on the crash pulse curve are within the corridor defined in Figure 6.

S14 *Advanced air bag requirements for passenger cars and for trucks, buses, and multipurpose passenger vehicles with a GVWR of 3,855 kg (8500 pounds) or less and an unloaded vehicle weight of 2,495 kg (5500 pounds) or less, except for walk-in van-type trucks or vehicles designed to be sold exclusively to the U.S. Postal Service.*

S14.1 *Vehicles manufactured on or after September 1, 2003, and before September 1, 2006.* (a) For vehicles manufactured for sale in the United States on or after September 1, 2003, and before September 1, 2006, a percentage of the manufacturer's production, as specified in S14.1.1, shall meet the requirements specified in S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

(b) Manufacturers that sell three or fewer carlines, as that term is defined at 49 CFR 585.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph instead of paragraph (a) of this section. At least 95 percent of the vehicles manufactured by the manufacturer on or after September 1, 2005 and before September 1, 2006 shall meet the requirements specified in S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S14.1.

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.1.

S14.1.1 *Phase-in schedule.*

S14.1.1.1 *Vehicles manufactured on or after September 1, 2003, and before September 1, 2004.* Subject to S14.1.2(a), for vehicles manufactured by a manufacturer on or after September 1, 2003, and before September 1, 2004, the amount of vehicles complying with S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25, shall be not less than 20 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2003, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2001, and before September 1, 2004, or

(b) The manufacturer's production on or after September 1, 2003, and before September 1, 2004.

S14.1.1.2 *Vehicles manufactured on or after September 1, 2004, and before September 1, 2005.* Subject to S14.1.2(b), for vehicles manufactured by a manufacturer on or after September 1, 2004, and before September 1, 2005, the amount of vehicles complying with S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be not less than 65 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2004, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2002, and before September 1, 2005, or

(b) The manufacturer's production on or after September 1, 2004, and before September 1, 2005.

S14.1.1.3 *Vehicles manufactured on or after September 1, 2005, and before September 1, 2006.* Subject to S14.1.2(c), for vehicles manufactured by a manufacturer on or after September 1, 2005, and before September 1, 2006, the amount of vehicles complying with S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be 100 percent of the manufacturer's production during that period.

S14.1.2 Calculation of complying vehicles.

(a) For the purposes of complying with S14.1.1.1, a manufacturer may count a vehicle if it is manufactured on or after June 12, 2000, but before September 1, 2004.

(b) For purposes of complying with S14.1.1.2, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after June 12, 2000, but before September 1, 2005, and

(2) Is not counted toward compliance with S14.1.1.1.

(c) For purposes of complying with S14.1.1.3, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after June 12, 2000, but before September 1, 2006, and (2) Is not counted toward compliance with S14.1.1.1 or S14.1.1.2.

S14.1.3 *Vehicles produced by more than one manufacturer.*

S14.1.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.1.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S14.1.3.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S14.1.3.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.1.3.1.

S14.2 *Vehicles manufactured on or after September 1, 2006.* Each vehicle shall meet the requirements specified in S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

S14.3 *Vehicles manufactured on or after September 1, 2007, and before September 1, 2010.*

(a) For vehicles manufactured for sale in the United States on or after September 1, 2007, and before September 1, 2010, a percentage of the manufacturer's production, as specified in S14.3.1, shall meet the requirements specified in S14.5.1(b) (in addition to the other requirements of this standard).

(b) Manufacturers that sell two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2008, and before September 1, 2010, shall meet the requirements specified in S14.5.1(b) (in addition to the other requirements specified in this standard).

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with part 567 of this chapter are not subject to the requirements of S14.3.

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.3.

S14.3.1 *Phase-in schedule.*

S14.3.1.1 *Vehicles manufactured on or after September 1, 2007, and before September 1, 2008.* Subject to S14.3.2(a), for vehicles manufactured by a manufacturer on or after September 1, 2007, and before September 1, 2008, the amount of vehicles complying with S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25, shall be not less than 35 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2007, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2005, and before September 1, 2008, or

(b) The manufacturer's production on or after September 1, 2007, and before September 1, 2008.

S14.3.1.2 *Vehicles manufactured on or after September 1, 2008, and before September 1, 2009.* Subject to S14.3.2(b), for vehicles manufactured by a manufacturer on or after September 1, 2008, and before September 1, 2009, the amount of vehicles complying with S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be not less than 65 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2008, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2006 and before September 1, 2009, or

(b) The manufacturer's production on or after September 1, 2008, and before September 1, 2009.

S14.3.1.3 *Vehicles manufactured on or after September 1, 2009, and before September 1, 2010.* Subject to S14.3.2(c), for vehicles manufactured by a manufacturer on or after September 1, 2009, and before September 1, 2010, the amount of vehicles complying with S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be 100 percent of the manufacturer's production during that period.

S14.3.2 *Calculation of complying vehicles.*

(a) For the purposes of complying with S14.3.1.1, a manufacturer may count a vehicle if it is manufactured on or after September 1, 2006, but before September 1, 2008.

(b) For purposes of complying with S14.3.1.2, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2006, but before September 1, 2009, and

(2) Is not counted toward compliance with S14.3.1.1.

(c) For purposes of complying with S14.3.1.3, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2006, but before September 1, 2010, and

(2) Is not counted toward compliance with S14.3.1.1 or S14.3.1.2.

S14.3.3 *Vehicles produced by more than one manufacturer.*

S14.3.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.3.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S14.3.3.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S14.3.3.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.3.3.1.

S14.4 *Vehicles manufactured on or after September 1, 2010.* Each vehicle shall meet the requirements specified in S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

S14.5 *Barrier test requirements using 50th percentile adult male dummies.*

S14.5.1 *Rigid barrier belted test.* (a) Each vehicle that is certified as complying with S14.1 or S14.2 shall, at each front outboard designated seating position, meet the injury criteria specified in S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 when tested under S5.1.1(b)(1).

(b) Each vehicle that is certified as complying with S14.3 or S14.4 shall, at each front outboard designated seating position, meet the injury criteria specified in S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 when tested under S5.1.1(b)(2).

S14.5.2 *Rigid barrier unbelted test.* Each vehicle that is certified as complying with S14 shall, at each front outboard designated seating position, meet the injury criteria specified in S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 when tested under S5.1.2(b).

S14.6 *Vehicles manufactured on or after September 1, 2009, and before September 1, 2012 (Phase-in of higher maximum speed (56 km/h (35 mph)) belted test requirement using 5th percentile adult female dummies).*

(a) For vehicles manufactured for sale in the United States on or after September 1, 2009, and before September 1, 2012, a percentage of the manufacturer's production, as specified in S14.6.1, shall meet the requirements specified in S15.1(b) (in addition to the other requirements specified in this standard).

(b) Manufacturers that sell two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2010, and before September 1, 2012, shall meet the requirements specified in S15.1(b) (in addition to the other requirements specified in this standard).

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S14.6.

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.6.

S14.6.1 *Phase-in schedule.*

S14.6.1.1 *Vehicles manufactured on or after September 1, 2009, and before September 1, 2010.* Subject to S14.6.2(a), for vehicles manufactured by a manufacturer on or after September 1, 2009, and before September 1, 2010, the amount of vehicles complying with S15.1(b) shall be not less than 35 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2009, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2007, and before September 1, 2010, or

(b) The manufacturer's production on or after September 1, 2009, and before September 1, 2010.

S14.6.1.2 *Vehicles manufactured on or after September 1, 2010, and before September 1, 2011.* Subject to S14.6.2(b), for

vehicles manufactured by a manufacturer on or after September 1, 2010, and before September 1, 2011, the amount of vehicles complying with S15.1(b) shall be not less than 65 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2010, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2008 and before September 1, 2011, or

(b) The manufacturer's production on or after September 1, 2010, and before September 1, 2011.

S14.6.1.3 *Vehicles manufactured on or after September 1, 2011, and before September 1, 2012.* Subject to S14.6.2(c), for vehicles manufactured by a manufacturer on or after September 1, 2011, and before September 1, 2012, the amount of vehicles complying with S15.1(b) shall be 100 percent of the manufacturer's production during that period.

S14.6.2 *Calculation of complying vehicles.*

(a) For the purposes of complying with S14.6.1.1, a manufacturer may count a vehicle if it is manufactured on or after September 1, 2008, but before September 1, 2010.

(b) For purposes of complying with S14.6.1.2, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2008, but before September 1, 2011, and

(2) Is not counted toward compliance with S14.6.1.1.

(c) For purposes of complying with S14.6.1.3, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2008, but before September 1, 2012, and

(2) Is not counted toward compliance with S14.6.1.1 or S14.6.1.2.

S14.6.3 *Vehicles produced by more than one manufacturer.*

S14.6.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.6.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S14.6.3.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S14.6.3.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.6.3.1.

S14.7 *Vehicles manufactured on or after September 1, 2012. (Higher maximum speed (56km/h (35 mph)) belted test requirement using 5th percentile adult female dummies*). Each vehicle shall meet the requirements specified in S15.1(b) (in addition to the other requirements specified in this standard). However, vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with part 567 of this chapter may comply with the requirements specified in S15.1(a) instead of S15.1(b), if they are manufactured before September 1, 2013.

S14.8 *Vehicles manufactured on or after September 1, 2025, and before September 1, 2026.* Vehicles manufactured on or after September 1, 2025, and before September 1, 2026, shall comply with S14.8.1 through S14.8.4 of this standard. At any time during the production year ending August 31, 2026, each manufacturer shall, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles by make, model and vehicle identification number that have been certified as complying with S19, S21, and S23 of this standard (in addition to the other requirements specified in this standard) when using the child restraint systems specified in appendix A–1 of this standard. The manufacturer's designation of a vehicle as meeting the requirements when using the child restraint systems in appendix A–1 of this standard is irrevocable.

S14.8.1 Subject to S14.8.2 of this standard, for vehicles manufactured on or after September 1, 2025, the number of vehicles certified as complying with S19, S21, and S23 of this standard when using the child restraint systems specified in appendix A–1 of this standard shall be not less than 40 percent of:

(a) The manufacturer's average annual production of vehicles subject to S19, S21, and S23 of this standard manufactured on or after September 1, 2022, and before September 1, 2025; or

(b) The manufacturer's production of vehicles subject to S19, S21, and S23 of this standard manufactured on or after September 1, 2025, and before September 1, 2026.

S14.8.2 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.8.1 of this standard, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as provided in S14.8.2(a) through (c) of this standard, subject to S14.8.3 of this standard.

(a) A vehicle which is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer which markets the vehicle.

(c) A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.8.2(a) or (b) of this standard.

S14.8.3 For the purposes of calculating average annual production of vehicle for each manufacturer and the number of vehicles by each manufacturer under S14.8.1 of this standard, each vehicle that is excluded from the requirement to test with child restraints listed in appendix A or A–1 of this standard is not counted.

S14.8.4 Until September 1, 2027, vehicles manufactured by a final-stage manufacturer or alterer may certify compliance with S19, S21, and S23 of this standard when using the child restraint systems specified in appendix A. Vehicles manufactured on or after September 1, 2027, by these manufacturers must be certified as complying with S19, S21, and S23 when using the child restraint systems specified in appendix A–1 of this standard.

S14.8.5 Until September 1, 2027, manufacturers selling fewer than 5,000 vehicles per year in the U.S. may certify their vehicles as complying with S19, S21, and S23 of this standard when using the child restraint systems specified in appendix A. Vehicles manufactured on or after September 1, 2027, by these manufacturers must be certified as complying with S19, S21, and S23 when using the child restraint systems specified in appendix A–1 of this standard.

S15 *Rigid barrier test requirements using 5th percentile adult female dummies.*

S15.1 *Belted Test.* (a) Each vehicle that is certified as complying with S14.1 or S14.2 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 when tested under S16.1(a)(1).

(b) Each vehicle that is certified as complying with S14.6 or S14.7 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 when tested under S16.1(a)(2).

S15.2 *Unbelted test.* Each vehicle that is certified as complying with S14 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 of this standard when the vehicle is crash tested in accordance with the procedures specified in S16.1(b) of this standard with the anthropomorphic test devices unbelted.

S15.3 *Injury criteria for the 49 CFR part 572, subpart O Hybrid III 5th percentile female test dummy.*

S15.3.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S15.3.2 *Head injury criteria.* (a) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the

head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} a_r\, dt\right]^{2.5}(t_2 - t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 700.

S15.3.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S15.3.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shown shall not exceed 52 mm (2.0 in).

S15.3.5 The force transmitted axially through each femur shall not exceed 6805 N (1530 lb).

S15.3.6 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: Tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S15.3.6(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 4287 N (964 lbf) when Fz is in tension

(ii) Fzc = 3880 N (872 lbf) when Fz is in compression

(iii) Myc = 155 Nm (114 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 67 Nm (49 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij = (Fz/Fzc) + (Mocy/Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 2620 N (589 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 2520 N (566 lbf) at any time.

S15.3.7 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR part 572, subpart O Hybrid III 5th percentile female test dummy.

S16. *Test procedures for rigid barrier test requirements using 5th percentile adult female dummies.*

S16.1 *General provisions.* Crash testing to determine compliance with the requirements of S15 of this standard is conducted as specified in the following paragraphs (a) and (b).

(a) *Belted test*—(1) *Vehicles certified to S14.1 or S14.2.* Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular within a tolerance of ±5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

(2) *Vehicles certified to S14.6 or S14.7.* Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of

a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 56km/h (35 mph), into a fixed rigid barrier that is perpendicular within a tolerance of ±5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

(b) *Unbelted test.* Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard, except S16.3.5. Impact the vehicle traveling longitudinally forward at any speed, from 32 km/h (20 mph) to 40 km/h (25 mph), inclusive, into a fixed rigid barrier that is perpendicular within a tolerance of ±5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

S16.2 *Test conditions.*

S16.2.1 The vehicle, including test devices and instrumentation, is loaded as in S8.1.1.

S16.2.2 Movable vehicle windows and vents are placed in the fully closed position, unless the vehicle manufacturer chooses to specify a different adjustment position prior to the time the vehicle is certified.

S16.2.3 Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S16.2.4 Doors are fully closed and latched but not locked.

S16.2.5 The dummy is clothed in form fitting cotton stretch garments with short sleeves and above the knee length pants. A size 7½ W shoe which meets the configuration and size specifications of MIL–S–21711E (incorporated by reference, see § 571.5) or its equivalent is placed on each foot of the test dummy.

S16.2.6 Limb joints are set at one g, barely restraining the weight of the limb when extended horizontally. Leg joints are adjusted with the torso in the supine position.

S16.2.7 Instrumentation shall not affect the motion of dummies during impact.

S16.2.8 The stabilized temperature of the dummy is at any level between 20.6 °C and 22.2 °C (69 °F to 72 °F).

S16.2.9 *Steering control adjustment.*

S16.2.9.1 Adjust a tiltable steering control, if possible, so that the steering control hub is at the geometric center of its full range of driving positions.

S16.2.9.2 If there is no setting detent at the mid-position, lower the steering control to the detent just below the mid-position.

S16.2.9.3 If the steering column is telescoping, place the steering column in the mid-position. If there is no mid-position, move the steering control rearward one position from the mid-position.

S16.2.10 *Front seat set-up.*

S16.2.10.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S16.2.10.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position any adjustable head restraint in the lowest and most forward position.

S16.2.10.3 *Seat position adjustment.* If the front right outboard passenger seat does not adjust independently of the front left outboard seat, the front left outboard seat shall control the final position of the front right outboard passenger seat. If an inboard passenger seat does not adjust independently of an outboard seat, the outboard seat shall control the final position of the inboard passenger seat.

S16.2.10.3.1 Using only the controls that primarily move the seat and seat cushion independent of the seat back in the fore and aft directions, move the seat cushion reference point (SCRP) to the rearmost position. Using any part of any control, other than those just used, determine the full range of angles of the seat cushion reference line and set the seat cushion reference line to the middle of the range. Using any part of any control other than those that primarily move the seat or seat cushion fore and aft, while maintaining the seat cushion reference line angle, place the SCRP to its lowest position.

S16.2.10.3.2 Using only the control that primarily moves the seat fore and aft, move the SCRP to the full forward position.

S16.2.10.3.3 If the seat or seat cushion height is adjustable, other than by the controls that primarily move the seat or seat cushion fore and aft, determine the maximum and minimum heights of the SCRP, while maintaining, as closely as possible, the angle determined in S16.2.10.3.1. Set the SCRP at the midpoint height with the seat cushion reference line angle set as closely as possible to the angle determined in S16.2.10.3.1. Mark location of the seat for future reference.

S16.3 *Dummy seating positioning procedures.* The 49 CFR Part 572 Subpart O 5th percentile adult female test dummy is positioned as follows:

S16.3.1 *General provisions and definitions.*

S16.3.1.1 All angles are measured with respect to the horizontal plane unless otherwise stated.

S16.3.1.2 The dummy's neck bracket is adjusted to align the zero degree index marks.

S16.3.1.3 The term ''midsagittal plane'' refers to the vertical plane that separates the dummy into equal left and right halves.

S16.3.1.4 The term ''vertical longitudinal plane'' refers to a vertical plane parallel to the vehicle's longitudinal centerline.

S16.3.1.5 The term ''vertical plane'' refers to a vertical plane, not necessarily parallel to the vehicle's longitudinal centerline.

S16.3.1.6 The term ''transverse instrumentation platform'' refers to the transverse instrumentation surface inside the dummy's skull casting to which the neck load cell mounts. This surface is perpendicular to the skull cap's machined inferior-superior mounting surface.

S16.3.1.7 The term ''thigh'' refers to the femur between, but not including, the knee and the pelvis.

S16.3.1.8 The term ''leg'' refers to the lower part of the entire leg, including the knee.

S16.3.1.9 The term ''foot'' refers to the foot, including the ankle.

S16.3.1.10 The longitudinal centerline of a bucket seat cushion is defined by a vertical plane that passes through the SgRP and is parallel to the longitudinal centerline of the vehicle.

S16.3.1.11 For leg and thigh angles, use the following references:

S16.3.1.11.1 *Thigh*—a straight line on the thigh skin between the center of the 1/2–13 UNC–2B tapped hole in the upper leg femur clamp (see drawings 880105–504 (left thigh) and 880105–505 (right thigh), upper leg femur clamp) and the knee pivot shoulder bolt (part 880105–527 in drawing 880105–528R & 528L, sliding knee assembly without potentiometer).

S16.3.1.11.2 *Leg*—a straight line on the leg skin between the center of the ankle shell (parts 880105–609 & 633 in drawing 880105–660, ankle assembly) and the knee pivot shoulder bolt (part 880105–527 in drawing 880105–528R & 528L, sliding knee assembly without potentiometer).

S16.3.1.12 The term ''seat cushion reference point'' (SCRP) means a point placed on the outboard side of the seat cushion at a horizontal distance between 150 mm (5.9 in) and 250 mm (9.8 in) from the front edge of the seat used as a guide in positioning the seat.

S16.3.1.13 The term ''seat cushion reference line'' means a line on the side of the seat cushion, passing through the seat cushion reference point, whose projection in the vehicle vertical longitudinal plane is straight and has a known angle with respect to the horizontal.

S16.3.2 *Driver dummy positioning.*

S16.3.2.1 *Driver torso/head/seat back angle positioning.*

S16.3.2.1.1 With the seat in the position determined in S16.2.10.3.3, use only the control that primarily moves the seat fore and aft to place the seat in the rearmost position. If the seat cushion reference line angle automatically changes as the seat is moved from the full forward position, maintain, as closely as possible, the seat cushion reference line angle determined in S16.2.10.3.1, for the final forward position when measuring the pelvic angle as specified in S16.3.2.1.11. The seat cushion reference angle position may be achieved through the use of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft.

S16.3.2.1.2 Fully recline the seat back, if adjustable. Install the dummy into the driver's seat, such that when the legs are positioned 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

S16.3.2.1.3 *Bucket seats.* Place the dummy on the seat cushion so that its midsagittal plane is vertical and coincides with the vertical longitudinal plane through the center of the seat cushion, within ±10 mm (±0.4 in).

S16.3.2.1.4 *Bench seats.* Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and aligned within ±10 mm (±0.4 in) of the center of the steering control.

S16.3.2.1.5 Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

S16.3.2.1.6 Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

S16.3.2.1.7 Gently rock the upper torso laterally in a side to side motion three times through a ±5 degree arc (approximately 51 mm (2 in) side to side).

S16.3.2.1.8 If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. Keeping the leg and the thigh in a vertical plane, place the foot in the vertical longitudinal plane that passes through the centerline of the accelerator pedal. Rotate the left thigh outboard about the hip until the center of the knee is the same distance from the midsagittal plane of the dummy as the right knee ±5 mm (±0.2 in). Using only the control that primarily moves the seat fore and aft, attempt to return the seat to the full forward position. If either of the dummy's legs first contacts the steering control, then adjust the steering control, if adjustable, upward until contact with the steering control is avoided. If the steering control is not adjustable, separate the knees enough to avoid steering control contact. Proceed with moving the seat forward until either the leg contacts the vehicle interior or the seat reaches the full forward position. (The right foot may contact and depress the accelerator and/or change the angle of the foot with respect to the leg during seat movement.) If necessary to avoid contact with the vehicles brake or clutch pedal, rotate the test dummy's left foot about the leg. If there is still interference, rotate the left thigh outboard about the hip the minimum distance necessary to avoid pedal interference. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seat is a power seat, move the seat fore and aft to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior. If the steering control was moved, return it to the position described in S16.2.9. If the steering control contacts the dummy's leg(s) prior to attaining this position, adjust it to the next higher detent, or if infinitely adjustable, until there is 5 mm (0.2 in) clearance between the control and the dummy's leg(s).

S16.3.2.1.9 For vehicles without adjustable seat backs, adjust the lower neck bracket to level the head as much as possible. For vehicles with adjustable seat backs, while holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform of the head is level to within ±0.5 degree, making sure that the pelvis does not interfere with the seat bight. Inspect the abdomen to ensure that it is properly installed. If the torso contacts the steering control, adjust the steering control in the following order until there is no contact: Telescoping adjustment, lowering adjustment, raising adjustment. If the vehicle has no adjustments, or contact with the steering control cannot be eliminated by adjustment, position the seat at the next detent where there is

no contact with the steering control as adjusted in S16.2.9. If the seat is a power seat, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the steering control as adjusted in S16.2.9 and the point of contact on the dummy.

S16.3.2.1.10 If it is not possible to achieve the head level within ±0.5 degrees, minimize the angle.

S16.3.2.1.11 Measure and set the dummy's pelvic angle using the pelvic angle gauge (drawing TE–2504, incorporated by reference in 49 CFR part 572, subpart O of this chapter). The angle shall be set to 20.0 degrees ±2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible by adjustments specified in S16.3.2.1.9 and S16.3.2.1.10.

S16.3.2.1.12 If the dummy is contacting the vehicle interior after these adjustments, using only the control that primarily moves the seat fore and aft, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments, the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forwardmost position, move the seat forward until the contact point is a maximum of 5 mm (0.2 in) from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position that causes no contact, or until the seat reaches its forwardmost position, whichever occurs first.

S16.3.2.2 *Driver foot positioning.*

S16.3.2.2.1 If the vehicle has an adjustable accelerator pedal, adjust it to the full forward position. If the heel of the right foot can contact the floor pan, follow the positioning procedure in (a). If not, follow the positioning procedure in (b).

(a) Rest the right foot of the test dummy on the undepressed accelerator pedal with the rearmost point of the heel on the floor pan in the plane of the pedal. If the foot cannot be placed on the accelerator pedal, set it initially perpendicular to the leg and then place it as far forward as possible in the direction of the pedal centerline with the rearmost point of the heel resting on the floor pan. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot. If the accelerator pedal in the full rearward position still does not touch the foot, leave the pedal in that position. Extend the foot and lower leg by decreasing the knee flexion angle until any part of the foot contacts the undepressed accelerator pedal. If the foot does not contact the pedal, place the highest part of the foot at the same height as the highest part of the pedal.

(b) Extend the foot and lower leg by decreasing the knee flexion angle until any part of the foot contacts the undepressed accelerator pedal or the highest part of the foot is at the same height as the highest part of the pedal. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot.

S16.3.2.2.2 If the ball of the right foot does not contact the pedal, increase the ankle plantar flexion angle such that the toe of the foot contacts or is as close as possible to contact with the undepressed accelerator pedal.

S16.3.2.2.3 If, in its final position, the heel is off of the vehicle floor, a spacer block must be used under the heel to support the final foot position (see figure 13). The surface of the block in contact with the heel must have an inclination of 30 degrees, measured from the horizontal, with the highest surface towards the rear of the vehicle.

S16.3.2.2.4 Place the left foot on the toe-board with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toe-board and floor pan.

S16.3.2.2.5 If the left foot cannot be positioned on the toe board, place the foot perpendicular to the lower leg centerline as far forward as possible with the heel resting on the floor pan.

S16.3.2.2.6 If the left foot does not contact the floor pan, place the foot

parallel to the floor and place the lower leg as perpendicular to the thigh as possible.

S16.3.2.2.7 When positioning the test dummy under S16.3.2.2.4, S16.3.2.2.5, and S16.2.2.6, avoid contact between the left foot of the test dummy and the vehicle's brake pedal, clutch pedal, wheel well projection, and foot rest. To avoid this contact, use the three foot position adjustments listed in paragraphs (a) through (c). The adjustment options are listed in priority order, with each subsequent option incorporating the previous. In making each adjustment, move the foot the minimum distance necessary to avoid contact. If it is not possible to avoid all prohibited foot contact, give priority to avoiding brake or clutch pedal contact.

(a) Rotate (abduction/adduction) the test dummy's left foot about the lower leg,

(b) Plantar flex the foot,

(c) Rotate the left leg about the hip in either an outboard or inboard direction.

S16.3.2.3 *Driver arm/hand positioning.*

S16.3.2.3.1 Place the dummy's upper arms adjacent to the torso with the arm centerlines as close to a vertical longitudinal plane as possible.

S16.3.2.3.2 Place the palms of the dummy in contact with the outer part of the steering control rim at its horizontal centerline with the thumbs over the steering control rim.

S16.3.2.3.3 If it is not possible to position the thumbs inside the steering control rim at its horizontal centerline, then position them above and as close to the horizontal centerline of the steering control rim as possible.

S16.3.2.3.4 Lightly tape the hands to the steering control rim so that if the hand of the test dummy is pushed upward by a force of not less than 9 N (2 lb) and not more than 22 N (5 lb), the tape releases the hand from the steering control rim.

S16.3.3 Front outboard *passenger dummy positioning.*

S16.3.3.1 Front outboard *passenger torso/head/seat back angle positioning.*

S16.3.3.1.1 With the seat at the midheight in the full forward position determined in S16.2.10.3.3, use only the control that primarily moves the seat fore and aft to place the seat in the rearmost position, without adjusting independent height controls. If the seat cushion reference line angle automatically changes as the seat is moved from the full forward position, maintain as closely as possible the seat cushion reference line angle in S16.2.10.3.1, for the final forward position when measuring the pelvic angle as specified in S16.3.3.1.11. The seat cushion reference line angle position may be achieved through the use of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft.

S16.3.3.1.2 Fully recline the seat back, if adjustable. Install the dummy into any front outboard passenger seat, such that when the legs are 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

S16.3.3.1.3 *Bucket seats.* Place the dummy on the seat cushion so that its midsagittal plane is vertical and coincides with the vertical longitudinal plane through the center of the seat cushion, within ±10 mm (±0.4 mm).

S16.3.3.1.4 *Bench seats.* Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the midsagittal plane of the driver dummy, if there is a driver's seating position. Otherwise, the midsagittal plane of any front outboard passenger dummy shall be vertical, parallel to the vehicle's longitudinal centerline, and pass, within ±10 mm (±0.4 in), through the seating reference point of the seat that it occupies.

S16.3.3.1.5 Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

S16.3.3.1.6 Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between

the back of the dummy's calves and the front of the seat cushion.

S16.3.3.1.7 Gently rock the upper torso laterally side to side three times through a ±5 degree arc (approximately 51 mm (2 in) side to side).

S16.3.3.1.8 If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. With the feet perpendicular to the legs, place the heels on the floor pan. If a heel will not contact the floor pan, place it as close to the floor pan as possible. Using only the control that primarily moves the seat fore and aft, attempt to return the seat to the full forward position. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seats are power seats, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior.

S16.3.3.1.9 For vehicles without adjustable seat backs, adjust the lower neck bracket to level the head as much as possible. For vehicles with adjustable seat backs, while holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform of the head is level to within ±0.5 degrees, making sure that the pelvis does not interfere with the seat bight. Inspect the abdomen to insure that it is properly installed.

S16.3.3.1.10 If it is not possible to orient the head level within ±0.5 degrees, minimize the angle.

S16.3.3.1.11 Measure and set the dummy's pelvic angle using the pelvic angle gauge (drawing TE–2504, incorporated by reference in 49 CFR Part 572, Subpart O, of this chapter). The angle shall be set to 20.0 degrees ±2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible, as specified in S16.3.3.1.9 and S16.3.3.1.10.

S16.3.3.1.12 If the dummy is contacting the vehicle interior after these adjustments, using only the control that primarily moves the seat fore and aft, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments, the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forwardmost position, move the seat forward until the contact point is a maximum of 5 mm (0.2 in) from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position that causes no contact, or until the seat reaches its forwardmost position, whichever occurs first.

S16.3.3.2 Front outboard *passenger foot positioning*.

S16.3.3.2.1 Place the passenger's feet flat on the toe board.

S16.3.3.2.2 If the feet cannot be placed flat on the toe board, set them perpendicular to the leg centerlines and place them as far forward as possible with the heels resting on the floor pan. If either foot does not contact the floor pan, place the foot parallel to the floor pan and place the lower leg as perpendicular to the thigh as possible.

S16.3.3.3 Front outboard *passenger arm/hand positioning*.

S16.3.3.3.1 Place the dummy's upper arms in contact with the seat back and the torso.

S16.3.3.3.2 Place the palms of the dummy in contact with the outside of the thighs.

S16.3.3.3.3 Place the little fingers in contact with the seat cushion.

S16.3.4 *Driver and front outboard passenger adjustable head restraints*.

S16.3.4.1 If the head restraint has an automatic adjustment, leave it where the system positions the restraint after the dummy is placed in the seat.

S16.3.4.2 Adjust each head restraint to its lowest position.

S16.3.4.3 Measure the vertical distance from the top most point of the head restraint to the bottom most point. Locate a horizontal plane through the midpoint of this distance. Adjust each head restraint vertically so that this horizontal plane is aligned with the center of gravity (CG) of the dummy head.

S16.3.4.3 If the above position is not attainable, move the vertical center of the head restraint to the closest detent below the center of the head CG.

S16.3.4.4 If the head restraint has a fore and aft adjustment, place the restraint in the forwardmost position or until contact with the head is made, whichever occurs first.

S16.3.5 *Driver and front outboard passenger manual belt adjustment (for tests conducted with a belted dummy)*

S16.3.5.1 If an adjustable seat belt D-ring anchorage exists, place it in the manufacturer's design position for a 5th percentile adult female with the seat in the position specified in S16.2.10.3.

S16.3.5.2 Place the Type 2 manual belt around the test dummy and fasten the latch.

S16.3.5.3 Ensure that the dummy's head remains as level as possible, as specified in S16.3.2.1.9 and S16.3.2.1.10 and S16.3.3.1.9 and S16.3.3.1.10.

S16.3.5.4 Remove all slack from the lap belt. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this operation four times. Apply a 9 N (2 lbf) to 18 N (4 lbf) tension load to the lap belt. If the belt system is equipped with a tension-relieving device, introduce the maximum amount of slack into the upper torso belt that is recommended by the manufacturer. If the belt system is not equipped with a tension-relieving device, allow the excess webbing in the shoulder belt to be retracted by the retractive force of the retractor.

S17 *Offset frontal deformable barrier requirements using 5th percentile adult female test dummies.* Each vehicle that is certified as complying with S14 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 of this standard when the vehicle is crash tested in accordance with the procedures specified in S18 of this standard with the anthropomorphic test devices restrained by a Type 2 seat belt assembly.

S18 *Test procedure for offset frontal deformable barrier requirements using 5th percentile adult female dummies.*

S18.1 *General provisions.* Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 40 km/h (25 mph), into a fixed offset deformable barrier under the conditions and procedures specified in S18.2 of this standard, impacting only the left side of the vehicle.

S18.2 *Test conditions.*

S18.2.1 *Offset frontal deformable barrier.* The offset frontal deformable barrier shall conform to the specifications set forth in Subpart C of part 587 of this chapter.

S18.2.2 *General test conditions.* All of the test conditions specified in S16.2 of this standard apply.

S18.2.3 *Dummy seating procedures.* Position the anthropomorphic test dummies as specified in S16.3 of this standard.

S18.2.4 *Impact configuration.* The test vehicle shall impact the barrier with the longitudinal centerline of the vehicle parallel to the line of travel and perpendicular to the barrier face within a tolerance of ±5 degrees. The test vehicle shall be aligned so that the vehicle strikes the barrier with 40 percent overlap on the left side of the vehicle, with the vehicle's front engaging the barrier face such that the vehicle's longitudinal centerline is offset outboard of the edge of the barrier face by 10 percent of the vehicle's width ±50 mm (2.0 in) as illustrated in Figure 10. The vehicle width is defined as the maximum dimension measured across the widest part of the vehicle, including bumpers and molding but excluding such components as exterior mirrors, flexible mud flaps, marker lamps, and dual rear wheel configurations.

S19 *Requirements to provide protection for infants in rear facing and convertible child restraints and car beds.*

S19.1 Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S19.2 or S19.3, under the test procedures specified in S20.

S19.2 *Option 1—Automatic suppression feature.* Each vehicle shall meet the requirements specified in S19.2.1 through S19.2.3.

S19.2.1 The vehicle shall be equipped with an automatic suppression feature

for any front outboard passenger air bag which results in deactivation of the air bag during each of the static tests specified in S20.2 (using the 49 CFR part 572 Subpart R 12-month-old CRABI child dummy in any of the child restraints identified in sections B and C of appendix A or A–1 of this standard, as appropriate and the 49 CFR part 572 subpart K Newborn Infant dummy in any of the car beds identified in section A of appendix A or A–1, as appropriate), and activation of the air bag system during each of the static tests specified in S20.3 (using the 49 CFR part 572 Subpart O 5th percentile adult female dummy).

S19.2.2 The vehicle shall be equipped with telltales for each front outboard passenger seat which emit light whenever the associated front outboard passenger air bag system is deactivated and does not emit light whenever the associated front outboard passenger air bag system is activated, except that the telltale(s) need not illuminate when the associated front outboard passenger seat is unoccupied. For telltales associated with multiple front outboard passenger seats, it shall be clearly recognizable to a driver and any front outboard passenger the seat with which seat each telltale is associated. Each telltale:

(a) Shall emit yellow light;

(b) Shall have the identifying words ''PASSENGER AIR BAG OFF'' or ''PASS AIR BAG OFF'' on the telltale or within 25 mm (1.0 in) of the telltale; and

(c) Shall not be combined with the readiness indicator required by S4.5.2 of this standard.

(d) Shall be located within the interior of the vehicle and forward of and above the design H-point of both the driver's and any front outboard passenger's seat in their forwardmost seating positions and shall not be located on or adjacent to a surface that can be used for temporary or permanent storage of objects that could obscure the telltale from either the driver's or any-front outboard passenger's view, or located where the telltale would be obscured from the driver's view or the adjacent front outboard passenger's view if a rear-facing child restraint listed in appendix A or A–1, as appropriate, is installed in any-front outboard passenger's seat.

(e) Shall be visible and recognizable to a driver and any front outboard passenger during night and day when the occupants have adapted to the ambient light roadway conditions.

(f) Telltales need not be visible or recognizable when not activated.

(g) Means shall be provided for making telltales visible and recognizable to the driver and any front outboard passenger under all driving conditions. The means for providing the required visibility may be adjustable manually or automatically, except that the telltales may not be adjustable under any driving conditions to a level that they become invisible or not recognizable to the driver and any front outboard passenger.

(h) The telltale must not emit light except when any passenger air bag is turned off or during a bulb check upon vehicle starting.

S19.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag system is suppressed, regardless of whether any front outboard passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S19.2.2.

S19.3 *Option 2—Low risk deployment.* Each vehicle shall meet the injury criteria specified in S19.4 of this standard when any front outboard passenger air bag is deployed in accordance with the procedures specified in S20.4.

S19.4 *Injury criteria for the 49 CFR part 572, Subpart R 12-month-old CRABI test dummy.*

S19.4.1 All portions of the test dummy and child restraint shall be contained within the outer surfaces of the vehicle passenger compartment.

S19.4.2 Head injury criteria.

(a) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5}(t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 390.

S19.4.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 50 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S19.4.4 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S19.4.4(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 1460 N (328 lbf) when Fz is in tension

(ii) Fzc = 1460 N (328 lbf) when Fz is in compression

(iii) Myc = 43 Nm (32 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 17 Nm (13 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij ' (Fz / Fzc) + (Mocy / Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 780 N (175 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 960 N (216 lbf) at any time.

S19.4.5 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR part 572 Subpart R 12-month-old CRABI test dummy.

S20 *Test procedure for S19.*

S20.1 *General provisions.*

S20.1.1 Tests specifying the use of a car bed, a rear facing child restraint, or a convertible child restraint may be conducted using any such restraint listed in sections A, B, and C, respectively, of appendix A or A–1 of this standard, as appropriate. The car bed, rear facing child restraint, or convertible child restraint may be unused or have been previously used only for automatic suppression tests. If it has been used, there shall not be any visible damage prior to the test.

S20.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with any front outboard passenger seating position, if adjustable fore and aft, at full rearward, middle, and full forward positions. If the child restraint or dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance, or if the seat is a power seat, using only the control that primarily moves the seat fore and aft, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance between the dummy or child restraint and the vehicle interior.

S20.1.3 If the car bed, rear facing child restraint, or convertible child restraint is equipped with a handle, the vehicle shall comply in tests conducted with the handle at both the child restraint manufacturer's recommended position for use in vehicles and in the upright position.

S20.1.4 If the car bed, rear facing child restraint, or convertible child restraint is equipped with a sunshield, the vehicle shall comply in tests conducted with the sunshield both fully open and fully closed.

S20.1.5 The vehicle shall comply in tests with the car bed, rear facing child restraint, or convertible child restraint uncovered and in tests with a towel or blanket weighing up to 1.0 kg (2.2 lb) placed on or over the restraint in any of the following positions:

(a) with the blanket covering the top and sides of the restraint, and

(b) with the blanket placed from the top of the vehicle's seat back to the forwardmost edge of the restraint.

S20.1.6 Except as otherwise specified, if the car bed, rear facing child restraint, or convertible child restraint has an anchorage system as specified in S5.9 of FMVSS No. 213 and is tested in a vehicle with a front outboard passenger vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply in the belted tests with the restraint anchorage system attached to the vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply in the belted test requirements with the restraint anchorage system unattached to the vehicle seat anchorage system and the vehicle seat belt attached. The vehicle shall comply in the unbelted tests with the restraint anchorage system unattached to the vehicle seat anchorage system.

S20.1.7 If the car bed, rear facing child restraint, or convertible child restraint comes equipped with a detachable base, the vehicle shall comply in tests conducted with the detachable base attached to the child restraint and with the detachable base unattached to the child restraint.

S20.1.8 Do not attach any tethers.

S20.1.9 *Seat set-up.* Unless otherwise stated.

S20.1.9.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S20.1.9.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.

S20.1.9.3 Set the seat and seat cushion in the position determined in S16.2.10.3.1.

S20.1.9.4 Using only the control that primarily moves the seat in the fore and aft direction, determine the full rearward, middle, and full forward positions of the SCRP. Using any part of any seat or seat cushion adjustments, other than that which primarily moves the seat or seat cushion fore-aft, determine the SCRP mid-point height for each of the three fore-aft test positions, while maintaining, as closely as possible, the seat cushion reference line middle angle determined in S16.2.10.3.1.

S20.1.9.5 The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3.

S20.1.9.6 If adjustable, set the head restraint at the full down and full forward position.

S20.1.10 The longitudinal centerline of a bucket seat cushion is defined by a vertical plane that passes through the SgRP and is parallel to the longitudinal centerline of the vehicle.

S20.2 *Static tests of automatic suppression feature which shall result in deactivation of any front outboard passenger air bag, associated with that designated seating position.* Each vehicle that is certified as complying with S19.2 shall meet the following test requirements.

S20.2.1 *Belted rear facing and convertible child restraints.*

S20.2.1.1 The vehicle shall comply in tests using any child restraint specified in section B and section C of appendix A or A–1 of this standard, as appropriate, installed in the front outboard passenger vehicle seat in the following orientations:

(a) With the section B and section C child restraints facing rearward as appropriate; and

(b) With the section C child restraints facing forward.

S20.2.1.2 The vehicle shall comply with the child restraint attached to the vehicle in the following manner:

(a) Using the vehicle safety belts as specified in S20.2.1.5; and

(b) If the child restraint is certified to S5.9 of § 571.213, and the vehicle seat has an anchorage system as specified in § 571.225, using only the mechanism provided by the child restraint manufacturer for attachment to the lower anchorages as specified in S20.2.1.6.

S20.2.1.3 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane A.''

S20.2.1.4 For bucket seats, ''Plane B'' refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of any front outboard passenger vehicle seat cushion. For bench seats in vehicles with manually operated driving controls, ''Plane B'' refers to a vertical plane through any front outboard passenger vehicle seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering control. For bench seats in vehicles without manually operated driving controls, ''Plane B'' refers to the vertical plane parallel to the vehicle longitudinal centerline, through any front outboard passenger seat's SgRP.

S20.2.1.5 *Installation with vehicle safety belts.*

(a) Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant.

(b) Without attaching the child restraint anchorage system components specified in S5.9 of § 571.213 to a vehicle child restraint anchorage system specified in § 571.225, align the child restraint system facing rearward or forward, depending on the orientation being tested, such that Plane A is aligned with Plane B.

(c) While maintaining the child restraint positions achieved in S20.2.1.5(b), secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint for the orientation being tested. Cinch the vehicle belts to any tension from zero up to 134 N to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

(d) Position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(e) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.1.6 *Installation using the lower anchor bars and the child restraint manufacturer provided attachment mechanism.*

S20.2.1.6.1 If the attachment mechanism provided by the manufacturer incorporates a strap(s), use the following procedure:

(a) Place the child restraint on the vehicle seat facing rearward or forward, depending on the orientation being tested, with Plane A of the child restraint aligned within ±10 mm with a longitudinal vertical plane passing though a point midway between the centers of the two lower anchor bars.

(b) Position any adjustments on the child restraint, to the extent possible according to the child restraint manufacturer's instructions.

(c) Connect the lower anchor straps of the restraint to the lower anchor bars of the seat and remove the slack, but do not apply any load using these straps.

(d) Move the child restraint rearward until it contacts the seat back.

(e) Use the loading device equipped with the loading foot shown in Figure A1 and position it as shown in Figure A2 of appendix A and appendix A–1 of this section. The 15±3 degree angle of the loading device illustrated in Figure A2 is determined with an initial preload of 75±25N.

(f) Over a period of 90±30 seconds, increase the load to 875N±25 N.

(g) After achieving the 875 N load in step (f) of this section, hold the bar length at present position and allow the load to settle for 60 seconds.

(h) Following the one-minute settling period specified in step (g) of this section, increase the load to 875±25 N such

that the 875±25 N load is achieved within 10 seconds of the settling period.

(i) Hold the bar length at present position and allow the load to settle for 120 seconds after achieving the load in step (f) of this section.

(j) Following the settling period specified in step (i) of this section, increase the load to 875±25 N such that the 875±25 N load is achieved within 10 seconds of the settling period.

(k) Observe the settling of the load and tighten the lower anchor straps when the load is 850±5N or 180 seconds has elapsed since achieving the 875±25 N load in step (f) of this section, whichever comes first. Tighten the lower anchor straps at the same time such that the load is reduced 15±10 N and the change occurs within 2 seconds.

(l) Remove the loading device and position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(m) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.1.6.2 If the mechanism provided by the manufacturer does not incorporate a strap(s), use the following procedure:

(a) Place the vehicle seat in the rearmost and mid-height position.

(b) Place the child restraint on the vehicle seat facing rearward or forward, depending on the orientation being tested, with Plane A of the child restraint aligned within ±10 mm with a longitudinal vertical plane passing though a point midway between the centers of the two lower anchor bars.

(c) Position any adjustments on the child restraint, to the extent possible, according to the child restraint manufacturer's instructions.

(d) Connect the lower anchor attachments to the lower anchor bars following, to the extent possible, the child restraint manufacturer's instructions.

(e) Move the child restraint rearward until it contacts the seat back.

(f) If the child restraint does not use a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, follow, to the extent possible, the CRS manufacturer's instructions for installing the child restraint onto the seat. Do not load the seat as provided in S20.2.1.6.2(g).

(g) If the child restraint uses a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, within 25±5 seconds, apply a 475±25N force, that has no lateral component, aligned angularly ±10 degrees with a parallel plane located within ±100 mm of the plane formed by the linear mechanism. Release the force.

(h) Position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(i) Move the vehicle seat to the seat position being tested (full rear, mid, full forward).

(j) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.2 *Unbelted rear facing and convertible child restraints.*

S20.2.2.1 The vehicle shall comply in tests using any child restraint specified in section B and section C of appendix A or A–1 of this standard, as appropriate.

S20.2.2.2 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane A''.

S20.2.2.3 For bucket seats, ''Plane B'' refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of any front outboard passenger vehicle seat cushion. For bench seats in vehicles with manually operated driving controls, ''Plane B'' refers to a vertical plane through any front outboard passenger seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering control. For bench seats in vehicles without manually operated driving controls, ''Plane B'' refers to the

vertical plane parallel to the vehicle longitudinal centerline, through any front outboard passenger seat's SgRP.

S20.2.2.4 *Facing rear.*

(a) Align the child restraint system facing rearward such that Plane A is aligned with Plane B and the child restraint is in contact with the seat back.

(b) Position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(c) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.2.5 *Facing forward.*

(a) Align the child restraint system facing forward such that Plane A is aligned with Plane B and the child restraint is in contact with the seat back.

(b) Position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(c) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.3 *Tests with a belted car bed.*

S20.2.3.1 The vehicle shall comply in tests using any car bed specified in section A of appendix A or A–1 of this standard, as appropriate.

S20.2.3.2 (a) Install the car bed following, to the extent possible, the car bed manufacturer's directions regarding proper installation of the car bed. If the seat belt cannot be secured around the car bed, move the seat rearward to the next detent that allows the belt to be secured around the car bed, or if the seat is a power seat, using only the control that primarily moves the seat fore and aft, move the seat rearward the minimum distance necessary for the seat belt to be secured around the car bed.

(b) Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to secure the car bed.

(c) Position the 49 CFR part 572 subpart K Newborn Infant dummy in the car bed by following, to the extent possible, the car bed manufacturer's instructions provided with the car bed for positioning infants.

(d) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.3 *Static tests of automatic suppression feature which shall result in activation of any front outboard passenger air bag system.*

S20.3.1 Each vehicle certified to this option shall comply in tests conducted with any front outboard passenger seating position, if adjustable fore and aft, at the mid-height, in the full rearward and middle positions determined in S20.1.9.4, and the forward position determined in S16.3.3.1.8.

S20.3.2 Place a 49 CFR part 572 subpart O 5th percentile adult female test dummy at any front outboard passenger seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S20.3.1, subject to the fore-aft seat positions in S20.3.1. Do not fasten the seat belt.

S20.3.3 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

S20.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S20.4 *Low risk deployment test.* Each vehicle that is certified as complying with S19.3 shall meet the following test requirements.

S20.4.1 Position any front outboard passenger vehicle seat at the mid-height in the full forward position determined in S20.1.9.4, and adjust the seat back (if adjustable independent of the seat) to the nominal design position for a 50th percentile adult male as specified in S8.1.3. Position adjustable lumbar supports so that the lumbar

support is in its lowest, retracted or deflated adjustment position. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint at the full down and most forward position. If the child restraint or dummy contacts the vehicle interior, do the following: Using only the control that primarily moves the seat in the fore and aft direction, move the seat rearward to the next detent that provides clearance; or if the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance.

S20.4.2 The vehicle shall comply in tests using any child restraint specified in section B and section C of appendix A or A–1 of this standard, as appropriate.

S20.4.3 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane A''.

S20.4.4 For bucket seats, ''Plane B'' refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of any front outboard passenger seat cushion. For bench seats in vehicles with manually operated driving controls, ''Plane B'' refers to a vertical plane through any front outboard passenger seat parallel to the vehicle longitudinal centerline that is the same distance from the longitudinal centerline of the vehicle as the center of the steering control. For bench seats in vehicles without manually operated driving controls, ''Plane B'' refers to the vertical plane parallel to the vehicle longitudinal centerline, through any front outboard passenger seat's SgRP.

S20.4.5 Align the child restraint system facing rearward such that Plane A is aligned with Plane B.

S20.4.6 If the child restraint is certified to S5.9 of §571.213, and the vehicle seat has an anchorage system as specified in §571.225, attach the child restraint to the vehicle seat anchorage as specified in S20.2.1.6. Do not attach the top tether of the child restraint system. Do not attach the vehicle safety belt.

S20.4.7 While maintaining the child restraint position achieved in S20.4.5, secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint in the rear facing mode. Place any adjustable seat belt anchorages at the manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to any tension from zero up to 134 N (30 lb) to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

S20.4.8 Position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

S20.4.9 Deploy any front outboard passenger frontal air bag system. If the air bag system contains a multistage inflator, the vehicle shall be able to comply at any stage or combination of stages or time delay between successive stages that could occur in the presence of an infant in a rear facing child restraint and a 49 CFR part 572, subpart R 12-month-old CRABI dummy positioned according to S20.4, and also with the seat at the mid-height, in the middle and full rearward positions determined in S20.1.9.4, in a rigid barrier crash test at speeds up to 64 km/h (40 mph).

S21 *Requirements using 3-year-old child dummies.*

S21.1 Each vehicle that is certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S21.2, S21.3, S21.4 or S21.5, under the test procedures specified in S22 or S28, as applicable.

S21.2 *Option 1—Automatic suppression feature.* Each vehicle shall meet the requirements specified in S21.2.1 through S21.2.3.

S21.2.1 The vehicle shall be equipped with an automatic suppression feature for any front outboard passenger air bag which results in deactivation of the air bag during each of the static tests specified in S22.2 (using the 49 CFR part 572 subpart P 3-year-old child

dummy and, as applicable, any child restraint specified in section C and section D of appendix A or A–1 of this standard, as appropriate), and activation of the air bag system during each of the static tests specified in S22.3 (using the 49 CFR part 572 subpart O 5th percentile adult female dummy).

S21.2.2 The vehicle shall be equipped with a telltale light meeting the requirements specified in S19.2.2.

S21.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag is suppressed, regardless of whether any front outboard passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S21.2.2.

S21.3 *Option 2—Dynamic automatic suppression system that suppresses the air bag when an occupant is out of position.* (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for any front outboard passenger air bag system which meets the requirements specified in S27.

S21.4 *Option 3—Low risk deployment.* Each vehicle shall meet the injury criteria specified in S21.5 of this standard when any front outboard passenger air bag is deployed in accordance with both of the low risk deployment test procedures specified in S22.4.

S21.5 *Injury criteria for the 49 CFR part 572, subpart P 3-year-old child test dummy.*

S21.5.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S21.5.2 *Head injury criteria.*

(a) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5}(t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 570.

S21.5.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 55 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S21.5.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shall not exceed 34 millimeters (1.3 in).

S21.5.5 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: Tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S21.5.5(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 2120 N (477 lbf) when Fz is in tension

(ii) Fzc = 2120 N (477 lbf) when Fz is in compression

(iii) Myc = 68 Nm (50 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 27 Nm (20 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be

considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij = (Fz / Fzc) + (Mocy / Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 1130 N (254 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 1380 N (310 lbf) at any time.

S21.5.6 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given in 49 CFR part 572 subpart P 3-year-old child test dummy.

S22 *Test procedure for S21.*

S22.1 *General provisions and definitions.*

S22.1.1 Tests specifying the use of a forward facing child restraint, including a booster seat where applicable, may be conducted using any such restraint listed in section C and section D of appendix A or A–1 of this standard, as appropriate. The child restraint may be unused or have been previously used only for automatic suppression tests. If it has been used, there shall not be any visible damage prior to the test. Booster seats are to be used in the manner appropriate for a 3-year-old child of the same height and weight as the 3-year-old child dummy.

S22.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with any front outboard passenger seating position at the mid-height, in the full rearward, middle, and the full forward positions determined in S22.1.7.4. If the dummy contacts the vehicle interior, using only the control that primarily moves the seat fore and aft, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance.

S22.1.3 Except as otherwise specified, if the child restraint has an anchorage system as specified in S5.9 of FMVSS No. 213 and is tested in a vehicle with any front outboard passenger vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply with the belted test conditions with the restraint anchorage system attached to the vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply with the belted test conditions with the restraint anchorage system unattached to the vehicle seat anchorage system and the vehicle seat belt attached.

S22.1.4 Do not attach any tethers.

S22.1.5 The definitions provided in S16.3.1 through S16.3.10 apply to the tests specified in S22.

S22.1.6 For leg and thigh angles use the following references:

(a) *Thigh*—a straight line on the thigh skin between the center of the 5/16 × ½ in. screw (part 9001024, item 10 in drawing 210–0000 sheet 2 of 7, complete assembly (HYB III 3 YR OLD)) and the knee bolt (part 210–5301 in drawing 210–5000–1 & –1, leg assembly).

(b) *Leg*—a straight line on the leg skin between the center of the ankle bolt (part 210–5701 in drawing 210–5000–1 & –2, leg assembly) and the knee bolt (part 210–5301 in drawing 210–5000–1 & –2, leg assembly).

S22.1.7 *Seat set-up.* Unless otherwise stated,

S22.1.7.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S22.1.7.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.

S22.1.7.3 Set the seat and seat cushion in the position determined in S16.2.10.3.1.

S22.1.7.4 Using only the control that primarily moves the seat in the fore and aft direction, determine the full rearward, middle, and full forward positions of the SCRP. Using any part of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft, determine the SCRP mid-point height for each of the three fore-aft test positions, while maintaining, as closely as

possible, the seat cushion reference line angle determined in S16.2.10.3.1.

S22.1.7.5 The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3.

S22.1.7.6 If adjustable, set the head restraint at the full down and full forward position.

S22.2 *Static tests of automatic suppression feature which shall result in deactivation of any front outboard passenger air bag, associated with that designated seating position.* Each vehicle that is certified as complying with S21.2 shall meet the following test requirements:

22.2.1 *Belted test with forward facing or booster seat child restraint*

S22.2.1.1 Install the restraint in any front outboard passenger vehicle seat in accordance, to the extent possible, with the child restraint manufacturer's instructions provided with the seat for use by children with the same height and weight as the 3-year-old child dummy.

S22.2.1.2 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane A''.

S22.2.1.3 For bucket seats, ''Plane B'' refers to a vertical longitudinal plane through the longitudinal centerline of the seat cushion of any front outboard passenger vehicle seat. For bench seats in vehicles with manually operated driving controls, ''Plane B'' refers to a vertical plane through any front outboard passenger vehicle seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering control. For bench seats in vehicles without manually operated driving controls, ''Plane B'' refers to the vertical plane parallel to the vehicle longitudinal centerline, through any front outboard passenger seat's SgRP.

S22.2.1.4 The vehicle shall comply with the child restraint belted to the vehicle in the following manner:

(a) Using the vehicle safety belts as specified in S22.2.1.5 with section C and section D child restraints of appendix A or A–1, as appropriate, of this section designed to be secured to the vehicle seat even when empty; and

(b) If the child restraint is certified to S5.9 of § 571.213, and the vehicle seat has an anchorage system as specified in § 571.225, using only the mechanism provided by the child restraint manufacturer for attachment to the lower anchorage as specified in S22.2.1.6.

S22.2.1.5 *Installation with vehicle safety belts.*

(a) Place any adjustable safety belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant.

(b) Without attaching the child restraint anchorage system components specified in S5.9 of § 571.213 to a vehicle child restraint anchorage system specified in § 571.225, align the child restraint system facing forward, such that Plane A is aligned with Plane B.

(c) While maintaining the child restraint positions achieved in S22.2.1.5(b), secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint. Cinch the vehicle belts to any tension from zero up to 134 N to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

S22.2.1.6 *Installation using the lower anchor bars and the attachment mechanism provided by the child restraint manufacturer.*

S22.2.1.6.1 If the mechanism provided by the manufacturer incorporates a strap(s), use the following procedure.

(a) Place the child restraint on the vehicle seat facing forward, with Plane A of the child restraint aligned within ±10 mm with a longitudinal vertical plane passing through a point midway between the centers of the two lower anchor bars.

(b) Position any adjustments on the child restraint, to the extent possible, according to the child restraint manufacturer's instructions.

(c) Connect the lower anchor straps to the lower anchor bars and remove most of the slack, but do not apply any load using these straps.

(d) Move the child restraint rearward until it contacts the seat back.

(e) Do not attach any top tethers.

(f) Use the loading device equipped with the loading foot shown in Figure A1 and position it as shown in Figure A2 of appendix A and appendix A–1 of this standard. The 15±3 degree angle of the loading device is determined with an initial preload of 75±25 N.

(g) Over a period of 90±30 seconds, increase the load to 875±25 N.

(h) After achieving the 875 N load in step (g) of this section, hold the bar length at the present position and allow the load to settle for 60 seconds.

(i) Following the one-minute settling period specified in step (h) of this section, increase the load to 875±25 N such that the 875±25 N load is achieved within 10 seconds of the settling period.

(j) Hold the bar length at present position and allow the load to settle for 120 seconds after achieving the load in step (g) of this section.

(k) Following the settling period specified in step (j) of this section, increase the load to 875±25 N such that the 875±25 N load is achieved within 10 seconds of the settling period.

(l) Observe the settling of the load and tighten the lower anchor straps when the load is 850±5N or 180 seconds has elapsed since achieving the 875±25 N load in step (g) of this section, whichever comes first. Tighten the lower anchor straps at the same time such that the load is reduced 15±10 N and the change occurs within 2 seconds.

(m) Remove the loading device.

S22.2.1.6.2 If the mechanism provided by the manufacturer does not incorporate a strap(s), use the following procedure.

(a) Place the vehicle seat in the rearmost and mid-height position.

(b) Place the child restraint on the vehicle seat facing forward with Plane A of the child restraint aligned within ±10 mm with a longitudinal vertical plane passing through a point midway between the centers of the two lower anchor bars.

(c) Position any adjustments on the child restraint, to the extent possible, according to the child restraint manufacturer's instructions.

(d) Connect the lower anchor attachments to the lower anchor bars following, to the extent possible, the child restraint manufacturer's instructions.

(e) Move the child restraint rearward until it contacts the seat back.

(f) Do not attach any top tethers.

(g) If the child restraint does not use a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, follow, to the extent possible, the manufacturer's instructions for installing the child restraint onto the seat. Do not load the seat as provided in S22.2.1.6.2(h).

(h) If the child restraint uses a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, within 25±5 seconds, apply a 475±25N force, that has no lateral component, aligned angularly ±10 degrees with a parallel plane located within ±100 mm of the plane formed by the linear mechanism. Release the force.

(i) Move the vehicle seat to the seat position being tested (full rear, mid, full forward).

S22.2.1.7 *Forward facing child restraint.*

S22.2.1.7.1 After installation of a forward facing child restraint, position the 49 CFR part 572 subpart P 3-year-old child dummy in the child restraint such that the dummy's lower torso is centered on the child restraint and the dummy's spine is against the seat back of the child restraint. Place the arms at the dummy's sides.

S22.2.1.7.2 Attach all belts that come with the child restraint that are appropriate for a child of the same height and weight as the 3-year-old child dummy, if any, by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating children.

S22.2.1.7.3 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.1.8 *Booster seat child restraint.*

S22.2.1.8.1 After installation of a booster seat child restraint, position the 49 CFR part 572 subpart P 3-year-old child dummy in the booster seat

such that the dummy's lower torso is centered on the booster seat cushion and the dummy's back is parallel to and in contact with the booster seat back or, if there is no booster seat back, the vehicle seat back. Place the arms at the dummy's sides.

S22.2.1.8.2 If applicable, attach all belts that come with the child restraint that are appropriate for a child of the same height and weight as the 3-year-old child dummy, if any, by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating children.

S22.2.1.8.3 If applicable, place the Type 2 manual belt around the test dummy and fasten the latch. Remove all slack from the lap belt portion. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this four times. Apply a 9 to 18 N (2 to 4 lb) tension load to the lap belt. Allow the excess webbing in the upper torso belt to be retracted by the retractive force of the retractor.

S22.2.1.8.4 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2 *Unbelted tests with dummies.* Place the 49 CFR part 572 subpart P 3-year-old child dummy on any front outboard passenger vehicle seat in any of the following positions (without using a child restraint or booster seat or the vehicle's seat belts):

S22.2.2.1 *Sitting on seat with back against seat back.*

(a) Place the dummy on any front outboard passenger seat.

(b) In the case of vehicles equipped with bench seats and with manually operated driving controls, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the center of the steering control. For bench seats in vehicles without manually operated driving controls, position the midsagittal plane of any front outboard dummy vertically and parallel to the vehicle's longitudinal centerline, within ±10 mm (±0.4 in) of the seating reference point of the seat that it occupies. In the case of vehicles equipped with bucket seats, position the midsagittal plane of any front outboard dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ±10 mm (±0.4 in). Position the torso of the dummy against the seat back. Position the dummy's thighs against the seat cushion.

(c) Allow the legs of the dummy to extend off the surface of the seat.

(d) Rotate the dummy's upper arms down until they contact the seat back.

(e) Rotate the dummy's lower arms until the dummy's hands contact the seat cushion.

(f) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(g) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.2 *Sitting on seat with back against reclined seat back.* Repeat the test sequence in S22.2.2.1 with the seat back angle 25 degrees rearward of the manufacturer's nominal design position for the 50th percentile adult male. If the seat will not recline 25 degrees rearward of the nominal design position, use the closest position that does not exceed 25 degrees.

S22.2.2.3 *Sitting on seat with back not against seat back.*

(a) Place the dummy on any front outboard passenger seat.

(b) In the case of vehicles equipped with bench seats and with manually operated driving controls, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the center of the steering control. For bench seats in vehicles without manually operated driving controls, position the midsagittal plane of any front outboard dummy vertically and parallel to the vehicle's longitudinal centerline, within ±10 mm (±0.4 in) of the seating reference point of the seat that it occupies. In the case of vehicles equipped with bucket seats, position the midsagittal plane of any front

outboard dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ±10 mm (±0.4 in). Position the dummy with the spine vertical so that the horizontal distance from the dummy's back to the seat back is no less than 25 mm (1.0 in) and no more than 150 mm (6.0 in), as measured along the dummy's midsagittal plane at the mid-sternum level. To keep the dummy in position, a material with a maximum breaking strength of 311 N (70 lb) may be used to hold the dummy.

(c) Position the dummy's thighs against the seat cushion.

(d) Allow the legs of the dummy to extend off the surface of the seat.

(e) Position the upper arms parallel to the spine and rotate the dummy's lower arms until the dummy's hands contact the seat cushion.

(f) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(g) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.4 *Sitting on seat edge, spine vertical, hands by the dummy's sides.*

(a) In the case of vehicles equipped with bench seats and with manually operated driving controls, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the center of the steering control. For bench seats in vehicles without manually operated driving controls, position the midsagittal plane of any front outboard dummy vertically and parallel to the vehicle's longitudinal centerline, within ±10 mm (±0.4 in) of the seating reference point of the seat that it occupies. In the case of vehicles equipped with bucket seats, position the midsagittal plane of any front outboard dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ±10 mm (±0.4 in).

(b) Position the dummy in the seated position forward in the seat such that the legs are vertical and the back of the legs rest against the front of the seat with the spine vertical. If the dummy's feet contact the floor pan, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan and the dummy spine vertical. To keep the dummy in position, a material with a maximum breaking strength of 311 N (70 lb) may be used to hold the dummy.

(c) Place the upper arms parallel to the spine.

(d) Lower the dummy's lower arms such that they contact the seat cushion.

(e) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(f) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.5 *Standing on seat, facing forward.*

(a) In the case of vehicles equipped with bench seats and with manually operated driving controls, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the center of the steering control rim. For bench seats in vehicles without manually operated driving controls, position the midsagittal plane of any front outboard dummy vertically and parallel to the vehicle's longitudinal centerline, within ±10 mm (±0.4 in) of the seating reference point of the seat that it occupies. In the case of vehicles equipped with bucket seats, position the midsagittal plane of any front outboard dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ±10 mm (±0.4 in). Position the dummy in a standing position on any front outboard passenger seat cushion facing the front of the vehicle while placing the heels of the dummy's feet in contact with the seat back.

(b) Rest the dummy against the seat back, with the arms parallel to the spine.

(c) If the head contacts the vehicle roof, recline the seat so that the head is no longer in contact with the vehicle roof, but allow no more than 5 mm (0.2 in) distance between the head and the roof. If the seat does not sufficiently

recline to allow clearance, omit the test.

(d) If necessary use a material with a maximum breaking strength of 311 N (70 lb) or spacer blocks to keep the dummy in position.

(e) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(f) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.6 *Kneeling on seat, facing forward.*

(a) In the case of vehicles equipped with bench seats and manually operated driving controls, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the center of the steering control. For bench seats in vehicles without manually operated driving controls, position the midsagittal plane of any front outboard dummy vertically and parallel to the vehicle's longitudinal centerline, within ±10 mm (±0.4 in) of the seating reference point of the seat that it occupies. In the case of vehicles equipped with bucket seats, position the midsagittal plane of any front outboard dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ±10 mm (±0.4 in).

(b) Position the dummy in a kneeling position in any front outboard passenger vehicle seat with the dummy facing the front of the vehicle with its toes at the intersection of the seat back and seat cushion. Position the dummy so that the spine is vertical. Push down on the legs so that they contact the seat as much as possible and then release. Place the arms parallel to the spine.

(c) If necessary use a material with a maximum breaking strength of 311 N (70 lb) or spacer blocks to keep the dummy in position.

(d) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(e) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.7 *Kneeling on seat, facing rearward.*

(a) In the case of vehicles equipped with bench seats and manually operated driving controls, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the center of the steering control. For bench seats in vehicles without manually operated driving controls, position the midsagittal plane of any front outboard dummy vertically and parallel to the vehicle's longitudinal centerline, within ±10 mm (±0.4 in) of the seating reference point of the seat that it occupies. In the case of vehicles equipped with bucket seats, position the midsagittal plane of any front outboard dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ±10 mm (±0.4 in).

(b) Position the dummy in a kneeling position in any front outboard passenger vehicle seat with the dummy facing the rear of the vehicle. Position the dummy such that the dummy's head and torso are in contact with the seat back. Push down on the legs so that they contact the seat as much as possible and then release. Place the arms parallel to the spine.

(c) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(d) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.8 *Lying on seat.* This test is performed only in vehicles with 3 designated front seating positions.

(a) Lay the dummy on any front outboard passenger vehicle seat such that the following criteria are met:

(1) The midsagittal plane of the dummy is horizontal,

(2) The dummy's spine is perpendicular to the vehicle's longitudinal axis,

(3) The dummy's arms are parallel to its spine,

(4) A plane passing through the two shoulder joints of the dummy is vertical,

(5) The anterior of the dummy is facing the vehicle front,

(6) The head of the dummy is positioned towards the nearest passenger door, and

(7) The horizontal distance from the topmost point of the dummy's head to the vehicle door is 50 to 100 mm (2–4 in).

(8) The dummy is as far back in the seat as possible.

(b) Rotate the thighs as much as possible toward the chest of the dummy and rotate the legs as much as possible against the thighs.

(c) Move the dummy's upper left arm parallel to the vehicle's transverse plane and the lower left arm 90 degrees to the upper arm. Rotate the lower left arm about the elbow joint and toward the dummy's head until movement is obstructed.

(d) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(e) Wait 10 seconds, then check whether the air bag is deactivated.

S22.3 *Static tests of automatic suppression feature which shall result in activation of any front outboard passenger air bag system.*

S22.3.1 Each vehicle certified to this option shall comply in tests conducted with any front outboard passenger seating position at the mid-height, in the full rearward, and middle positions determined in S22.1.7.4, and the forward position determined in S16.3.3.1.8.

S22.3.2 Place a 49 CFR part 572 subpart O 5th percentile adult female test dummy at any front outboard passenger seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S22.3.1. Do not fasten the seat belt.

S22.3.3 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

S22.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S22.4 *Low risk deployment tests.*

S22.4.1 Each vehicle that is certified as complying with S21.4 shall meet the following test requirements with the 49 CFR part 572, subpart P 3-year-old child dummy in both of the following positions: Position 1 (S22.4.2) and Position 2 (S22.4.3).

S22.4.1.1 Locate and mark a point on the front of the dummy's chest jacket on the midsagittal plane that is 114 mm (4.5 in) ±3 mm (±0.1 in) along the surface of the skin from the top of the skin at the neck line. This is referred to as ''Point 1.''

S22.4.1.2 Mark a point on the instrument panel that is longitudinally and transversely, as measured along the surface of the instrument panel, within ±6 mm (±0.2 in) of the point that is defined by the intersection of the instrument panel and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric center of the static fully inflated air bag.

S22.4.1.3 Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located in S22.4.1.2. This is referred to as ''Plane D.''

S22.4.1.4 Locate the horizontal plane through the point located in S22.4.1.2. This is referred to as ''Plane C.''

S22.4.2 *Position 1 (chest on instrument panel).*

S22.4.2.1 Set the seat and seat cushion in the positions determined in S16.2.10.3.1. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest and most forward position.

S22.4.2.2 Place the dummy in any front outboard passenger seat such that:

S22.4.2.2.1 The midsagittal plane is coincident with Plane D within ±10 mm (±0.4 in).

S22.4.2.2.2 The legs are initially vertical to the floor pan. The legs and thighs shall be adjusted to the extent

necessary for the head/torso to contact the instrument panel as specified in S22.4.2.3.

S22.4.2.2.3 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S22.4.2.3 Without changing the seat position and with the dummy's thorax instrument cavity rear face vertical, move the dummy forward until the dummy head/torso contacts the instrument panel. If the dummy loses contact with the seat cushion because of the forward movement, maintain the height of the dummy and the angle of the thigh with respect to the torso. Once contact is made, raise the dummy vertically until Point 1 lies in Plane C within ±10 mm (±0.4 in). If the dummy's head contacts the windshield and keeps Point 1 from reaching Plane C, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the head and the windshield. (The dummy shall remain in contact with the instrument panel while being raised or lowered, which may change the dummy's fore-aft position.)

S22.4.2.4 If possible, position the legs of the dummy so that the legs are vertical and the feet rest flat on the floor pan of the vehicle. If the positioning against the instrument panel does not allow the feet to be on the floor pan, the feet shall be parallel to the floor pan.

S22.4.2.5 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S22.4.3 *Position 2 (head on instrument panel).*

S22.4.3.1 Place any front outboard passenger seat at the mid-height, in full rearward seating position determined in S22.1.7.4. Place the seat back, if adjustable independent of the seat, at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest and most forward position.

S22.4.3.2 Place the dummy in any front outboard passenger seat such that:

S22.4.3.2.1 The midsagittal plane is coincident with Plane D within ±10 mm (±0.4 in).

S22.4.3.2.2 The legs are vertical to the floor pan, the back of the legs are in contact with the seat cushion, and the dummy's thorax instrument cavity rear face is vertical. If it is not possible to position the dummy with the legs in the prescribed position, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan, and the back of the legs are in contact with the front of the seat cushion. Set the transverse distance between the longitudinal centerlines at the front of the dummy's knees at 86 to 91 mm (3.4 to 3.6 in), with the thighs and the legs of the dummy in vertical planes.

S22.4.3.2.3 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S22.4.3.3 Using only the control that primarily moves the seat in the fore and aft direction, move the seat forward, while maintaining the thorax instrument cavity rear face orientation until any part of the dummy contacts the vehicle's instrument panel.

S22.4.3.4 If dummy contact has not been made with the vehicle's instrument panel at the full forward seating position of the seat, slide the dummy forward until contact is made. Maintain the thorax instrument cavity rear face vertical orientation. If the dummy loses contact with the seat, from that point forward, maintain the height of the dummy. Except as provided in S22.4.3.5, maintain the angle of the thigh with respect to the horizontal.

S22.4.3.5 If head/torso contact with the instrument panel has not been made, maintain the angle of the thighs with respect to the horizontal while applying a force towards the front of the vehicle on the spine of the dummy between the shoulder joints, perpendicular to the thorax instrument cavity rear face, until the head or torso comes into contact with the vehicle's

instrument panel or until a maximum force of 222 N (50 lb) is achieved. If the head/torso is still not in contact with the instrument panel, hold the femurs and release the 222 N (50 lb) force. While maintaining the relative angle between the torso and the femurs, roll the dummy forward on the seat cushion, without sliding, until head/torso contact with the instrument panel is achieved. If seat contact is lost prior to or during femur rotation out of the horizontal plane, constrain the dummy to rotate about the dummy H-point. If the dummy cannot be rolled forward on the seat due to contact of the dummy feet with the floor pan, extend the lower legs forward, at the knees, until floor pan contact is avoided.

S22.4.3.6 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S22.4.4 Deploy any front outboard passenger frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash test at or below 26 km/h (16 mph), under the test procedure specified in S22.5.

S22.5 *Test procedure for determining stages of air bag systems subject to low risk deployment (low speed crashes) test requirement.*

S22.5.1 The test described in S22.5.2 shall be conducted with an unbelted 50th percentile adult male test dummy in the driver's seating position according to S8 as it applies to that seating position and an unbelted 5th percentile adult female test dummy either in any front outboard passenger vehicle seating position according to S16 as it applies to that seating position or at any fore-aft seat position on any passenger side.

S22.5.2 Impact the vehicle traveling longitudinally forward at any speed, up to and including 26 km/h (16 mph) into a fixed rigid barrier that is perpendicular ±5 degrees to the line of travel of the vehicle under the applicable conditions of S8, S10, and S16 excluding S10.7, S10.8, S10.9, and S16.3.5.

S22.5.3 Determine which inflation stage or combination of stages are fired and determine the time delay between successive stages. That stage or combination of stages, with time delay between successive stages, shall be used in deploying the air bag when conducting the low risk deployment tests described in S22.4, S24.4, and S26.

S22.5.4 If the air bag does not deploy in the impact described in S22.5.2, the low risk deployment tests described in S22.4, S24.4, and S26 shall be conducted with all stages using the maximum time delay between stages.

S23 *Requirements using 6-year-old child dummies.*

S23.1 Each vehicle that is certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S23.2, S23.3, or S23.4, under the test procedures specified in S24 or S28, as applicable.

S23.2 *Option 1—Automatic suppression feature.* Each vehicle shall meet the requirements specified in S23.2.1 through S23.2.3.

S23.2.1 The vehicle shall be equipped with an automatic suppression feature for any front outboard passenger frontal air bag system which results in deactivation of the air bag during each of the static tests specified in S24.2 (using the 49 CFR part 572 subpart N 6-year-old child dummy in any of the child restraints specified in section D of appendix A or A–1 of this standard, as appropriate), and activation of the air bag system during each of the static tests specified in S24.3 (using the 49 CFR part 572 subpart O 5th percentile adult female dummy).

S23.2.2 The vehicle shall be equipped with a telltale light meeting the requirements specified in S19.2.2.

S23.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag is suppressed, regardless of whether any front outboard passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S23.2.2.

S23.3 *Option 2—Dynamic automatic suppression system that suppresses the air bag when an occupant is out of position.* (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for any front outboard passenger frontal air bag system which meets the requirements specified in S27.

S23.4 *Option 3—Low risk deployment.* Each vehicle shall meet the injury criteria specified in S23.5 of this standard when any front outboard passenger air bag is statically deployed in accordance with both of the low risk deployment test procedures specified in S24.4.

S23.5 *Injury criteria for the 49 CFR part 572 subpart N 6-year-old child dummy.*

S23.5.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S23.5.2 *Head injury criteria.*

(a) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5}(t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 700.

S23.5.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S23.5.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shall not exceed 40 mm (1.6 in).

S23.5.5 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S23.5.5(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 2800 N (629 lbf) when Fz is in tension

(ii) Fzc = 2800 N (629 lbf) when Fz is in compression

(iii) Myc = 93 Nm (69 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 37 Nm (27 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

$$Nij = (Fz / Fzc) + (Mocy / Myc)$$

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 1490 N (335 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 1820 N (409 lbf) at any time.

S23.5.6 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR part 572 subpart N 6-year-old child test dummy.

S24 *Test procedure for S23.*

S24.1 *General provisions and definitions.*

S24.1.1 Tests specifying the use of a booster seat may be conducted using any such restraint listed in section D of appendix A or A–1 of this standard, as appropriate. The booster seat may be unused or have been previously used only for automatic suppression tests. If it has been used, there shall not be any visible damage prior to the test. Booster seats are to be used in the manner appropriate for a 6-year-old child of the same height and weight as the 6-year-old child dummy.

S24.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with any front outboard passenger seating position at the mid-height, in the full rearward seat track position, the middle seat track position, and the full forward seat track position as determined in this section. Using only the control that primarily moves the seat in the fore and aft direction, determine the full rearward, middle, and full forward positions of the SCRP. Using any seat or seat cushion adjustments other than that which primarily moves the seat fore-aft, determine the SCRP midpoint height for each of the three fore-aft test positions, while maintaining as closely as possible, the seat cushion angle determined in S16.2.10.3.1. Set the seat back angle, if adjustable independent of the seat, at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. If the dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior.

S24.1.3 Except as otherwise specified, if the booster seat has an anchorage system as specified in S5.9 of FMVSS No. 213 and is used under this standard in testing a vehicle with any front outboard passenger vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply with the belted test conditions with the restraint anchorage system attached to the FMVSS No. 225 vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply with the belted test conditions with the restraint anchorage system unattached to the FMVSS No. 225 vehicle seat anchorage system and the vehicle seat belt attached. The vehicle shall comply with the unbelted test conditions with the restraint anchorage system unattached to the FMVSS No. 225 vehicle seat anchorage system.

S24.1.4 Do not attach any tethers.

S24.1.5 The definitions provided in S16.3.1 through S16.3.10 apply to the tests specified in S24.

S24.1.6 For leg and thigh angles, use the following references:

S24.1.6.1 *Thigh*—a straight line on the thigh skin between the center of the 5/16–18 UNC–2B threaded access hole in the upper leg clamp (drawing 127–4004, 6 YR H3—upper leg clamp) and the knee screw (part 9000248 in drawing 127–4000–1 & –2, leg assembly).

S24.1.6.2 *Leg*—a straight line on the leg skin between the center of the lower leg screw (part 9001170 in drawing 127–4000–1 & –2, leg assembly) and the knee screw (part 9000248 in drawing 127–4000–1 & –2, leg assembly).

S24.2 *Static tests of automatic suppression feature which shall result in deactivation of any passenger air bag, associated with that designated seating position.* Each vehicle that is certified as complying with S23.2 of FMVSS No. 208 shall meet the following test requirements with the child restraint in any front outboard passenger vehicle seat under the following conditions:

(a) Using the vehicle safety belts as specified in S22.2.1.5 with section D child restraints designed to be secured to the vehicle seat even when empty;

(b) If the child restraint is certified to S5.9 of § 571.213, and the vehicle seat has an anchorage system as specified in § 571.225, using only the mechanism provided by the child restraint manufacturer for attachment to the lower anchorage as specified in S22.2.1.6; and

(c) Without securing the child restraint with either the vehicle safety belts or any mechanism provided with a child restraint certified to S5.9 of § 571.213.

S24.2.1 Except as provided in S24.2.2, conduct all tests as specified in S22.2, except that the 49 CFR part 572 subpart

N 6-year-old child dummy shall be used.

S24.2.2 *Exceptions.* The tests specified in the following paragraphs of S22.2 need not be conducted: S22.2.1.7, S22.2.2.3, S22.2.2.5, S22.2.2.6, S22.2.2.7, and S22.2.2.8.

S24.2.3 *Sitting back in the seat and leaning on any front outboard passenger door.*

(a) Place the dummy in the seated position in any front outboard passenger vehicle seat. For bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ±10 mm (±0.4 in). For bench seats in vehicles with manually operated driving controls, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the longitudinal centerline of the vehicle, within ±10 mm (±0.4 in), as the center of rotation of the steering control. For bench seats in vehicles without manually operated driving controls, position the midsagittal plane of any front outboard dummy vertically and parallel to the vehicle's longitudinal centerline, within ±10 mm (±0.4 in) of the seating reference point of the seat that it occupies.

(b) Place the dummy's back against the seat back and rest the dummy's thighs on the seat cushion.

(c) Allow the legs and feet of the dummy to extend off the surface of the seat. If this positioning of the dummy's legs is prevented by contact with the instrument panel, using only the control that primarily moves the seat fore and aft, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward, while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the part of the dummy that was in contact with the vehicle interior.

(d) Rotate the dummy's upper arms toward the seat back until they make contact.

(e) Rotate the dummy's lower arms down until they contact the seat.

(f) Close the vehicle's passenger-side door and then start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system.

(g) Push against the dummy's left shoulder to lean the dummy against the door; close all remaining doors.

(h) Wait ten seconds, then check whether the air bag is deactivated.

S24.3 *Static tests of automatic suppression feature which shall result in activation of any front outboard passenger air bag system.*

S24.3.1 Each vehicle certified to this option shall comply in tests conducted with any front outboard passenger seating position at the mid-height, in the full rearward and middle positions determined in S24.1.2, and the forward position determined in S16.3.3.1.8.

S24.3.2 Place a 49 CFR part 572 subpart O 5th percentile adult female test dummy at any front outboard passenger seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S24.3.1. Do not fasten the seat belt.

S24.3.3 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

S24.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S24.4 *Low risk deployment tests.*

S24.4.1 Each vehicle that is certified as complying with S23.4 shall meet the following test requirements with the 49 CFR part 572, subpart N 6-year-old child dummy in both of the following positions: Position 1 (S24.4.2) or Position 2 (S24.4.3).

S24.4.1.1 Locate and mark a point on the front of the dummy's chest jacket on the midsagittal plane that is 139 mm (5.5 in) ±3 mm (±0.1in) along the surface of the skin from the top of the skin at the neckline. This is referred to as ''Point 1.''

S24.4.1.2 Mark a point on the instrument panel that is longitudinally and transversely, as measured along the surface of the instrument panel, within ±6 mm (±0.2 in) of the point that is defined by the intersection of the instrument panel and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric

center of the static fully inflated air bag.

S22.4.1.3 Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located in S24.4.1.2. This is referred to as ''Plane D.''

S24.4.1.4 Locate the horizontal plane through the point located in S24.4.1.2. This is referred to as ''Plane C.''

S24.4.2 *Position 1 (chest on instrument panel).*

S24.4.2.1 Set the seat and seat cushion in the positions determined in S16.2.10.3.1. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest and most forward position.

S24.4.2.2 Remove the legs of the dummy at the pelvic interface.

S24.4.2.3 Place the dummy in any front outboard passenger seat such that:

(a) The midsagittal plane is coincident with Plane D within ±10 mm (±0.4 in).

(b) The upper arms are parallel to the torso and the hands are next to where the thighs would be.

(c) Without changing the seat position and with the dummy's thorax instrument cavity rear face 6 degrees forward of the vertical, move the dummy forward until the dummy head/torso contacts the instrument panel. If the dummy loses contact with the seat cushion because of the forward movement, maintain the height of the dummy while moving the dummy forward. If the head contacts the windshield before head/torso contact with the instrument panel, maintain the thorax instrument cavity angle and move the dummy forward such that the head is following the angle of the windshield until there is head/torso contact with the instrument panel. Once contact is made, raise or lower the dummy vertically until Point 1 lies in Plane C within ±10 mm (±0.4 in). If the dummy's head contacts the windshield and keeps Point 1 from reaching Plane C, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the head and the windshield. (The dummy shall remain in contact with the instrument panel while being raised or lowered which may change the dummy's fore-aft position.)

S24.4.2.4 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S24.4.3 *Position 2 (head on instrument panel).*

S24.4.3.1 Place any front outboard passenger seat at the mid-height full rearward seating position determined in S24.1.2. Place the seat back, if adjustable independent of the seat, at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest and most forward position.

S24.4.3.2 Place the dummy in any front outboard passenger seat such that:

(a) The midsagittal plane is coincident with Plane D within ±10 mm (±0.4 in).

(b) The legs are perpendicular to the floor pan, the back of the legs are in contact with the seat cushion, and the dummy's thorax instrument cavity rear face is 6 degrees forward of vertical. If it is not possible to position the dummy with the legs in the prescribed position, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan and the back of the legs are in contact with the front of the seat cushion. Set the transverse distance between the longitudinal centerlines at the front of the dummy's knees at 112 to 117 mm (4.4 to 4.6 in), with the thighs and the legs of the dummy in vertical planes.

(c) The upper arms are parallel to the torso and the hands are in contact with the thighs.

S24.4.3.3 Using only the control that primarily moves the seat in the fore and aft direction, move the seat forward, while maintaining the thorax instrument cavity rear face orientation until any part of the dummy contacts the vehicle's instrument panel.

S24.4.3.4 If dummy contact has not been made with the vehicle's instrument panel at the full forward seating position of the seat, slide the dummy forward on the seat until contact is made. Maintain the thorax instrument cavity rear face orientation. If the dummy loses contact with the seat, from that point forward maintain the height of the dummy. Except as provided in S24.4.3.5, maintain the angle of the thigh with respect to the horizontal.

S24.4.3.5 If head/torso contact with the instrument panel has not been made, maintain the angle of the thighs with respect to the horizontal while applying a force towards the front of the vehicle on the spine of the dummy between the shoulder joints, perpendicular to the thorax instrument cavity rear face, until the head or torso comes into contact with the vehicle's instrument panel or until a maximum force of 222 N (50 lb) is achieved. If the head/torso is still not in contact with the instrument panel, hold the femurs and release the 222 N (50 lb) force. While maintaining the relative angle between the torso and the femurs, roll the dummy forward on the seat cushion, without sliding, until head/torso contact with the instrument panel is achieved. If seat contact is lost prior to or during femur rotation out of the horizontal plane, constrain the dummy to rotate about the dummy H-point. If the dummy cannot be rolled forward on the seat due to contact of the dummy feet with the floor pan, extend the lower legs forward, at the knees, until floor pan contact is avoided.

S24.4.3.6 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S24.4.4 Deploy any front outboard passenger frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash test at or below 26 km/h (16 mph), under the test procedure specified in S22.5.

S25 *Requirements using an out-of-position 5th percentile adult female dummy at the driver position.*

S25.1 Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S25.2 or S25.3 under the test procedures specified in S26 or S28, as appropriate.

S25.2 *Option 1—Dynamic automatic suppression system that suppresses the air bag when the driver is out of position.* (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for the driver air bag which meets the requirements specified in S27.

S25.3 *Option 2—Low risk deployment.* Each vehicle shall meet the injury criteria specified by S15.3 of this standard, except as modified in S25.4, when the driver air bag is statically deployed in accordance with both of the low risk deployment test procedures specified in S26.

S25.4 *Neck injury criteria driver low risk deployment tests.* When measuring neck injury in low risk deployment tests for the driver position, each of the following neck injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S25.4(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 3880 N (872 lbf) when Fz is in tension

(ii) Fzc = 3880 N (872 lbf) when Fz is in compression

(iii) Myc = 155 Nm (114 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 61 Nm (45 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

$$Nij = (Fz / Fzc) + (Mocy / Myc)$$

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 2070 N (465 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 2520 N (566 lbf) at any time.

(d) Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given in 49 CFR part 572 subpart O 5th percentile female test dummy.

S26 *Procedure for low risk deployment tests of driver air bag.*

S26.1 Each vehicle that is certified as complying with S25.3 shall meet the requirements of S25.3 and S25.4 with the 49 CFR part 572 subpart O 5th percentile adult female dummy in both of the following positions: Driver position 1 (S26.2) and Driver position 2 (S26.3).

S26.2 *Driver position 1 (chin on module).*

S26.2.1 Adjust the steering controls so that the steering control hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If there is no setting at the geometric center, position it one setting lower than the geometric center. Set the rotation of the steering control so that the vehicle wheels are pointed straight ahead.

S26.2.2 Mark a point on the steering control cover that is longitudinally and transversely, as measured along the surface of the steering control cover, within ±6 mm (±0.2 in) of the point that is defined by the intersection of the steering control cover and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric center of the static fully inflated air bag. Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located on the steering control cover. This is referred to as ''Plane E.''

S26.2.3 Place the seat and seat cushion in the position achieved in S16.2.10.3.1. If the seat or seat cushion is adjustable in the vertical direction by adjustments other than that which primarily moves the seat or seat cushion fore-aft, determine the maximum and minimum heights of the SCRP at this position, while maintaining the seat cushion reference line angle as closely as possible. Place the SCRP in the mid-height position. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest and most forward position.

S26.2.4 Place the dummy in the driver's seat such that:

S26.2.4.1 The midsagittal plane is coincident with Plane E within ±10 mm (±0.4 in).

S26.2.4.2 The legs are perpendicular to the floor pan and the back of the

legs are in contact with the seat cushion. The legs may be adjusted if necessary to achieve the final head position.

S26.2.4.3 The dummy's thorax instrument cavity rear face is 6 degrees forward (toward the front of the vehicle) of the steering control angle (*i.e.*, if the steering control angle is 25 degrees from vertical, the thorax instrument cavity rear face angle is 31 degrees).

S26.2.4.4 The initial transverse distance between the longitudinal centerlines at the front of the dummy's knees is 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes.

S26.2.4.5 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S26.2.5 Maintaining the spine angle, slide the dummy forward until the head/torso contacts the steering control.

S26.2.6 While maintaining the spine angle, adjust the height of the dummy so that the bottom of the chin is in the same horizontal plane as the highest point of the air bag module cover (dummy height can be adjusted using the seat height adjustments and/or spacer blocks). If the seat prevents the bottom of the chin from being in the same horizontal plane as the module cover, adjust the dummy height to as close to the prescribed position as possible.

S26.2.7 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S26.3 *Driver position 2 (chin on rim).*

S26.3.1 Place the seat and seat cushion in the position achieved in S16.2.10.3.1. If the seat or seat cushion is adjustable in the vertical direction by adjustments other than that which primarily moves the seat or seat cushion fore-aft, determine the maximum and minimum heights of the SCRP at this position, while maintaining the seat cushion reference line angle as closely as possible. Place the SCRP in the mid-height position. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest position.

S26.3.2 Adjust the steering controls so that the steering control hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If there is no setting at the geometric center, position it one setting lower than the geometric center. Set the rotation of the steering control so that the vehicle wheels are pointed straight ahead.

S26.3.3 Mark a point on the steering control cover that is longitudinally and transversely, as measured along the surface of the steering control cover, within ±6 mm (±0.2 in) of the point that is defined by the intersection of the steering control cover and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric center of the static fully inflated air bag. Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located on the steering control cover. This is referred to as ''Plane E.''

S26.3.4 Place the dummy in the driver's seat position such that:

S26.3.4.1 The midsagittal plane is coincident with Plane E within ±10 mm (±0.4 in).

S26.3.4.2 The legs are perpendicular to the floor pan and the back of the legs are in contact with the seat cushion. The legs may be adjusted if necessary to achieve the final head position.

S26.3.4.3 The dummy's thorax instrument cavity rear face is 6 degrees forward (toward the front of the vehicle) of the steering control angle (*i.e.*, if the steering control angle is 25 degrees from vertical, the thorax instrument cavity rear face angle is 31 degrees).

S26.3.4.4 The initial transverse distance between the longitudinal centerlines at the front of the dummy's

knees is 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes.

S26.3.4.5 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S26.3.5 Maintaining the spine angle, slide the dummy forward until the head/torso contacts the steering control.

S26.3.6 While maintaining the spine angle, position the dummy so that a point on the chin 40 mm (1.6 in) ±3 mm (±0.1 in) below the center of the mouth (chin point) is, within ±10 mm (±0.4 in), in contact with a point on the steering control rim surface closest to the dummy that is 10 mm (0.4 in) vertically below the highest point on the rim in Plane E. If the dummy's head contacts the vehicle windshield or upper interior before the prescribed position can be obtained, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the vehicle's windshield or upper interior, as applicable.

S26.3.7 If the steering control can be adjusted so that the chin point can be in contact with the rim of the uppermost portion of the steering control, adjust the steering control to that position. If the steering control contacts the dummy's leg(s) prior to attaining this position, adjust it to the next highest detent, or if infinitely adjustable, until there is a maximum of 5 mm (0.2 in) clearance between the control and the dummy's leg(s). Readjust the dummy's torso such that the thorax instrument cavity rear face is 6 degrees forward of the steering control angle. Position the dummy so that the chin point is in contact, or if contact is not achieved, as close as possible to contact with the rim of the uppermost portion of the steering control.

S26.3.8 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S26.4 Deploy the driver frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash test at or below 26 km/h (16 mph), under the test procedure specified in S22.5.

S27 *Option for dynamic automatic suppression system that suppresses the air bag when an occupant is out-of-position.*

S27.1 *Availability of option.* This option is available for either air bag, singly or in conjunction, subject to the requirements of S27, if:

(a) A petition for rulemaking to establish dynamic automatic suppression system test procedures is submitted pursuant to subpart B of part 552 and a test procedure applicable to the vehicle is added to S28 pursuant to the procedures specified by that subpart, or

(b) A test procedure applicable to the vehicle is otherwise added to S28.

S27.2 *Definitions.* For purposes of S27 and S28, the following definitions apply:

Automatic suppression zone or ASZ means a three-dimensional zone adjacent to the air bag cover, specified by the vehicle manufacturer, where the deployment of the air bag will be suppressed by the DASS if a vehicle occupant enters the zone under specified conditions.

Dynamic automatic suppression system or DASS means a portion of an air bag system that automatically controls whether or not the air bag deploys during a crash by:

(1) Sensing the location of an occupant, moving or still, in relation to the air bag;

(2) Interpreting the occupant characteristics and location information to determine whether or not the air bag should deploy; and

(3) Activating or suppressing the air bag system based on the interpretation of occupant characteristics and location information.

S27.3 *Requirements.* Each vehicle shall, at each applicable front outboard designated seating position, when tested under the conditions of S28 of this standard, comply with the requirements specified in S27.4 through S27.6.

S27.4 Each vehicle shall be equipped with a DASS.

S27.5 *Static test requirement (low risk deployment for occupants outside the ASZ).*

S27.5.1 *Driver (49 CFR part 572 subpart O 5th percentile female dummy).* Each vehicle shall meet the injury criteria specified in S15.3 of this standard when the driver air bag is deployed in accordance with the procedures specified in S28.1.

S27.5.2 Front outboard *passenger (49 CFR part 572 subpart P 3-year-old child dummy and 49 CFR part 572 subpart N 6-year-old child dummy).* Each vehicle shall meet the injury criteria specified in S21.5 and S23.5, as appropriate, when any front outboard passenger air bag is deployed in accordance with the procedures specified in S28.2.

S27.6 *Dynamic test requirement (suppression of air bag for occupants inside the ASZ).*

S27.6.1 *Driver.* The DASS shall suppress the driver air bag before the head, neck, or torso of the specified test device enters the ASZ when the vehicle is tested under the procedures specified in S28.3.

S27.6.2 Front outboard *passenger.* The DASS shall suppress any front outboard passenger air bag before head, neck, or torso of the specified test device enters the ASZ when the vehicle is tested under the procedures specified in S28.4.

S28 *Test procedure for S27 of this standard.* [Reserved]

S28.1 *Driver suppression zone verification test (49 CFR part 572 Subpart O 5th percentile female dummy).* [Reserved]

S28.2 Front outboard *passenger suppression zone verification test (49 CFR part 572 subpart P 3-year-old child dummy and 49 CFR part 572 subpart N 6-year-old child dummies).* [Reserved]

S28.3 *Driver dynamic test procedure for DASS requirements.* [Reserved]

S28.4 Front outboard *passenger dynamic test procedure for DASS requirements.* [Reserved]

S29 *Manufacturer option to certify vehicles to certain static suppression test requirements using human beings rather than test dummies.*

S29.1 At the option of the manufacturer, instead of using test dummies in conducting the tests for the following automatic suppression and occupant recognition parts of the low risk deployment test requirements, human beings may be used as specified. If human beings are used, they shall assume, to the extent possible, the final physical position specified for the corresponding dummies for each test.

(a) If a manufacturer decides to certify a vehicle using a human being for a test of the passenger automatic suppression, it shall use humans for the entire series of tests, e.g., 3-year-old children for each test of the system involving 3-year-old test dummies. If a manufacturer decides to certify a vehicle using a test dummy for a test of the system, it shall use test dummies for the entire series of tests, e.g., a Hybrid III 3-year-old child dummy for each test of the system involving 3-year-old child test dummies.

(b) For S19.2, instead of using the 49 CFR part 572 subpart R 12-month-old child dummy, a human child who weighs between 8.2 and 9.1 kg (18 and 20 lb), and who is between 61 and 66 cm (24 and 26 in) tall may be used.

(c) For S19.2, instead of using the 49 CFR part 572 subpart K newborn infant dummy, a human child who weighs between 8.2 and 9.1 kg (18 and 20 lb), and who is between 61 and 66 cm (24 and 26 in) tall may be used.

(d) For S21.2 and S21.5.1, instead of using the 49 CFR part 572 subpart P 3-year-old child dummy, a human child who weighs between 13.4 and 18 kg (29.5 and 39.5 lb), and who is between 89 and 99 cm (35 and 39 in) tall may be used.

(e) For S23.2 and S23.5.1, instead of using the 49 CFR part 572 subpart N 6-year-old child dummy, a human child who weighs between 21 and 25.6 kg (46.5 and 56.5 lb), and who is between 114 and 124.5 cm (45 and 49 in) tall may be used.

(f) For S19.2, S21.2, and S23.2, instead of using the 49 CFR part 572 subpart O 5th percentile adult female test dummy, a female who weighs between 46.7 and 51.25 kg (103 and 113 lb), and who is between 139.7 and 150 cm (55 and 59 in) tall may be used.

S29.2 Human beings shall be dressed in a cotton T-shirt, full length cotton trousers, and sneakers. Specified weights and heights include clothing.

S29.3 A manufacturer exercising this option shall upon request:

(a) Provide NHTSA with a method to deactivate the air bag during compliance testing under S20.2, S20.3, S22.2, S22.3, S24.2, and S24.3, and identify any parts or equipment necessary for deactivation; such assurance may be made by removing the air bag; and

(b) Provide NHTSA with a method to assure that the same test results would be obtained if the air bag were not deactivated.

FIGURES TO §571.208

Figure 1. [Reserved]

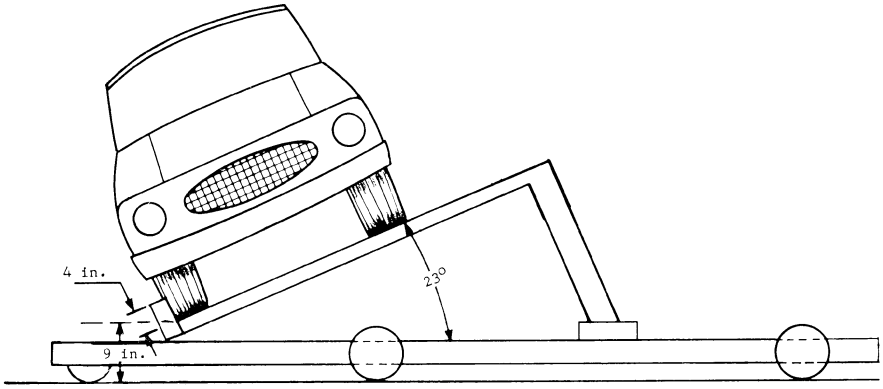


FIGURE 2 - TYPICAL DEVICE FOR ROLLOVER TEST

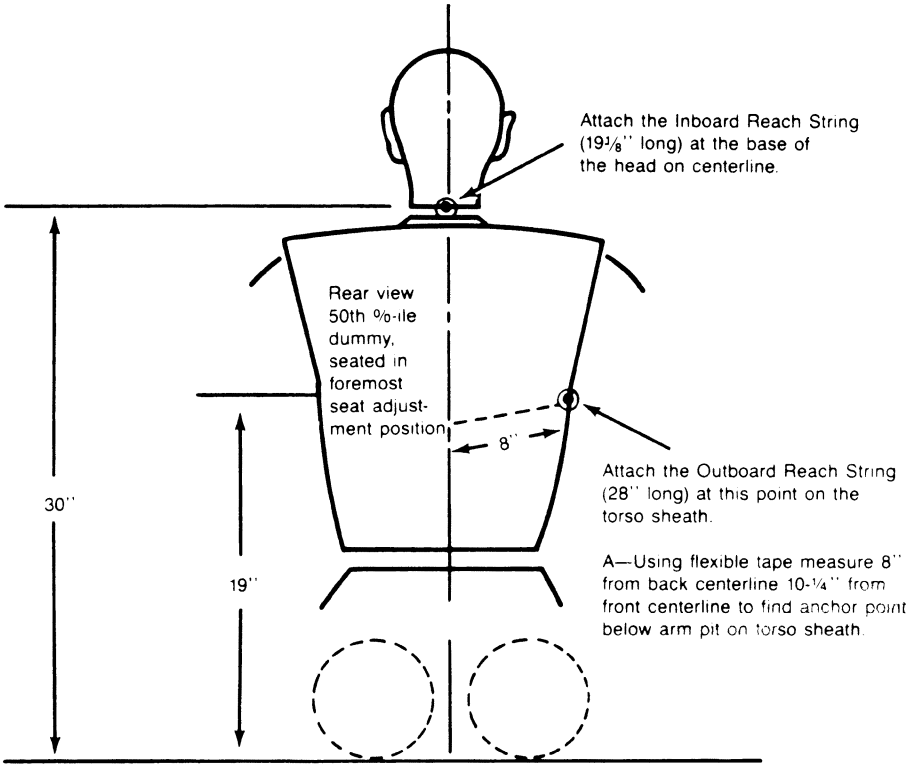


Figure 3. Location of Anchoring Points for Latchplate Reach Limiting Chains or Strings to Test for Latchplate Accessibility Using Subpart E Test Device

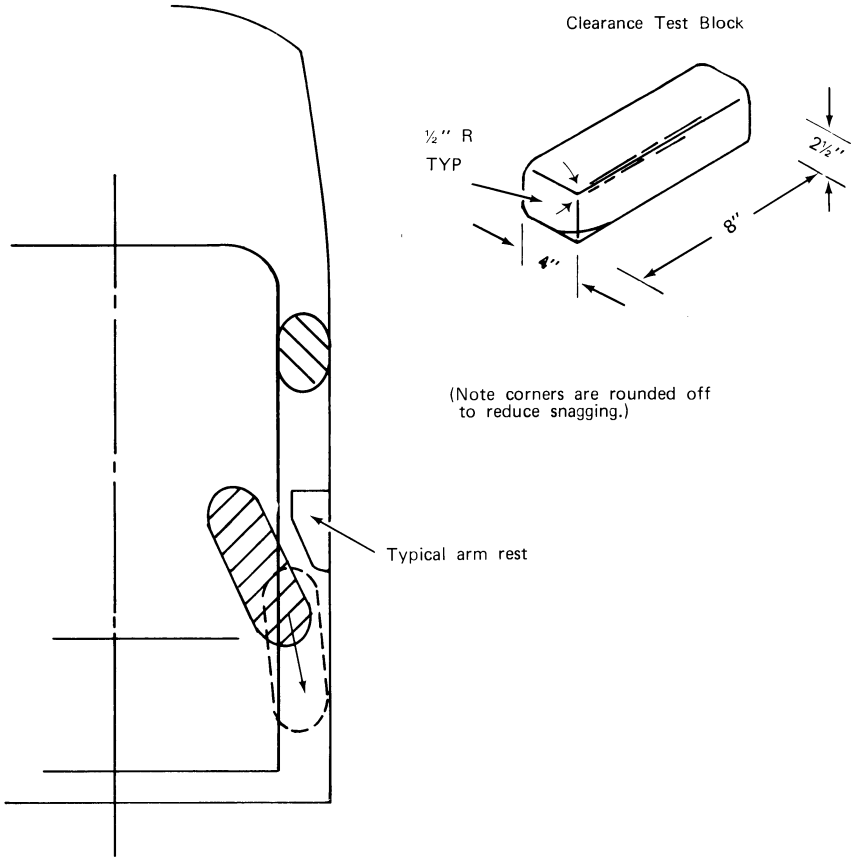
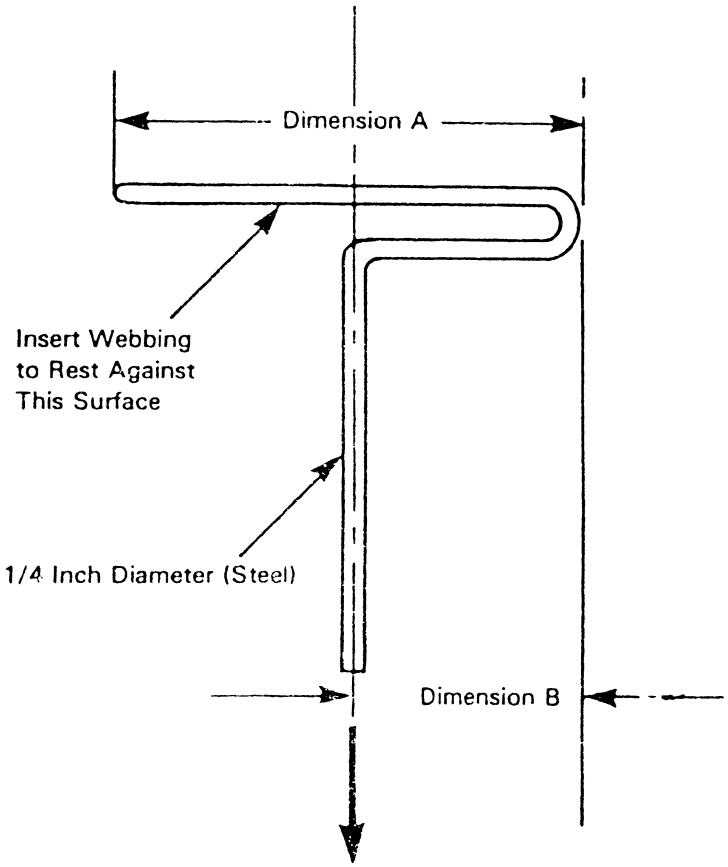


Figure 4—USE OF CLEARANCE TEST BLOCK TO DETERMINE HAND/ARM ACCESS

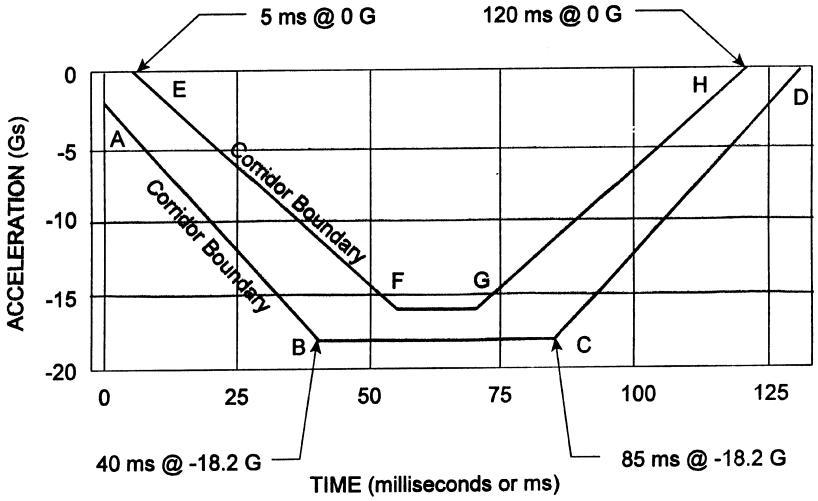


Dimension A - Width of Webbing Plus 1/2 Inch

Dimension B - 1/2 of Dimension A

Figure 5. - Webbing Tension Pull Device

SLED PULSE WITH MAXIMUM AND MINIMUM CORRIDORS



Sled pulse for delta V = 30(+0,-2) mph. The Time Zero for the test is defined by the point when the sled acceleration achieves -0.5 G's.

SLED PULSE AND COORDINATES

REFERENCE POINT	t (ms)	ACCELERATION (G)
A	0	-2
B	40	-18.2
C	85	-18.2
D	130	0
E	5	0
F	55	-16
G	70	-16
H	120	0.00

Figure 6 - Sled Pulse and Coordinates



Figure 6a. Sun Visor Label Visible when Visor is in Down Position.

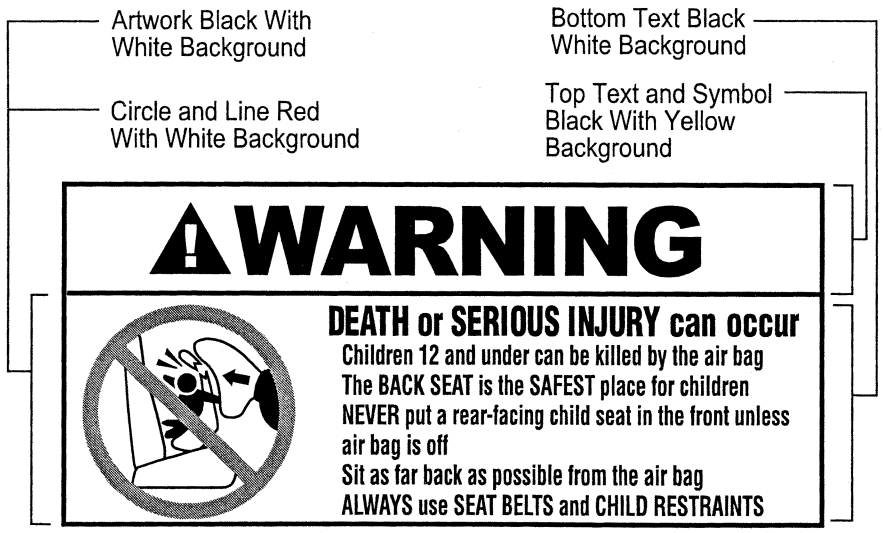


Figure 6b. Sun Visor Label Visible when Visor is in Down Position.

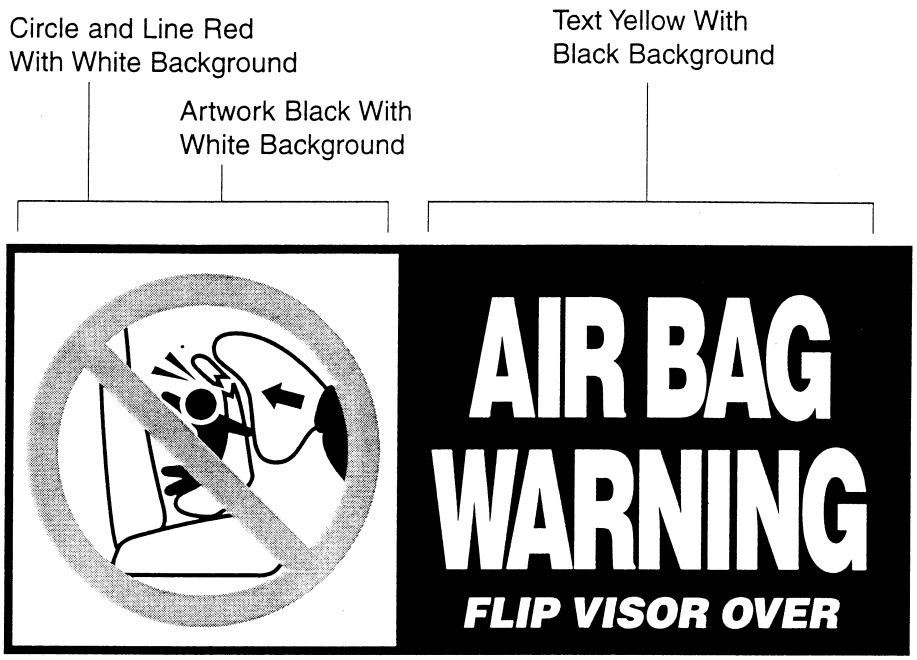


Figure 6c. Sun Visor Label Visible When Visor is in Up Position.

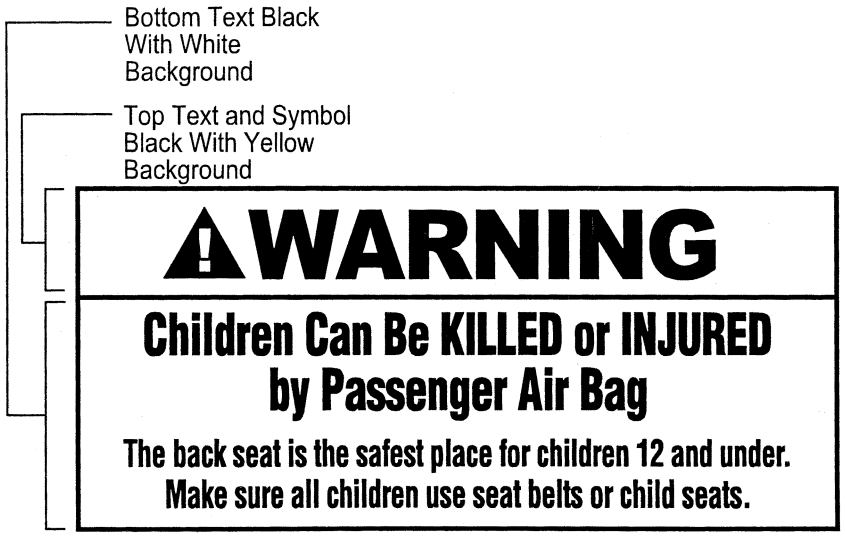


Figure 7. Removable Label on Dash.



Figure 8. Sun Visor Label Visible when Visor is in Down Position.

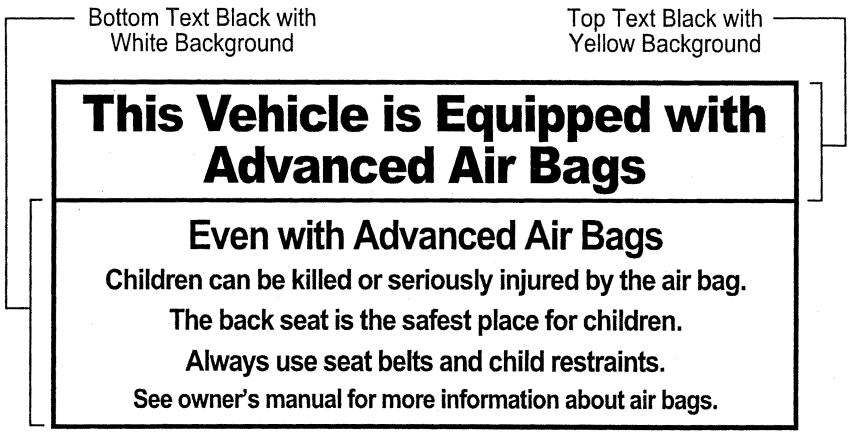


Figure 9. Removable Label on Dash.

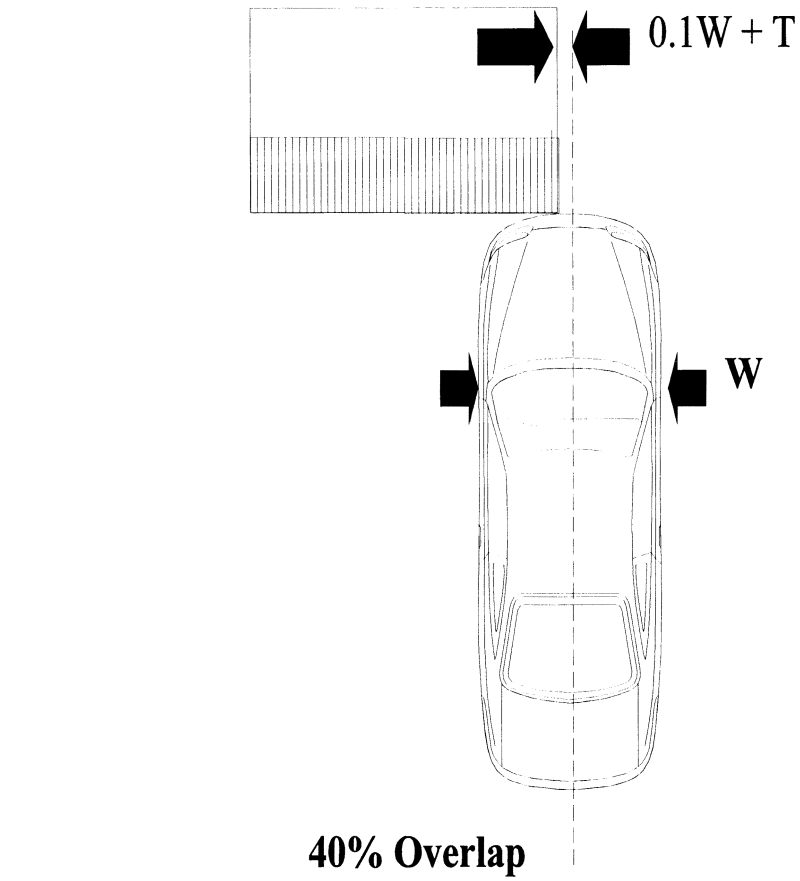


Figure 10 Configuration for Frontal Offset Deformable Barrier Test

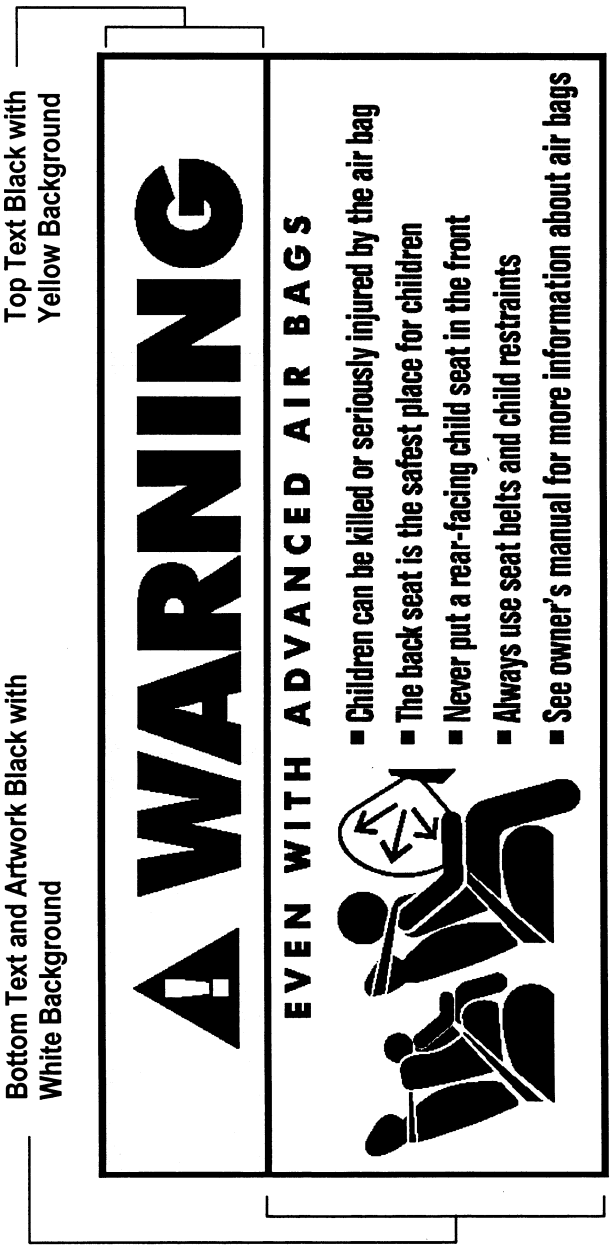


Figure 11. Sun Visor Label Visible when Visor is in Down Position.

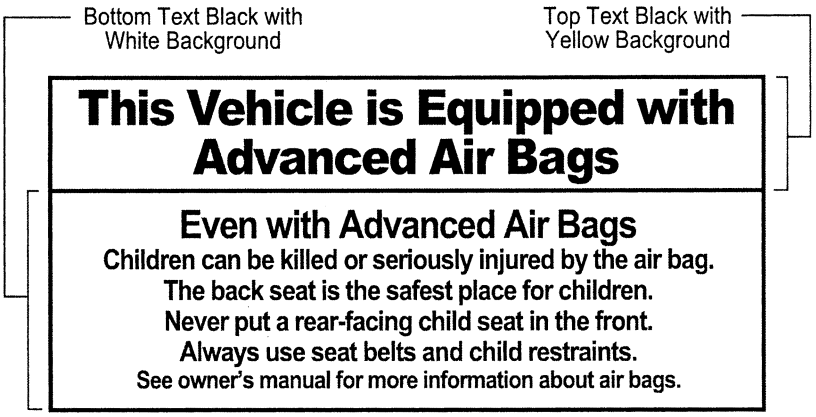


Figure 12. Removable Label on Dash.

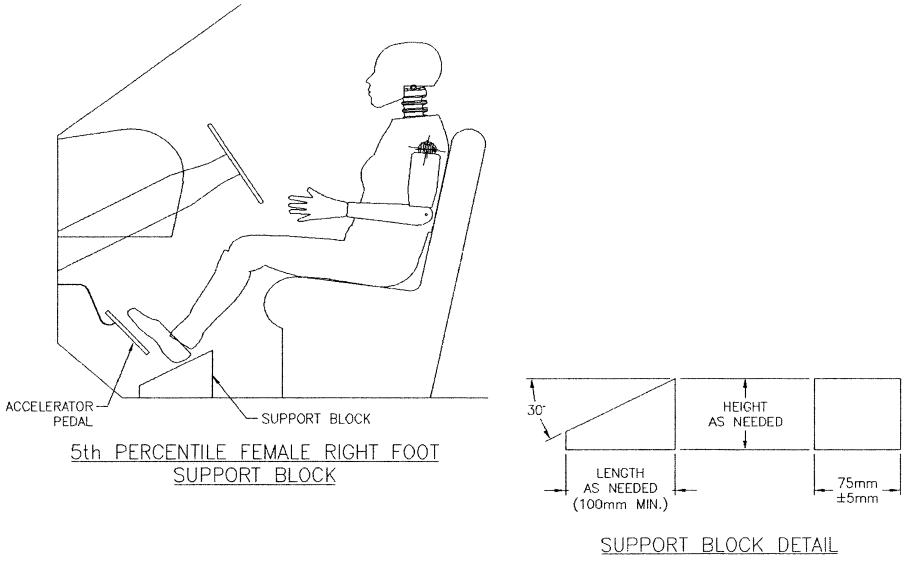


Figure 13

APPENDIX A TO § 571.208—SELECTION OF CHILD RESTRAINT SYSTEMS

This appendix A applies to vehicles manufactured before September 1, 2025, and to not more than 60 percent of a manufacturer's vehicles manufactured on or after September 1, 2025, and before September 1, 2026, as specified in S14.8 of this standard. This appendix does not apply to vehicles manufactured on or after September 1, 2026.

A. The following car bed, manufactured on or after the date listed, may be used by the National Highway Traffic Safety Administration to test the suppression system of a vehicle that has been certified as being in compliance with 49 CFR 571.208 S19:

SUBPART A—CAR BED CHILD RESTRAINTS OF APPENDIX A

	Manufactured on or after
Angel Guard Angel Ride XX2403XXX	September 25, 2007.

B. Any of the following rear-facing child restraint systems specified in the table in subpart B of this appendix, manufactured on or after the date listed, may be used by the National Highway Traffic Safety Administration to test the suppression or low risk deployment (LRD) system of a vehicle that has been certified as being in compliance with S19 of this standard. When the restraint system comes equipped with a removable base, the test may be run either with the base attached or without the base.

SUBPART B—REAR-FACING CHILD RESTRAINTS OF APPENDIX A

	Manufactured on or after
Century Smart Fit 4543	December 1, 1999.
Cosco Arriva 22–013 PAW and base 22–999 WHO	September 25, 2007.
Evenflo Discovery Adjust Right 212	December 1, 1999.
Graco Infant 8457	December 1, 1999.
Graco Snugride	September 25, 2007.
Peg Perego Primo Viaggio SIP IMUN00US	September 25, 2007.

C. Any of the following forward-facing child restraint systems, and forward-facing child restraint systems that also convert to rear-facing, manufactured on or after the date listed, may be used by the National Highway Traffic Safety Administration to test the suppression or LRD system of a vehicle that has been certified as being in compliance with S19 or S21 of this standard. (Note: Any child restraint listed in this subpart that does not have manufacturer instructions for using it in a rear-facing position is excluded from use in testing in a belted rear-facing configuration under S20.2.1.1(a) and S20.4.2 of this standard):

SUBPART C—FORWARD-FACING AND CONVERTIBLE CHILD RESTRAINTS OF APPENDIX A

	Manufactured on or after
Britax Roundabout E9L02xx	September 25, 2007.
Graco ComfortSport	September 25, 2007.
Cosco Touriva 02519	December 1, 1999.
Evenflo Tribute V 379xxxx or Evenflo Tribute 381xxxx	September 25, 2007.
Evenflo Medallion 254	December 1, 1999.
Cosco Summit Deluxe High Back Booster 22–262	September 25, 2007.
Evenflo Generations 352xxxx	September 25, 2007.
Graco Toddler SafeSeat Step 2	September 25, 2007.
Graco Platinum Cargo	September 25, 2007.
Cosco High Back Booster 22–209	September 25, 2007.

D. Any of the following forward-facing child restraint systems and belt positioning seats, manufactured on or after the date listed, may be used by the National Highway Traffic Safety Administration as test devices to test the suppression system of a vehicle that has been certified as being in compliance with S21 or S23 of this standard:

SUBPART D—FORWARD-FACING CHILD RESTRAINTS AND BELT POSITIONING SEATS OF APPENDIX A

	Manufactured on or after
Britax Roadster 9004	December 1, 1999.
Graco Platinum Cargo	September 25, 2007.
Cosco High Back Booster 22–209	September 25, 2007.
Evenflo Right Fit 245	December 1, 1999.
Evenflo Generations 352xxxx	September 25, 2007.
Cosco Summit Deluxe High Back Booster 22–262	September 25, 2007.

APPENDIX A–1 TO § 571.208—SELECTION OF CHILD RESTRAINT SYSTEMS

This appendix A–1 applies to not less than 40 percent of a manufacturer's vehicles manufactured on or after September 1, 2025, and before September 1, 2026, as specified in S14.8 of this standard. This appendix applies to all vehicles manufactured on or after September 1, 2026.

A. The following car bed, manufactured on or after [*Date of publication of final rule*], may be used by the National Highway Traffic Safety Administration to test the suppression system of a vehicle that has been certified as being in compliance with S19 of this standard:

SUBPART A—CAR BED CHILD RESTRAINTS OF APPENDIX A–1

Safety 1st Dreamride with LATCH #IC238xxx.

B. Any of the following rear-facing child restraint systems specified in the table below, manufactured on or after August 22, 2024, may be used by the National Highway Traffic Safety Administration to test the suppression or low risk deployment (LRD) system of a vehicle that has been certified as being in compliance with S19 of this standard. When the restraint system comes equipped with a removable base, the test may be run either with the base attached or without the base.

SUBPART B—REAR-FACING CHILD RESTRAINTS OF APPENDIX A–1

Evenflo Litemax #305xxxxx.
Chicco Keyfit 30 #04061472xxxxxx.
Doona Car Seat & Stroller.
Nuna Pipa RX with Pipa RELX base.
Cybex Cloud Q with SensorSafe.
Evenflo NurtureMax #364xxxxx.

C. Any of the following forward-facing child restraint systems, and forward-facing child restraint systems that also convert to rear-facing, manufactured on or after August 22, 2024, may be used by the National Highway Traffic Safety Administration to test the suppression or LRD system of a vehicle that has been certified as being in compliance with S19 or S21 of this standard. (*Note:* Any child restraint listed in this subpart that does not have manufacturer instructions for using it in a rear-facing position is excluded from use in testing in a belted rear-facing configuration under S20.2.1.1(a) and S20.4.2 of this standard):

SUBPART C—FORWARD-FACING AND CONVERTIBLE CHILD RESTRAINTS OF APPENDIX A–1

Britax Poplar #E1C93xx.
Cosco Scenera Next #CC123xxx.
Graco 4Ever DLX.
Nuna Rava #CS05116CVR.
Graco Contender Slim.
Cybex Eternis S with SensorSafe.
Safety 1st Grow and Go #CC138xxx.
Evenflo Chase Plus #307xxxxx.
Cosco Finale #BC110xxx.
Chicco MyFit #04079783—0070.

D. Any of the following forward-facing child restraint systems and belt positioning seats, manufactured on or after August 22, 2024, may be used by the National Highway Traffic Safety Administration as test devices to test the suppression system of a vehicle that has been certified as being in compliance with S21 or S23 of this standard:

SUBPART D—FORWARD-FACING CHILD RESTRAINTS AND BELT POSITIONING SEATS OF APPENDIX A–1

Chicco MyFit #04079783—0070.
Cybex Eternis S with SensorSafe.
Safety 1st Grow and Go #CC138xxx.
Evenflo Chase Plus #307xxxxx.
Cosco Finale #BC110xxx.
Cosco Rise #BC126xxx.
Graco TurboBooster Backless Booster Seat.
Britax Grow with You ClickTight #E1C19xx.

Figure A1 to Appendix A and Appendix A–1 to §571.208: Loading Bar Foot Detail

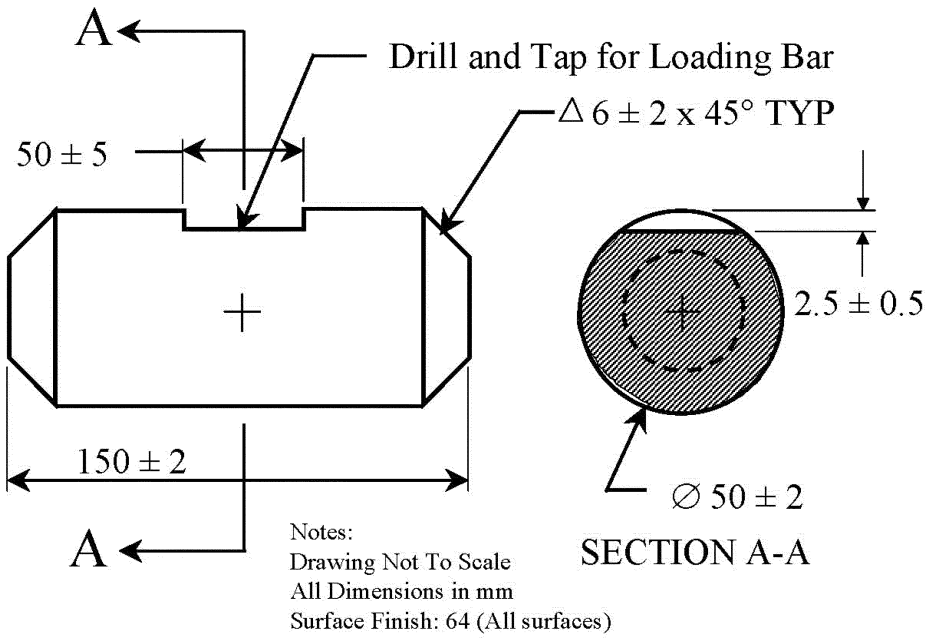
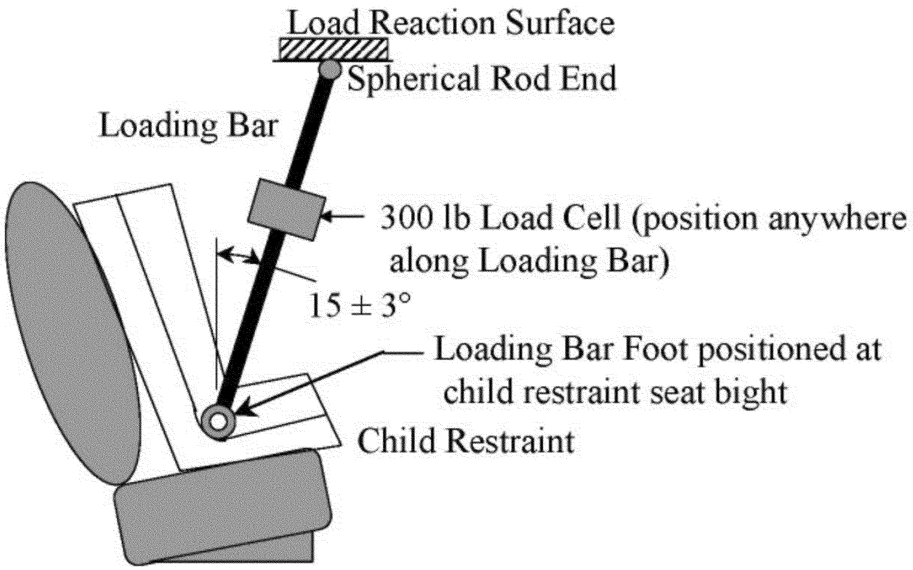


Figure A2 to Appendix A and Appendix A–1 to §571.208: Loading Bar Installation



[36 FR 22902, Dec. 2, 1971]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 571.208, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 571.209 Standard No. 209; Seat belt assemblies.

S1. *Purpose and scope.* This standard specifies requirements for seat belt assemblies.

S2. *Application.* This standard applies to seat belt assemblies for use in passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. *Definitions. Adjustment hardware* means any or all hardware designed for adjusting the size of a seat belt assembly to fit the user, including such hardware that may be integral with a buckle, attachment hardware, or retractor.

Attachment hardware means any or all hardware designed for securing the webbing of a seat belt assembly to a motor vehicle.

Automatic-locking retractor means a retractor incorporating adjustment hardware by means of a positive self-locking mechanism which is capable when locked of withstanding restraint forces.

Buckle means a quick release connector which fastens a person in a seat belt assembly.

Emergency-locking retractor means a retractor incorporating adjustment hardware by means of a locking mechanism that is activated by vehicle acceleration, webbing movement relative to the vehicle, or other automatic action during an emergency and is capable when locked of withstanding restraint forces.

Hardware means any metal or rigid plastic part of a seat belt assembly.

Load-limiter means a seat belt assembly component or feature that controls tension on the seat belt to modulate the forces that are imparted to occupants restrained by the belt assembly during a crash.

Nonlocking retractor means a retractor from which the webbing is extended to essentially its full length by a small external force, which provides no adjustment for assembly length, and which may or may not be capable of sustaining restraint forces at maximum webbing extension.

Pelvic restraint means a seat belt assembly or portion thereof intended to restrain movement of the pelvis.

Retractor means a device for storing part or all of the webbing in a seat belt assembly.

Seat back retainer means the portion of some seat belt assemblies designed to restrict forward movement of a seat back.

Seat belt assembly means any strap, webbing, or similar device designed to secure a person in a motor vehicle in order to mitigate the results of any accident, including all necessary buckles and other fasteners, and all hardware designed for installing such seat belt assembly in a motor vehicle.

Strap means a narrow nonwoven material used in a seat belt assembly in place of webbing.

Type 1 seat belt assembly is a lap belt for pelvic restraint.

Type 2 seat belt assembly is a combination of pelvic and upper torso restraints.

Type 2a shoulder belt is an upper torso restraint for use only in conjunction with a lap belt as a Type 2 seat belt assembly.

Upper torso restraint means a portion of a seat belt assembly intended to restrain movement of the chest and shoulder regions.

Webbing means a narrow fabric woven with continuous filling yarns and finished selvages.

S4. *Requirements.*

S4.1 (a) [Reserved]

(b) *Single occupancy.* A seat belt assembly shall be designed for use by one, and only one, person at any one time.

(c) *Upper torso restraint.* A Type 2 seat belt assembly shall provide upper torso restraint without shifting the pelvic restraint into the abdominal region. An upper torso restraint shall be designed to minimize vertical forces on the shoulders and spine. Hardware for upper torso restraint shall be so designed and located in the seat belt assembly that the possibility of injury to the occupant is minimized.

A Type 2a shoulder belt shall comply with applicable requirements for a Type 2 seat belt assembly in S4.1 to S4.4, inclusive.

(d) *Hardware.* All hardware parts which contact under normal usage a person, clothing, or webbing shall be free from burrs and sharp edges.

(e) *Release.* A Type 1 or Type 2 seat belt assembly shall be provided with a buckle or buckles readily accessible to the occupant to permit his easy and rapid removal from the assembly. Buckle release mechanism shall be designed to minimize the possibility of accidental release. A buckle with release mechanism in the latched position shall have only one opening in which the tongue can be inserted on the end of the buckle designed to receive and latch the tongue.

(f) *Attachment hardware.* A seat belt assembly shall include all hardware necessary for installation in a motor vehicle in accordance with SAE Recommended Practice J800c (1973) (incorporated by reference, see §571.5). However, seat belt assemblies designed for installation in motor vehicles equipped with seat belt assembly anchorages that do not require anchorage nuts, plates, or washers, need not have such hardware, but shall have 7/16–20 UNF–2A or 1/2–13 UNC–2A attachment bolts or equivalent metric hardware. The hardware shall be designed to prevent attachment bolts and other parts from becoming disengaged from the vehicle while in service. Reinforcing plates or washers furnished for universal floor, installations shall be of steel, free from burrs and sharp edges on the peripheral edges adjacent to the vehicle, at least 1.5 mm in thickness and at least 2580 mm^2 in projected area. The distance between any edge of the plate and the edge of the bolt hole shall be at least 15 mm. Any corner shall be rounded to a radius of not less than 6 mm or cut so that no corner angle is less than 135° and no side is less than 6 mm in length.

(g) *Adjustment.* (1) A Type 1 or Type 2 seat belt assembly shall be capable of adjustment to fit occupants whose dimensions and weight range from those of a 5th-percentile adult female to those of a 95th-percentile adult male. The seat belt assembly shall have either an automatic-locking retractor, an emergency-locking retractor, or an adjusting device that is within the reach of the occupant.

(2) A Type 1 or Type 2 seat belt assembly for use in a vehicle having seats that are adjustable shall conform to the requirements of S4.1(g)(1) regardless of seat position. However, if a seat has a back that is separately adjustable, the requirements of S4.1(g)(1) need be met only with the seat back in the manufacturer's nominal design riding position.

(3) The adult occupants referred to in S4.1(g)(1) shall have the following measurements:

	5th percentile adult female	95th percentile adult male
Weight	46.3 kg	97.5 kg.
Erect sitting height	785 mm	965 mm.
Hip breadth (sitting)	325 mm	419 mm.
Hip circumference (sitting).	925 mm	1199 mm.
Waist circumference (sitting).	599 mm	1080 mm.
Chest depth	190 mm	267 mm.
Chest circumference:		
Nipple	775 mm	1130 mm.
Upper	757 mm	1130 mm.
Lower	676 mm	1130 mm.

(h) *Webbing.* The ends of webbing in a seat belt assembly shall be protected or treated to prevent raveling. The end of webbing in a seat belt assembly having a metal-to-metal buckle that is used by the occupant to adjust the size of the assembly shall not pull out of the adjustment hardware at maximum size adjustment. Provision shall be made for essentially unimpeded movement of webbing routed between a seat back and seat cushion and attached to a retractor located behind the seat.

(i) *Strap.* A strap used in a seat belt assembly to sustain restraint forces shall comply with the requirements for webbing in S4.2, and if the strap is made from a rigid material, it shall comply with applicable requirements in S4.2, S4.3, and S4.4.

(j) *Marking.* Each seat belt assembly shall be permanently and legibly marked or labeled with year of manufacture, model, and name or trademark of manufacturer or distributor, or of importer if manufactured outside the United States. A model shall consist of a single combination of webbing having

a specific type of fiber weave and construction, and hardware having a specific design. Webbings of various colors may be included under the same model, but webbing of each color shall comply with the requirements for webbing in S4.2.

(k) *Installation instructions.* A seat belt assembly, other than a seat belt assembly installed in a motor vehicle by an automobile manufacturer, shall be accompanied by an instruction sheet providing sufficient information for installing the assembly in a motor vehicle. The installation instructions shall state whether the assembly is for universal installation or for installation only in specifically stated motor vehicles, and shall include at least those items specified in SAE Recommended Practice J800c (1973) (incorporated by reference, see §571.5). If the assembly is for use only in specifically stated motor vehicles, the assembly shall either be permanently and legibly marked or labeled with the following statement, or the instruction sheet shall include the following statement:

This seat belt assembly is for use only in [insert specific seating position(s), e.g., ''front right''] in [insert specific vehicle make(s) and model(s)].

(l) *Usage and maintenance instructions.* A seat belt assembly or retractor shall be accompanied by written instructions for the proper use of the assembly, stressing particularly the importance of wearing the assembly snugly and properly located on the body, and on the maintenance f the assembly and periodic inspection of all components. The instructions shall show the proper manner of threading webbing in the hardware of seat belt assemblies in which the webbing is not permanently fastened. Instructions for a nonlocking retractor shall include a caution that the webbing must be fully extended from the retractor during use of the seat belt assembly unless the retractor is attached to the free end of webbing which is not subjected to any tension during restraint of an occupant by the assembly. Instructions for Type 2a shoulder belt shall include a warning that the shoulder belt is not to be used without a lap belt.

(m) *Workmanship.* Seat belt assemblies shall have good workmanship in accordance with good commercial practice.

S4.2 *Requirements for webbing.*

(a) *Width.* The width of the webbing in a seat belt assembly shall be not less than 46 mm, except for portions that do not touch a 95th percentile adult male with the seat in any adjustment position and the seat back in the manufacturer's nominal design riding position when measured under the conditions prescribed in S5.1(a).

(b) *Breaking strength.* The webbing in a seat belt assembly shall have not less than the following breaking strength when tested by the procedures specified in S5.1(b): Type 1 seat belt assembly—26,689 N; Type 2 seat belt assembly—22,241 N for webbing in pelvic restraint and 17,793 N for webbing in upper torso restraint.

(c) *Elongation.* Except as provided in S4.5, the webbing in a seat belt assembly shall not extend to more than the following elongation when subjected to the specified forces in accordance with the procedure specified in S5.1(c): Type 1 seat belt assembly—20 percent at 11,120 N; Type 2 seat belt assembly 30 percent at 11,120 N for webbing in pelvic restraint and 40 percent at 11,120 N for webbing in upper torso restraint.

(d) *Resistance to abrasion.* The webbing of a seat belt assembly, after being subjected to abrasion as specified in S5.1(d) or S5.3(c), shall have a breaking strength of not less than 75 percent of the breaking strength listed in S4.2(b) for that type of belt assembly.

(e) *Resistance to light.* The webbing in a seat belt assembly after exposure to the light of a carbon arc and tested by the procedure specified in S5.1(e) shall have a breaking strength not less than 60 percent of the strength before exposure to the carbon arc and shall have a color retention not less than No. 2 on the AATCC Gray Scale for Evaluating Change in Color (incorporated by reference, see §571.5).

(f) *Resistance to micro-organisms.* The webbing in a seat belt assembly after being subjected to micro-organisms and tested by the procedures specified in S5.1(f) shall have a breaking strength not less than 85 percent of the strength before subjection to micro-organisms.

S4.3 *Requirements for hardware.*

(a) *Corrosion resistance.* (1) Attachment hardware of a seat belt assembly after being subjected to the conditions specified in S5.2(a) shall be free of ferrous corrosion on significant surfaces except for permissible ferrous corrosion at peripheral edges or edges of holes on underfloor reinforcing plates and washers. Alternatively, such hardware at or near the floor shall be protected against corrosion by at least an electrodeposited coating of nickel, or copper and nickel with at least a service condition number of SC2, and other attachment hardware shall be protected by an electrodeposited coating of nickel, or copper and nickel with a service condition number of SC1, in accordance with ASTM B456–79 (incorporated by reference, see §571.5), but such hardware shall not be racked for electroplating in locations subjected to maximum stress.

(2) Surfaces of buckles, retractors and metallic parts, other than attachment hardware, of a seat belt assembly after subjection to the conditions specified in S5.2(a) shall be free of ferrous or nonferrous corrosion which may be transferred, either directly or by means of the webbing, to the occupant or his clothing when the assembly is worn. After test, buckles shall conform to applicable requirements in paragraphs (d) to (g) of this section.

(b) *Temperature resistance.* Plastic or other nonmetallic hardware parts of a seat belt assembly when subjected to the conditions specified in S5.2(b) shall not warp or otherwise deteriorate to cause the assembly to operate improperly or fail to comply with applicable requirements in this section and S4.4.

(c) *Attachment hardware.* (1) Eye bolts, shoulder bolts, or other bolt used to secure the pelvic restraint of seat belt assembly to a motor vehicle shall withstand a force of 40,034 N when tested by the procedure specified in S5.2(c)(1), except that attachment bolts of a seat belt assembly designed for installation in specific models of motor vehicles in which the ends of two or more seat belt assemblies cannot be attached to the vehicle by a single bolt shall have breaking strength of not less than 22,241 N.

(2) Other attachment hardware designed to receive the ends of two seat belt assemblies shall withstand a tensile force of at least 26,689 N without fracture of a section when tested by the procedure specified in S5.2(c)(2).

(3) A seat belt assembly having single attachment hooks of the quick-disconnect type for connecting webbing to an eye bolt shall be provided with a retaining latch or keeper which shall not move more than 2 mm in either the vertical or horizontal direction when tested by the procedure specified in S5.2(c)(3).

(d) *Buckle release.* (1) The buckle of a Type 1 or Type 2 seat belt assembly shall release when a force of not more than 133 N is applied.

(2) A buckle designed for pushbutton application of buckle release force shall have a minimum area of 452 mm^2 with a minimum linear dimension of 10 mm for applying the release force, or a buckle designed for lever application of buckle release force shall permit the insertion of a cylinder 10 mm in diameter and 38 mm in length to at least the midpoint of the cylinder along the cylinder's entire length in the actuation portion of the buckle release. A buckle having other design for release shall have adequate access for two or more fingers to actuate release.

(3) The buckle of a Type 1 or Type 2 seat belt assembly shall not release under a compressive force of 1779 N applied as prescribed in paragraph S5.2(d)(3). The buckle shall be operable and shall meet the applicable requirement of paragraph S4.4 after the compressive force has been removed.

(e) *Adjustment force.* The force required to decrease the size of a seat belt assembly shall not exceed 49 N when measured by the procedure specified in S5.2(e).

(f) *Tilt-lock adjustment.* The buckle of a seat belt assembly having tilt-lock adjustment shall lock the webbing when tested by the procedure specified in S5.2(f) at an angle of not less than 30 degrees between the base of the buckle and the anchor webbing.

(g) *Buckle latch.* The buckle latch of a seat belt assembly when tested by the procedure specified in S5.2(g) shall not fail, nor gall or wear to an extent that normal latching and unlatching is impaired, and a metal-to-metal buckle shall separate when in any position of

partial engagement by a force of not more than 22 N.

(h) *Nonlocking retractor.* The webbing of a seat belt assembly shall extend from a nonlocking retractor within 6 mm of maximum length when a tension is applied as prescribed in S5.2(h). A nonlocking retractor on upper torso restraint shall be attached to the nonadjustable end of the assembly, the reel of the retractor shall be easily visible to an occupant while wearing the assembly, and the maximum retraction force shall not exceed 5 N in any strap or webbing that contacts the shoulder when measured by the procedure specified in S5.2(h), unless the retractor is attached to the free end of webbing which is not subjected to any tension during restraint of an occupant by the assembly.

(i) *Automatic-locking retractor.* The webbing of a seat belt assembly equipped with an automatic locking retractor, when tested by the procedure specified in S5.2(i), shall not move more than 25 mm between locking positions of the retractor, and shall be retracted with a force under zero acceleration of not less than 3 N when attached to pelvic restraint, and not less that 2 N nor more than 5 N in any strap or webbing that contacts the shoulders of an occupant when the retractor is attached to upper torso restraint. An automatic locking retractor attached to upper torso restraint shall not increase the restraint on the occupant of the seat belt assembly during use in a vehicle traveling over rough roads as prescribed in S5.2(i).

(j) *Emergency-locking retractor.*

(1) *For seat belt assemblies manufactured before February 22, 2007.* Except for manufacturers that, at the manufacturer's option, voluntarily choose to comply with S4.3(j)(2) during this period (with said option irrevocably selected prior to, or at the time of, certification of the seat belt assembly), an emergency-locking retractor of a Type 1 or Type 2 seat belt assembly, when tested in accordance with the procedures specified in paragraph S5.2(j)(1)—

(i) Shall lock before the webbing extends 25 mm when the retractor is subjected to an acceleration of 7 m/s^2 (0.7 g);

(ii) Shall not lock, if the retractor is sensitive to webbing withdrawal, before the webbing extends 51 mm when the retractor is subjected to an acceleration of 3 m/s^2 (0.3 g) or less;

(iii) Shall not lock, if the retractor is sensitive to vehicle acceleration, when the retractor is rotated in any direction to any angle of 15° or less from its orientation in the vehicle;

(iv) Shall exert a retractive force of at least 3 N under zero acceleration when attached only to the pelvic restraint;

(v) Shall exert a retractive force of not less than 1 N and not more than 5 N under zero acceleration when attached only to an upper torso restraint;

(vi) Shall exert a retractive force not less than 1 N and not more than 7 N under zero acceleration when attached to a strap or webbing that restrains both the upper torso and the pelvis.

(2) *For seat belt assemblies manufactured on or after February 22, 2007 and for manufacturers opting for early compliance.* An emergency-locking retractor of a Type 1 or Type 2 seat belt assembly, when tested in accordance with the procedures specified in paragraph S5.2(j)(2)—

(i) Shall under zero acceleration loading—

(A) Exert a retractive force of not less than 1 N and not more than 7 N when attached to a strap or webbing that restrains both the upper torso and the pelvis;

(B) Exert a retractive force not less than 3 N when attached only to the pelvic restraint; and

(C) Exert a retractive force of not less than 1 N and not more than 5 N when attached only to an upper torso restraint.

(D) For a retractor sensitive to vehicle acceleration, lock when tilted at any angle greater than 45 degrees from the angle at which it is installed in the vehicle or meet the requirements of S4.3(j)(2)(ii).

(E) For a retractor sensitive to vehicle acceleration, not lock when the retractor is rotated in any direction to any angle of 15 degrees or less from its orientation in the vehicle.

(ii) Shall lock before the webbing payout exceeds the maximum limit of

25 mm when the retractor is subjected to an acceleration of 0.7 g under the applicable test conditions of S5.2(j)(2)(iii)(A) or (B). The retractor is determined to be locked when the webbing belt load tension is at least 35 N.

(iii) For a retractor sensitive to webbing withdrawal, shall not lock before the webbing payout extends to the minimum limit of 51 mm when the retractor is subjected to an acceleration no greater than 0.3 g under the test condition of S5.2(j)(2)(iii)(C).

(k) *Performance of retractor.* A retractor used on a seat belt assembly after subjection to the tests specified in S5.2(k) shall comply with applicable requirements in paragraphs (h) to (j) of this section and S4.4, except that the retraction force shall be not less than 50 percent of its original retraction force.

S4.4 *Requirements for assembly performance.*

(a) *Type I seat belt assembly.* Except as provided in S4.5, the complete seat belt assembly including webbing, straps, buckles, adjustment and attachment hardware, and retractors shall comply with the following requirements when tested by the procedures specified in S5.3(a):

(1) The assembly loop shall withstand a force of not less than 22,241 N; that is, each structural component of the assembly shall withstand a force of not less than 11,120 N.

(2) The assembly loop shall extend not more than 7 inches or 178 mm when subjected to a force of 22,241 N; that is, the length of the assembly between anchorages shall not increase more than 356 mm.

(3) Any webbing cut by the hardware during test shall have a breaking strength at the cut of not less than 18,683 N.

(4) Complete fracture through any solid section of metal attachment hardware shall not occur during test.

(b) *Type 2 seat belt assembly.* Except as provided in S4.5, the components of a Type 2 seat belt assembly including webbing, straps, buckles, adjustment and attachment hardware, and retractors shall comply with the following requirements when tested by the procedure specified in S5.3(b):

(1) The structural components in the pelvic restraint shall withstand a force of not less than 11,120 N.

(2) The structural components in the upper torso restraint shall withstand a force of not less than 6,672 N.

(3) The structural components in the assembly that are common to pelvic and upper torso restraints shall withstand a force of not less than 13,345 N.

(4) The length of the pelvic restraint between anchorages shall not increase more than 508 mm when subjected to a force of 11,120 N.

(5) The length of the upper torso restraint between anchorages shall not increase more than 508 mm when subjected to a force of 6,672 N.

(6) Any webbing cut by the hardware during test shall have a breaking strength of not less than 15,569 N at a cut in webbing of the pelvic restraint, or not less than 12,455 N at a cut in webbing of the upper torso restraint.

(7) Complete fracture through any solid section of metal attachment hardware shall not occur during test.

S4.5 *Load-limiter.* (a) A Type 1 or Type 2 seat belt assembly that includes a load-limiter is not required to comply with the elongation requirements of S4.2(c), S4.4(a)(2), S4.4(b)(4) or S4.4(b)(5).

(b) A seat belt assembly that includes a load limiter and that does not comply with the elongation requirements of this standard may be installed in motor vehicles at any designated seating position that is subject to the requirements of S5.1 of Standard No. 208 (§571.208).

S4.6 *Manual belts subject to crash protection requirements of Standard No. 208.*

(a)(1) A manual seat belt assembly, which is subject to the requirements of S5.1 of Standard No. 208 (49 CFR 571.208) by virtue of any provision of Standard No. 208 other than S4.1.2.1(c)(2) of that standard, does not have to meet the requirements of S4.2(a)–(f) and S4.4 of this standard.

(2) A manual seat belt assembly subject to the requirements of S5.1 of Standard No. 208 (49 CFR 571.208) by virtue of S4.1.2.1(c)(2) of Standard No. 208 does not have to meet the elongation requirements of S4.2(c), S4.4(a)(2), S4.4(b)(4), and S4.4(b)(5) of this standard.

S5. *Demonstration procedures.*

S5.1 *Webbing*—(a) *Width.* The width of webbing from three seat belt assemblies shall be measured after conditioning for at least 24 hours in an atmosphere having relative humidity between 48 and 67 percent and a temperature of 23° ±2 °C. The tension during measurement of width shall be not more than 22 N on webbing from a Type 1 seat belt assembly, and 9786 N ±450 N on webbing from a Type 2 seat belt assembly. The width of webbing from a Type 2 seat belt assembly may be measured during the breaking strength test described in paragraph (b) of this section.

(b) *Breaking strength.* Webbing from three seat belt assemblies shall be conditioned in accordance with paragraph (a) of this section and tested for breaking strength in a testing machine of capacity verified to have an error of not more than one percent in the range of the breaking strength of the webbing in accordance with ASTM E4–79 (incorporated by reference, see §571.5). The machine shall be equipped with split drum grips illustrated in Figure 1, having a diameter between 51 and 102 mm. The rate of grip separation shall be between 51 and 102 mm per minute. The distance between the centers of the grips at the start of the test shall be between 102 and 254 mm. After placing the specimen in the grips, the webbing shall be stretched continuously at a uniform rate to failure. Each value shall be not less than the applicable breaking strength requirement in S4.2(b), but the median value shall be used for determining the retention of breaking strength in paragraphs (d), (e) and (f) of this section.

(c) *Elongation.* Elongation shall be measured during the breaking strength test described in paragraph (b) of this section by the following procedure: A preload between 196 N and 245 N shall be placed on the webbing mounted in the grips of the testing machine and the needle points of an extensometer, in which the points remain parallel during test, are inserted in the center of the specimen. Initially the points shall be set at a known distance apart between 102 and 203 mm. When the force on the webbing reaches the value specified in S4.2(c), the increase in separation of the points of the extensometer shall be measured and the percent elongation shall be calculated to the nearest 0.5 percent. Each value shall be not more than the appropriate elongation requirement in S4.2(c).

(d) *Resistance to abrasion.* The webbing from three seat belt assemblies shall be tested for resistance to abrasion by rubbing over the hexagon bar prescribed in Figure 2 in the following manner: The webbing shall be mounted in the apparatus shown schematically in Figure 2. One end of the webbing (A) shall be attached to a mass (B) of 2.35 kg ±.05 kg, except that a mass of 1.5 kg ±.05 kg shall be used for webbing in pelvic and upper torso restraints of a belt assembly used in a child restraint system. The webbing shall be passed over the two new abrading edges of the hexagon bar (C) and the other end attached to an oscillating drum (D) which has a stroke of 330 mm. Suitable guides shall be used to prevent movement of the webbing along the axis of hexagonal bar C. Drum D shall be oscillated for 5,000 strokes or 2,500 cycles at a rate of 60 ±2 strokes per minute or 30 ±1 cycles per minute. The abraded webbing shall be conditioned as prescribed in paragraph (a) of this section and tested for breaking strength by the procedure described in paragraph (b) of this section. The median values for the breaking strengths determined on abraded and unabraded specimens shall be used to calculate the percentage of breaking strength retained.

(e) *Resistance to light.* Webbing at least 508 mm in length from three seat belt assemblies shall be suspended vertically on the inside of the specimen track in a Type E carbon-arc light exposure apparatus described in ASTM G23–81 (incorporated by reference, see §571.5), except that the filter used for 100 percent polyester yarns shall be chemically strengthened soda-lime glass with a transmittance of less than 5 percent for wave lengths equal to or less than 305 nanometers and 90 percent or greater transmittance for wave lengths of 375 to 800 nanometers. The apparatus shall be operated without water spray at an air temperature of 60° ±2 °Celsius (°C) measured at a point 25 ±5 mm outside the specimen rack

and midway in height. The temperature sensing element shall be shielded from radiation. The specimens shall be exposed to light from the carbon-arc for 100 hours and then conditioned as prescribed in paragraph (a) of this section. The colorfastness of the exposed and conditioned specimens shall be determined on the AATCC Gray Scale for Evaluating Change in Color (incorporated by reference, see §571.5). The breaking strength of the specimens shall be determined by the procedure prescribed in paragraph (b) of this section. The median values for the breaking strengths determined on exposed and unexposed specimens shall be used to calculate the percentage of breaking strength retained.

(f) *Resistance to micro-organisms.* Webbing at least 508 millimeters (mm) in length from three seat belt assemblies shall first be preconditioned in accordance with appendix A(1) and (2) of AATCC Test Method 30–1981 (incorporated by reference, see §571.5), and then subjected to Test I, ''Soil Burial Test'' of that test method. After soil-burial for a period of 2 weeks, the specimen shall be washed in water, dried and conditioned as prescribed in paragraph (a) of this section. The breaking strengths of the specimens shall be determined by the procedure prescribed in paragraph (b) of this section. The median values for the breaking strengths determined on exposed and unexposed specimens shall be used to calculate the percentage of breaking strength retained.

NOTE: This test shall not be required on webbing made from material which is inherently resistant to micro-organisms.

S5.2 *Hardware.*

(a) *Corrosion resistance.* Three seat belt assemblies shall be tested in accordance with ASTM B117–73 (Reapproved 1979) (incorporated by reference, see §571.5). Any surface coating or material not intended for permanent retention on the metal parts during service life shall be removed prior to preparation of the test specimens for testing. The period of test shall be 50 hours for all attachment hardware at or near the floor, consisting of two periods of 24 hours exposure to salt spray followed by 1 hour drying and 25 hours for all other hardware, consisting of one period of 24 hours exposure to salt spray followed by 1 hour drying. In the salt spray test chamber, the parts from the three assemblies shall be oriented differently, selecting those orientations most likely to develop corrosion on the larger areas. At the end of test, the seat belt assembly shall be washed thoroughly with water to remove the salt. After drying for at least 24 hours under standard laboratory conditions specified in S5.1(a) attachment hardware shall be examined for ferrous corrosion on significant surfaces, that is, all surfaces that can be contacted by a sphere 19 mm in diameter, and other hardware shall be examined for ferrous and nonferrous corrosion which may be transferred, either directly or by means of the webbing, to a person or his clothing during use of a seat belt assembly incorporating the hardware.

NOTE: When attachment and other hardware are permanently fastened, by sewing or other means, to the same piece of webbing, separate assemblies shall be used to test the two types of hardware. The test for corrosion resistance shall not be required for attachment hardware made from corrosion-resistant steel containing at least 11.5 percent chromium or for attachment hardware protected with an electrodeposited coating of nickel, or copper and nickel, as prescribed in S4.3(a). The assembly that has been used to test the corrosion resistance of the buckle shall be used to measure adjustment force, tilt-lock adjustment, and buckle latch in paragraphs (e), (f), and (g), respectively, of this section, assembly performance in S5.3 and buckle release force in paragraph (d) of this section.

(b) *Temperature resistance.* Three seat belt assemblies having plastic or nonmetallic hardware or having retractors shall be subjected to the conditions prescribed in Procedure D of ASTM D756–78 (incorporated by reference, see §571.5). The dimension and weight measurement shall be omitted. Buckles shall be unlatched and retractors shall be fully retracted during conditioning. The hardware parts after conditioning shall be used for all applicable tests in S4.3 and S4.4.

(c) *Attachment hardware.* (1) Attachment bolts used to secure the pelvic restraint of a seat belt assembly to a motor vehicle shall be tested in a manner similar to that shown in Figure 3. The load shall be applied at an angle of

45° to the axis of the bolt through attachment hardware from the seat belt assembly, or through a special fixture which simulates the loading applied by the attachment hardware. The attachment hardware or simulated fixture shall be fastened by the bolt to the anchorage shown in Figure 3, which has a standard 7/16–20UNF–2B or 1/2-UNF–2B or metric equivalent threaded hole in a hardened steel plate at least 10 mm in thickness. The bolt shall be installed with two full threads exposed from the fully seated position. The appropriate force required by S4.3(c) shall be applied. A bolt from each of three seat belt assemblies shall be tested.

(2) Attachment hardware, other than bolts, designed to receive the ends of two seat belt assemblies shall be subjected to a tensile force of 26,689 N in a manner simulating use. The hardware shall be examined for fracture after the force is released. Attachment hardware from three seat belt assemblies shall be tested.

(3) Single attachment hook for connecting webbing to any eye bolt shall be tested in the following manner: The hook shall be held rigidly so that the retainer latch or keeper, with cotter pin or other locking device in place, is in a horizontal position as shown in Figure 4. A force of 667 N ±9 N shall be applied vertically as near as possible to the free end of the retainer latch, and the movement of the latch by this force at the point of application shall be measured. The vertical force shall be released, and a force of 667 N ±9 N shall be applied horizontally as near as possible to the free end of the retainer latch. The movement of the latch by this force at the point of load application shall be measured. Alternatively, the hook may be held in other positions, provided the forces are applied and the movements of the latch are measured at the points indicated in Figure 4. A single attachment hook from each of three seat belt assemblies shall be tested.

(d) *Buckle release.* (1) Three seat belt assemblies shall be tested to determine compliance with the maximum buckle release force requirements, following the assembly test in S5.3. After subjection to the force applicable for the assembly being tested, the force shall be reduced and maintained at 667 N on the assembly loop of a Type 1 seat belt assembly, 334 N on the components of a Type 2 seat belt assembly. The buckle release force shall be measured by applying a force on the buckle in a manner and direction typical of those which would be employed by a seat belt occupant. For push button-release buckles, the force shall be applied at least 3 mm from the edge of the push button access opening of the buckle in a direction that produces maximum releasing effect. For lever-release buckles, the force shall be applied on the centerline of the buckle lever or finger tab in a direction that produces maximum releasing effect.

(2) The area for application of release force on pushbutton actuated buckle shall be measured to the nearest 30 mm^2. The cylinder specified in S4.3(d) shall be inserted in the actuation portion of a lever released buckle for determination of compliance with the requirement. A buckle with other release actuation shall be examined for access of release by fingers.

(3) The buckle of a Type 1 or Type 2 seat belt assembly shall be subjected to a compressive force of 1779 N applied anywhere on a test line that is coincident with the center line of the belt extended through the buckle or on any line that extends over the center of the release mechanism and intersects the extended centerline of the belt at an angle of 60°. The load shall be applied by using a curved cylindrical bar having a cross section diameter of 19 mm and a radius of curvature of 152 mm, placed with its longitudinal center line along the test line and its center directly above the point or the buckle to which the load will be applied. The buckle shall be latched, and a tensile force of 334 N shall be applied to the connected webbing during the application of the compressive force. Buckles from three seat belt assemblies shall be tested to determine compliance with paragraph S4.3(d)(3).

(e) *Adjustment Force.* Three seat belt assemblies shall be tested for adjustment force on the webbing at the buckle, or other manual adjusting device normally used to adjust the size of the assembly. With no load on the anchor end, the webbing shall be drawn

through the adjusting device at a rate of 508 mm ±50 mm per minute and the maximum force shall be measured to the nearest 1 N after the first 25 mm of webbing movement. The webbing shall be precycled 10 times prior to measurement.

(f) *Tilt-lock adjustment.* This test shall be made on buckles or other manual adjusting devices having tilt-lock adjustment normally used to adjust the size of the assembly. Three buckles or devices shall be tested. The base of the adjustment mechanism and the anchor end of the webbing shall be oriented in planes normal to each other. The webbing shall be drawn through the adjustment mechanism in a direction to increase belt length at a rate of 508 mm ±50 mm per minute while the plane of the base is slowly rotated in a direction to lock the webbing. Rotation shall be stopped when the webbing locks, but the pull on the webbing shall be continued until there is a resistance of at least 89 N. The locking angle between the anchor end of the webbing and the base of the adjustment mechanism shall be measured to the nearest degree. The webbing shall be precycled 10 times prior to measurement.

(g) *Buckle latch.* The buckles from three seat belt assemblies shall be opened fully and closed at least 10 times. Then the buckles shall be clamped or firmly held against a flat surface so as to permit normal movement of buckle part, but with the metal mating plate (metal-to-metal buckles) or of webbing end (metal-to-webbing buckles) withdrawn from the buckle. The release mechanism shall be moved 200 times through the maximum possible travel against its stop with a force of 133 N ±13 N at a rate not to exceed 30 cycles per minute. The buckle shall be examined to determine compliance with the performance requirements of S4.3(g). A metal-to-metal buckle shall be examined to determine whether partial engagement is possible by means of any technique representative of actual use. If partial engagement is possible, the maximum force of separation when in such partial engagement shall be determined.

(h) *Nonlocking retractor.* After the retractor is cycled 10 times by full extension and retraction of the webbing, the retractor and webbing shall be suspended vertically and a force of 18 N shall be applied to extend the webbing from the retractor. The force shall be reduced to 13 N when attached to a pelvic restraint, or to 5 N per strap or webbing that contacts the shoulder of an occupant when retractor is attached to an upper torso restraint. The residual extension of the webbing shall be measured by manual rotation of the retractor drum or by disengaging the retraction mechanism. Measurements shall be made on three retractors. The location of the retractor attached to upper torso restraint shall be examined for visibility of reel during use of seat belt assembly in a vehicle.

NOTE: This test shall not be required on a nonlocking retractor attached to the free end of webbing which is not subjected to any tension during restraint of an occupant by the assembly.

(i) *Automatic-locking retractor.* Three retractors shall be tested in a manner to permit the retraction force to be determined exclusive of the gravitational forces on hardware or webbing being retracted. The webbing shall be fully extended from the retractor. While the webbing is being retracted, the average force or retraction within plus or minus 51 mm of 75 percent extension (25 percent retraction) shall be determined and the webbing movement between adjacent locking segments shall be measured in the same region of extension. A seat belt assembly with automatic locking retractor in upper torso restraint shall be tested in a vehicle in a manner prescribed by the installation and usage instructions. The retraction force on the occupant of the seat belt assembly shall be determined before and after traveling for 10 minutes at a speed of 24 kilometers per hour (km/h) or more over a rough road (e.g., Belgian block road) where the occupant is subjected to displacement with respect to the vehicle in both horizontal and vertical directions. Measurements shall be made with the vehicle stopped and the occupant in the normal seated position.

(j) *Emergency-locking retractor.*

(1) *For seat belt assemblies manufactured before February 22, 2007.* Except for manufacturers that elect to comply with S4.3(j)(2) and the corresponding

test procedures of S5.2(j)(2), a retractor shall be tested in a manner that permits the retraction force to be determined exclusive of the gravitational forces on hardware or webbing being retracted. The webbing shall be fully extended from the retractor, passing over or through any hardware or other material specified in the installation instructions. While the webbing is being retracted, the lowest force of retraction within ±51 mm of 75 percent extension shall be determined. A retractor that is sensitive to webbing withdrawal shall be subjected to an acceleration of 3 m/s^2 (0.3 g) within a period of 50 milliseconds (ms) while the webbing is at 75 percent extension, to determine compliance with S4.3(j)(1)(ii). The retractor shall be subjected to an acceleration of 7 m/s^2 (0.7 g) within a period of 50 ms, while the webbing is at 75 percent extension, and the webbing movement before locking shall be measured under the following conditions: For a retractor sensitive to webbing withdrawal, the retractor shall be accelerated in the direction of webbing retraction while the retractor drum's central axis is oriented horizontally and at angles of 45°, 90°, 135°, and 180° to the horizontal plane. For a retractor sensitive to vehicle acceleration, the retractor shall be:

(i) Accelerated in the horizontal plane in two directions normal to each other, while the retractor drum's central axis is oriented at the angle at which it is installed in the vehicle; and

(ii) Accelerated in three directions normal to each other while the retractor drum's central axis is oriented at angles of 45°, 90°, 135°, and 180° from the angle at which it is installed in the vehicle, unless the retractor locks by gravitational force when tilted in any direction to any angle greater than 45° from the angle at which it is installed in the vehicle.

(2) *For seat belt assemblies manufactured on or after February 22, 2007 and for manufacturers opting for early compliance.* A retractor shall be tested in a manner that permits the retraction force to be determined exclusive of the gravitational forces on the hardware or webbing being retracted.

(i) Retraction force: The webbing shall be extended fully from the retractor, passing over and through any hardware or other material specified in the installation instructions. While the webbing is being retracted, measure the lowest force of retraction within ±51 mm of 75 percent extension.

(ii) Gravitational locking: For a retractor sensitive to vehicle acceleration, rotate the retractor in any direction to an angle greater than 45 degrees from the angle at which it is installed in the vehicle. Apply a force to the webbing greater than the minimum force measured in S5.2(j)(2)(i) to determine compliance with S4.3(j)(2)(i)(D).

(iii) Dynamic tests: Each acceleration pulse shall be recorded using an accelerometer having a full scale range of ±10 g and processed according to the practices set forth in SAE Recommended Practice J211–1 DEC2003 (incorporated by reference, see §571.5) Channel Frequency Class 60. The webbing shall be positioned at 75 percent extension, and the displacement shall be measured using a displacement transducer. For tests specified in S5.2(j)(2)(iii)(A) and (B), the 0.7 g acceleration pulse shall be within the acceleration-time corridor shown in Figure 8 of this standard.

(A) For a retractor sensitive to vehicle acceleration—

(*1*) The retractor drum's central axis shall be oriented at the angle at which it is installed in the vehicle ±0.5 degrees. Accelerate the retractor in the horizontal plane in two directions normal to each other and measure the webbing payout; and

(*2*) If the retractor does not meet the 45-degree tilt-lock requirement of S4.3(j)(2)(i)(D), accelerate the retractor in three directions normal to each other while the retractor drum's central axis is oriented at angles of 45, 90, 135, and 180 degrees from the angle at which it is installed in the vehicle and measure webbing payout.

(B) For a retractor sensitive to webbing withdrawal—

(*1*) The retractor drum's central axis shall be oriented horizontally ±0.5 degrees. Accelerate the retractor in the direction of webbing retraction and measure webbing payout; and

(*2*) The retractor drum's central axis is oriented at angles of 45, 90, 135, and

180 degrees to the horizontal plane. Accelerate the retractor in the direction of the webbing retraction and measure the webbing payout.

(C) A retractor that is sensitive to webbing withdrawal shall be subjected to an acceleration no greater than 0.3 g occurring within a period of the first 50 ms and sustaining an acceleration no greater than 0.3 g throughout the test, while the webbing is at 75 percent extension. Measure the webbing payout.

(k) *Performance of retractor*. After completion of the corrosion-resistance test described in paragraph (a) of this section, the webbing shall be fully extended and allowed to dry for at least 24 hours under standard laboratory conditions specified in S5.1(a). The retractor shall be examined for ferrous and nonferrous corrosion which may be transferred, either directly or by means of the webbing, to a person or his clothing during use of a seat belt assembly incorporating the retractor, and for ferrous corrosion on significant surfaces if the retractor is part of the attachment hardware. The webbing shall be withdrawn manually and allowed to retract for 25 cycles. The retractor shall be mounted in an apparatus capable of extending the webbing fully, applying a force of 89 N at full extension, and allowing the webbing to retract freely and completely. The webbing shall be withdrawn from the retractor and allowed to retract repeatedly in this apparatus until 2,500 cycles are completed. The retractor and webbing shall then be subjected to the temperature resistance test prescribed in paragraph (b) of this section. The retractor shall be subjected to 2,500 additional cycles of webbing withdrawal and retraction. Then, the retractor and webbing shall be subjected to dust in a chamber similar to one illustrated in Figure 8 containing about 0.9 kg of coarse grade dust conforming to the specification given in SAE Recommended Practice J726 SEP79 (incorporated by reference, see §571.5). The dust shall be agitated every 20 minutes for 5 seconds by compressed air, free of oil and moisture, at a gage pressure of 550 ±55 kPa entering through an orifice 1.5 ±0.1 mm in diameter. The webbing shall be extended to the top of the chamber and kept extended at all times except that the webbing shall be subjected to 10 cycles of complete retraction and extension within 1 to 2 minutes after each agitation of the dust. At the end of 5 hours, the assembly shall be removed from the chamber. The webbing shall be fully withdrawn from the retractor manually and allowed to retract completely for 25 cycles. An automatic-locking retractor or a nonlocking retractor attached to pelvic restraint shall be subjected to 5,000 additional cycles of webbing withdrawal and retraction. An emergency locking retractor or a nonlocking retractor attached to upper torso restraint shall be subjected to 45,000 additional cycles of webbing withdrawal and retraction between 50 and 100 percent extension. The locking mechanism of an emergency locking retractor shall be actuated at least 10,000 times within 50 to 100 percent extension of webbing during the 50,000 cycles. At the end of test, compliance of the retractors with applicable requirements in S4.3 (h), (i), and (j) shall be determined. Three retractors shall be tested for performance.

S5.3 *Assembly performance—(a) Type 1 seat belt assembly*. Three complete seat belt assemblies, including webbing, straps, buckles, adjustment and attachment hardware, and retractors, arranged in the form of a loop as shown in Figure 5, shall be tested in the following manner:

(1) The testing machine shall conform to the requirements specified in S5.1(b). A double-roller block shall be attached to one head of the testing machine. This block shall consist of two rollers 102 mm in diameter and sufficiently long so that no part of the seat belt assembly touches parts of the block other than the rollers during test. The rollers shall be mounted on antifriction bearings and spaced 305 mm between centers, and shall have sufficient capacity so that there is no brinelling, bending or other distortion of parts which may affect the results. An anchorage bar shall be fastened to the other head of the testing machine.

(2) The attachment hardware furnished with the seat belt assembly shall be attached to the anchorage bar. The anchor points shall be spaced so that the webbing is parallel in the two

sides of the loop. The attaching bolts shall be parallel to, or at an angle of 45° or 90° to the webbing, whichever results in an angle nearest to 90° between webbing and attachment hardware except that eye bolts shall be vertical, and attaching bolts or nonthreaded anchorages of a seat belt assembly designed for use in specific models of motor vehicles shall be installed to produce the maximum angle in use indicated by the installation instructions, utilizing special fixtures if necessary to simulate installation in the motor vehicle. Rigid adapters between anchorage bar and attachment hardware shall be used if necessary to locate and orient the adjustment hardware. The adapters shall have a flat support face perpendicular to the threaded hole for the attaching bolt and adequate in area to provide full support for the base of the attachment hardware connected to the webbing. If necessary, a washer shall be used under a swivel plate or other attachment hardware to prevent the webbing from being damaged as the attaching bolt is tightened.

(3) The length of the assembly loop from attaching bolt to attaching bolt shall be adjusted to about 1295 mm, or as near thereto as possible. A force of 245 N shall be applied to the loop to remove any slack in webbing at hardware. The force shall be removed and the heads of the testing machine shall be adjusted for an assembly loop between 1220 and 1270 mm in length. The length of the assembly loop shall then be adjusted by applying a force between 89 and 98 N to the free end of the webbing at the buckle, or by the retraction force of an automatic-locking or emergency-locking retractor. A seat belt assembly that cannot be adjusted to this length shall be adjusted as closely as possible. An automatic-locking or emergency locking retractor when included in a seat belt assembly shall be locked at the start of the test with a tension on the webbing slightly in excess of the retractive force in order to keep the retractor locked. The buckle shall be in a location so that it does not touch the rollers during test, but to facilitate making the buckle release test in S5.2(d) the buckle should be between the rollers or near a roller in one leg.

(4) The heads of the testing machine shall be separated at a rate between 51 and 102 mm per minute until a force of 22,241 ±222 N is applied to the assembly loop. The extension of the loop shall be determined from measurements of head separation before and after the force is applied. The force shall be decreased to 667 ±45 N and the buckle release force measured as prescribed in S5.2(d).

(5) After the buckle is released, the webbing shall be examined for cutting by the hardware. If the yarns are partially or completely severed in a line for a distance of 10 percent or more of the webbing width, the cut webbing shall be tested for breaking strength as specified in S5.1(b) locating the cut in the free length between grips. If there is insufficient webbing on either side of the cut to make such a test for breaking strength, another seat belt assembly shall be used with the webbing repositioned in the hardware. A tensile force of 11,120 ±111 N shall be applied to the components or a force of 22,241 ±222 N shall be applied to the assembly loop. After the force is removed, the breaking strength of the cut webbing shall be determined as prescribed above.

(6) If a Type 1 seat belt assembly includes an automatic-locking retractor or an emergency-locking retractor, the webbing and retractor shall be subjected to a tensile force of 11,120 ±111 N with the webbing fully extended from the retractor.

(7) If a seat belt assembly has a buckle in which the tongue is capable of inverted insertion, one of the three assemblies shall be tested with the tongue inverted.

(b) *Type 2 seat belt assembly*. Components of three seat belt assemblies shall be tested in the following manner:

(1) The pelvic restraint between anchorages shall be adjusted to a length between 1220 and 1270 mm, or as near this length as possible if the design of the pelvic restraint does not permit its adjustment to this length. An automatic-locking or emergency-locking retractor when included in a seat belt assembly shall be locked at the start of the test with a tension on the webbing slightly in excess of the retractive

force in order to keep the retractor locked. The attachment hardware shall be oriented to the webbing as specified in paragraph (a)(2) of this section and illustrated in Figure 5. A tensile force 11,120 ±111 N shall be applied on the components in any convenient manner and the extension between anchorages under this force shall be measured. The force shall be reduced to 334 ±22 N and the buckle release force measured as prescribed in S5.2(d).

(2) The components of the upper torso restraint shall be subjected to a tensile force of 6,672 ±67 N following the procedure prescribed above for testing pelvic restraint and the extension between anchorages under this force shall be measured. If the testing apparatus permits, the pelvic and upper torso restraints may be tested simultaneously. The force shall be reduced to 334 ±22 N and the buckle release force measured as prescribed in S5.2(d).

(3) Any component of the seat belt assembly common to both pelvic and upper torso restraint shall be subjected to a tensile force of 13,344 ±134 N.

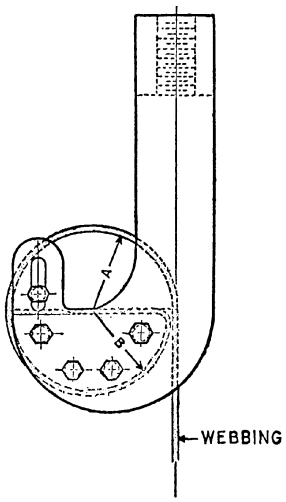
(4) After the buckle is released in tests of pelvic and upper torso restraints, the webbing shall be examined for cutting by the hardware. If the yarns are partially or completely severed in a line for a distance of 10 percent or more of the webbing width, the cut webbing shall be tested for breaking strength as specified in S5.1(b) locating the cut in the free length between grips. If there is insufficient webbing on either side of the cut to make such a test for breaking strength, another seat belt assembly shall be used with the webbing repositioned in the hardware. The force applied shall be 11,120 ±111 N for components of pelvic restraint, and 6,672 ±67 N for components of upper torso restraint. After the force is removed, the breaking strength of the cut webbing shall be determined as prescribed above.

(5) If a Type 2 seat belt assembly includes an automatic-locking retractor or an emergency-locking retractor the webbing and retractor shall be subjected to a tensile force of 11,120 ±111 N with the webbing fully extended from the retractor, or to a tensile force of 6,672 ±67 N with the webbing fully extended from the retractor if the design of the assembly permits only upper torso restraint forces on the retractor.

(6) If a seat belt assembly has a buckle in which the tongue is capable of inverted insertion, one of the three assemblies shall be tested with the tongue inverted.

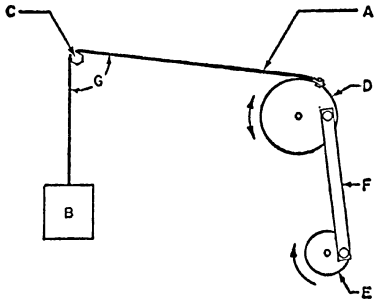
(c) *Resistance to buckle abrasion.* Seat belt assemblies shall be tested for resistance to abrasion by each buckle or manual adjusting device normally used to adjust the size of the assembly. The webbing of the assembly to be used in this test shall be exposed for 4 hours to an atmosphere having relative humidity of 65 per cent and temperature of 18 °C. The webbing shall be pulled back and forth through the buckle or manual adjusting device as shown schematically in Figure 7. The anchor end of the webbing (A) shall be attached to a mass (B) of 1.4 kg. The webbing shall pass through the buckle (C), and the other end (D) shall be attached to a reciprocating device so that the webbing forms an angle of 8° with the hinge stop (E). The reciprocating device shall be operated for 2,500 cycles at a rate of 18 cycles per minute with a stroke length of 203 mm. The abraded webbing shall be tested for breaking strength by the procedure described in paragraph S5.1(b).

S5.4 *Tolerances on angles.* Unless a range of angles is specified or a tolerance is otherwise explicitly provided, all angles and orientations of seat belt assemblies and components specified in this standard shall have a tolerance of ±3 degrees.



A 1 TO 2 INCHES OR 2.5 TO 5 CENTIMETERS
B A MINUS 0.06 INCH OR 0.15 CENTIMETER

FIGURE 1



A – WEBBING
B – WEIGHT
C – HEXAGONAL ROD
STEEL – SAE 51416
ROCKWELL HARDNESS – B-97 TO B-101
SURFACE – COLD DRAWN FINISH
SIZE – 0.250 ± 0.001 INCH OR
6.35 ± 0.03 MILLIMETER
RADIUS ON EDGES – 0.020 ± 0.004 INCH OR
0.5 ± 0.1 MILLIMETER
D – DRUM DIAMETER – 16 INCHES OR
40 CENTIMETERS
E – CRANK
F – CRANK ARM
G – ANGLE BETWEEN WEBBING – 85 ± 2 DEGS.

FIGURE 2

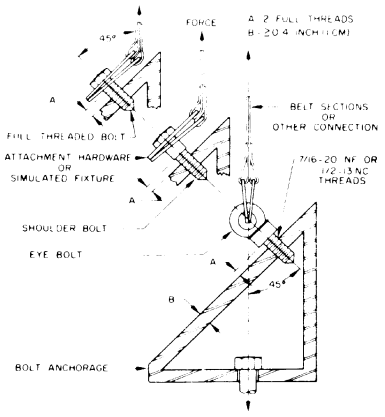


FIGURE 3

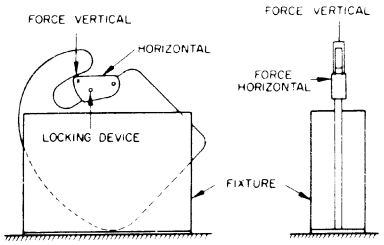


FIGURE 4
SINGLE ATTACHMENT HOOK

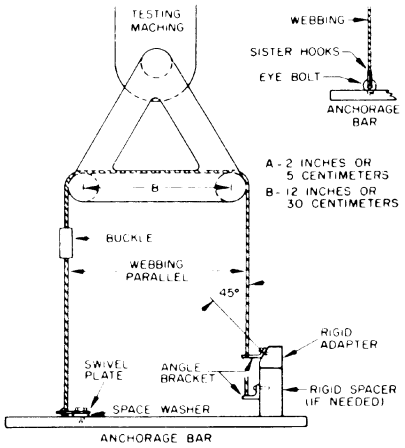


FIGURE 5

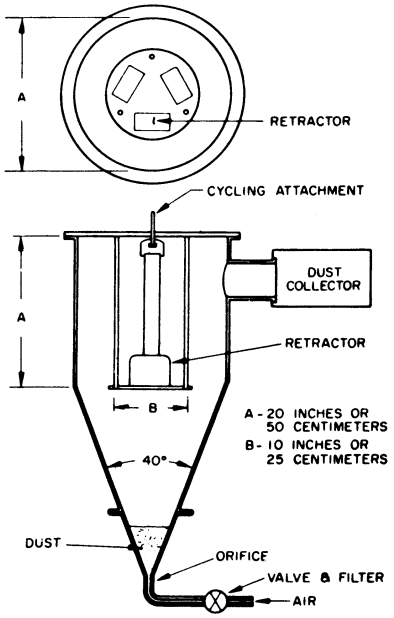


FIGURE 6

[34 F.R. 115
January 4, 1969]

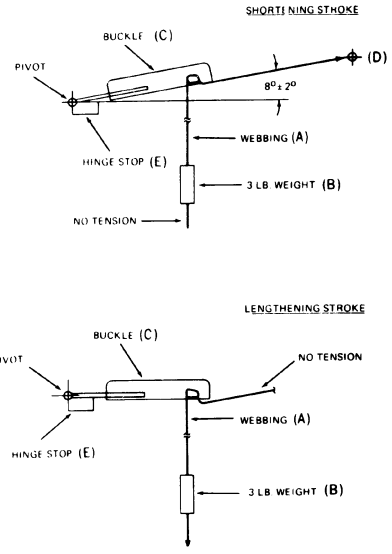
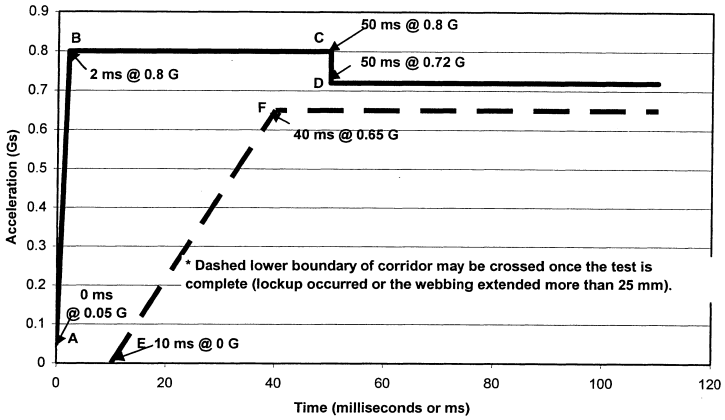


FIGURE 7

Figure 8: Acceleration Corridors



Reference Point	Time (ms)	Acceleration (g)
A	0	0.05
B	2	0.8
C	50	0.8
D	50	0.72
E	10	0
F	40	0.65

[44 FR 72139, Dec. 13, 1979]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.209, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.210 Standard No. 210; Seat belt assembly anchorages.

S1. *Purpose and scope.* This standard establishes requirements for seat belt assembly anchorages to insure their proper location for effective occupant restraint and to reduce the likelihood of their failure.

S2. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, buses, and school buses.

S3. *Definitions.*

Actuator means the device used to apply the load in performing testing.

Bridged pull yoke means the yoke that bridges the torso and pelvis on the FAD1 or FAD2 and is used for testing Type 1 seat belt assemblies.

FAD means the force application device, either the FAD1 or the FAD2, a one-piece device consisting of an upper torso portion and a pelvic portion hinged together.

FAD1 means the larger version of the force application device specified in drawings NHTSA221–210–01, ''Drawing Package for the Force Application Device 1 (FAD1),'' April 9, 2024 (incorporated by reference, see §571.5). FAD1 is depicted in figure 7 to this standard (figure provided for illustration purposes).

FAD2 means the smaller version of the force application device specified in drawings NHTSA221–210–01J, ''Drawing Package for the Force Application Device 2 (FAD2),'' April 9, 2024 (incorporated by reference; see §571.5). FAD2 is depicted in figure 8 to this standard

(figure provided for illustration purposes).

Midsagittal plane means the vertical plane that separates the FAD into equal left and right halves.

School bus torso belt adjusted height means the vertical height above the seating reference point (SgRP) of the horizontal plane containing a segment of the torso belt centerline located 25 mm to 75 mm forward of the torso belt height adjuster device, when the torso belt retractor is locked and the torso belt is pulled away from the seat back by applying a 20 N horizontal force in the forward direction through the webbing at a location 100 mm or more forward of the adjustment device as shown in Figure 5.

School bus torso belt anchor point means the midpoint of the torso belt width where the torso belt first contacts the uppermost torso belt anchorage. *Seat belt anchorage* means any component, other than the webbing or straps, involved in transferring seat belt loads to the vehicle structure, including, but not limited to, the attachment hardware, seat frames, seat pedestals, the vehicle structure itself, and any part of the vehicle whose failure causes separation of the belt from the vehicle structure.

Seat reference plane means the vertical plane that passes through the ''seating reference point'' (as defined at 49 CFR 571.3) and is parallel to the direction that the seat faces.

Small occupant seating position is as defined in 49 CFR 571.222.

S4. *Requirements.*

S4.1 *Type.*

S4.1.1 Seat belt anchorages for a Type 1 or a Type 2 seat belt assembly shall be installed for each designated seating position for which a Type 1 or a Type 2 seat belt assembly is required by Standard No. 208 (49 CFR 571.208). Seat belt anchorages for a Type 2 seat belt assembly shall be installed for each designated seating position for which a Type 2 seat belt assembly is required by Standard No. 208 (49 CFR 571.208).

S4.1.2 (a) Notwithstanding the requirement of S4.1.1, each vehicle manufactured on or after September 1, 1987 that is equipped with an automatic restraint at the front right outboard designated seating position, which automatic restraint cannot be used for securing a child restraint system or cannot be adjusted by the vehicle owner to secure a child restraint system solely through the use of attachment hardware installed as an item of original equipment by the vehicle manufacturer, shall have, at the manufacturer's option, either anchorages for a Type 1 seat belt assembly installed at that position or a Type 1 or Type 2 seat belt assembly installed at that position. If a manufacturer elects to install anchorages for a Type 1 seat belt assembly to comply with this requirement, those anchorages shall consist of, at a minimum, holes threaded to accept bolts that comply with S4.1(f) of Standard No. 209 (49 CFR 571.209).

(b) The requirement in S4.1.1 of this standard that seat belt anchorages for a Type 1 or a Type 2 seat belt assembly shall be installed for certain designated seating positions does not apply to any such seating positions that are equipped with a seat belt assembly that meets the frontal crash protection requirements of S5.1 of Standard No. 208 (49 CFR 571.208).

S4.1.3 *School bus passenger seats.*

S4.1.3.1 For school buses manufactured on or after October 21, 2011, seat belt anchorages for school bus passenger seats must be attached to the school bus seat structure, including seats with wheelchair positions or side emergency doors behind them. Seats with no other seats behind them, no wheelchair positions behind them and no side emergency door behind them are excluded from the requirement that the seat belt anchorages must be attached to the school bus seat structure. For school buses with a GVWR less than or equal to 4,536 kg (10,000 pounds), the seat belt shall be Type 2 as defined in S3. of FMVSS No. 209 (49 CFR 571.209). For school buses with a GVWR greater than 4,536 kg (10,000 pounds), the seat belt shall be Type 1 or Type 2 as defined in S3. of FMVSS No. 209 (49 CFR 571.209).

S4.1.3.2 Type 2 seat belt anchorages on school buses manufactured on or after October 21, 2011 must meet the following location requirements.

(a) For a small occupant seating position of a flexible occupancy seat, as defined in 49 CFR 571.222, the school bus torso belt anchor point must be 400 mm or more vertically above the seating reference point (SgRP) or adjustable to 400 mm or more vertically above the SgRP. For all other seating positions, the school bus torso belt anchor point must be 520 mm or more vertically above the SgRP or adjustable to 520 mm or more vertically above the SgRP. The school bus torso belt adjusted height at each seating position shall be adjustable to no more than 280 mm vertically above the SgRP in the lowest position and no less than the required vertical height of the school bus torso belt anchor point for that seating position in the highest position. (*See* Figure 4.)

(b) The minimum lateral distance between the vertical centerline of the bolt holes or the centroid of any other means of attachment to the structure specified in 4.1.3.1, simultaneously achievable by all seating positions, must be:

(i) 280 mm for seating positions in a flexible occupancy seat in a maximum occupancy configuration, as defined in 49 CFR 571.222; and

(ii) 330 mm for all other seating positions.

S4.1.3.3 School buses with a GVWR less than or equal to 4,536 kg (10,000 pounds) must meet the requirements of S4.2.2 of this standard.

S4.1.3.4 School buses with a GVWR greater than 4,536 kg (10,000 pounds) manufactured on or after October 21, 2011, with Type 1 seat belt anchorages, must meet the strength requirements specified in S4.2.1 of this standard.

S4.1.3.5 School buses with a GVWR greater than 4,536 kg (10,000 pounds) manufactured on or after October 21, 2011, with Type 2 seat belt anchorages, must meet the strength requirements specified in S4.2.2 of this standard.

S4.2 *Strength.*

S4.2.1 *Seats with Type 1 or certain Type 2 seat belt assemblies.*

(a) For vehicles manufactured on or after September 17, 2024, and before September 1, 2027, except as provided in S4.2.5, the anchorages, attachment hardware, and attachment bolts for any of the following seat belt assemblies shall withstand a 22,241 N (5,000 pound) force when tested in accordance with, at the choice of the manufacturer, S5.1(a), (b), or (c):

(1) Type 1 seat belt assembly; and

(2) Lap belt portion of either a Type 2 or automatic seat belt assembly, if such seat belt assembly is equipped with a detachable upper torso belt.

(b) For vehicles manufactured on or after September 1, 2027, except as provided in S4.2.5, the anchorages, attachment hardware, and attachment bolts for any of the following seat belt assemblies shall withstand a 22,241 N (5,000 pound) force when tested in accordance with, at the choice of the manufacturer, S5.1(b) or (c):

(1) Type 1 seat belt assembly; and

(2) Lap belt portion of either a Type 2 or automatic seat belt assembly, if such seat belt assembly is equipped with a detachable upper torso belt.

S4.2.2 *Seats with certain Type 2 or automatic seat belt assemblies.*

(a) For vehicles manufactured on or after September 17, 2024, and before September 1, 2027, except as provided in S4.2.5, the anchorages, attachment hardware, and attachment bolts for any of the following seat belt assemblies shall withstand a 13,345 N (3,000 pound) force applied to the lap belt portion of the seat belt assembly simultaneously with a 13,345 N (3,000 pound) force applied to the shoulder belt portion of the seat belt assembly, when tested in accordance with, at the choice of the manufacturer, S5.2(a), (b), or (c):

(1) Type 2 and automatic seat belt assemblies that are installed to comply with Standard No. 208 (49 CFR 571.208); and

(2) Type 2 and automatic seat belt assemblies that are installed at a seating position required to have a Type 1 or Type 2 seat belt assembly by Standard No. 208 (49 CFR 571.208).

(b) For vehicles manufactured on or after September 1, 2027, except as provided in S4.2.5, the anchorages, attachment hardware, and attachment bolts for any of the following seat belt assemblies shall withstand a 13,345 N (3,000 pound) force applied to the lap belt portion of the seat belt assembly simultaneously with a 13,345 N (3,000 pound) force applied to the shoulder

belt portion of the seat belt assembly, when tested in accordance with, at the choice of the manufacturer, S5.2(b) or (c):

(1) Type 2 and automatic seat belt assemblies that are installed to comply with Standard No. 208 (49 CFR 571.208); and

(2) Type 2 and automatic seat belt assemblies that are installed at a seating position required to have a Type 1 or Type 2 seat belt assembly by Standard No. 208 (49 CFR 571.208).

S4.2.3 Permanent deformation or rupture of a seat belt anchorage or its surrounding area is not considered to be a failure, if the required force is sustained for the specified time.

S4.2.4 Anchorages, attachment hardware, and attachment bolts shall be tested by simultaneously loading them in accordance with the applicable procedures set forth in S5 of this standard if the anchorages are either:

(a) For designated seating positions that are common to the same occupant seat and that face in the same direction, or

(b) For laterally adjacent designated seating positions that are not common to the same occupant seat, but that face in the same direction, if the vertical centerline of the bolt hole for at least one of the anchorages for one of those designated seating positions is within 305 mm of the vertical center line of the bolt hole for an anchorage for one of the adjacent seating positions.

S4.2.5 The attachment hardware of a seat belt assembly, which is subject to the requirements of S5.1 of Standard No. 208 (49 CFR 571.208) by virtue of any provision of Standard No. 208 other than S4.1.2.1(c)(2) of that standard, does not have to meet the requirements of S4.2.1 and S4.2.2 of this standard.

S4.2.6 *Manufacturer's choice of compliance option.* The manufacturer shall select the compliance option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon the request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it selected for a particular vehicle or make/model.

S4.3 *Location.* As used in this section, ''forward'' means the direction in which the seat faces, and other directional references are to be interpreted accordingly. Anchorages for seat belt assemblies that meet the frontal crash protection requirements of S5.1 of Standard No. 208 (49 CFR 571.208) are exempt from the location requirements of this section.

S4.3.1 *Seat belt anchorages for Type 1 seat belt assemblies and the pelvic portion of Type 2 seat belt assemblies.*

S4.3.1.1 In an installation in which the seat belt does not bear upon the seat frame:

(a) If the seat is a nonadjustable seat, then a line from the seating reference point to the nearest contact point of the belt with the anchorage shall extend forward from the anchorage at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

(b) If the seat is an adjustable seat, then a line from a point 64 mm forward of and 10 mm above the seating reference point to the nearest contact point of the belt with the anchorage shall extend forward from the anchorage at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

S4.3.1.2 In an installation in which the belt bears upon the seat frame, the seat belt anchorage, if not on the seat structure, shall be aft of the rearmost belt contact point on the seat frame with the seat in the rearmost position. The line from the seating reference point to the nearest belt contact point on the seat frame, with the seat positioned at the seating reference point, shall extend forward from that contact point at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

S4.3.1.3 In an installation in which the seat belt attaches to the seat structure, the line from the seating reference point to the nearest contact point of the belt with the hardware attaching it to the seat structure shall extend forward from that contact point at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

S4.3.1.4 Anchorages for an individual seat belt assembly shall be located at least 165 mm apart laterally, measured between the vertical center line of the bolt holes or, for designs using other means of attachment to the vehicle structure, between the centroid of such means.

S4.3.2 *Seat belt anchorages for the upper torso portion of Type 2 seat belt assemblies.* Adjust the seat to its full rearward and downward position and adjust the seat back to its most upright position. Except a small occupant seating position as defined in 49 CFR 571.222, with the seat and seat back so positioned, as specified by subsection (a) or (b) of this section, the upper end of the upper torso restraint shall be located within the acceptable range shown in Figure 1, with reference to a two-dimensional drafting template described in SAE Standard J826 MAY87 (incorporated by reference, see §571.5). The template's ''H'' point shall be at the design ''H'' point of the seat for its full rearward and full downward position, as defined in SAE Recommended Practice J1100 JUN84 (incorporated by reference, see §571.5), and the template's torso line shall be at the same angle from the vertical as the seat back.

(a) For fixed anchorages, compliance with this section shall be determined at the vertical centerline of the bolt holes or, for designs using another means of attachment to the vehicle structure, at the centroid of such means.

(b) Except for seating positions on school bus bench seats, compliance with this section shall be determined with adjustable anchorages at the midpoint of the adjustment range of all adjustable positions. For seating positions on school bus bench seats, place adjustable anchorages and torso belt height adjusters in their uppermost position.

S5. *Test procedures.*

(a) *General provisions.* Where a range of values is specified, the vehicle shall be able to meet the requirements at all points within the range. The anchorage shall be connected to material whose breaking strength is equal to or greater than the breaking strength of the webbing for the seat belt assembly installed as original equipment at that seating position. The geometry of the attachment duplicates the geometry, at the initiation of the test, of the attachment of the originally installed seat belt assembly.

(b) *Seat adjustment.* If adjustable, the seat shall be adjusted in the following way. Using any seat adjustment controls, place the seat and its components into the configurations and positions of the rearmost normal design driving or riding position consistent with the seating reference point (SgRP), where rearmost is in reference to the direction the seat is facing. The seat may face any direction in which it can be occupied while the vehicle is in motion.

(c) *Shoulder belt anchorage height adjustment.* The shoulder belt anchorage height adjustment (D-ring) may be set to any height.

S5.1 *Seats with Type 1 or certain Type 2 seat belt assemblies.*

(a) Apply a force of 22,241 N (5,000 pounds) in the direction in which the seat faces to a pelvic body block as described in figure 2A to this standard, in a plane parallel to the seat reference plane with an initial force application angle of not less than 5 degrees or more than 15 degrees above the horizontal. Apply the force at the onset rate of not more than 222,411 N (50,000 pounds) per second. Attain the 22,241 N (5,000 pound) force in not more than 30 seconds and maintain it for 10 seconds. At the manufacturer's option, the pelvic body block described in figure 2B to this standard may be substituted for the pelvic body block described in figure 2A to apply the specified force to the center set(s) of anchorages for any group of three or more sets of anchorages that are simultaneously loaded in accordance with S4.2.4.

(b) Choose the FAD(s) in accordance with S5.4 and position the FAD(s) in accordance with S5.5. Apply a force of 22,241 N (5,000 pounds) to the actuator attachment point of the bridged pull yoke attached to the FAD1 or FAD2 in the direction in which the seat faces, in a plane parallel to the seat reference plane with an initial force application angle of not less than 5 degrees or more than 15 degrees above the horizontal. Apply the force at the onset rate of not more than 222,411 N (50,000 pounds) per

second. Attain the 22,241 N (5,000 pound) force in not more than 30 seconds and maintain it for 10 seconds.

(c) Apply a force of 22,241 N (5,000 pounds) in the direction in which the seat faces to a pelvic body block as described in figure 2A to this standard and positioned in accordance with S5.3.1, in a plane parallel to the seat reference plane with an initial force application angle of not less than 5 degrees or more than 15 degrees above the horizontal. Apply the force at the onset rate of not more than 222,411 N (50,000 pounds) per second. Attain the 22,241 N (5,000 pound) force in not more than 30 seconds and maintain it for 10 seconds. At the manufacturer's option, the pelvic body block described in figure 2B to this standard may be substituted for the pelvic body block described in figure 2A to apply the specified force to the center set(s) of anchorages for any group of three or more sets of anchorages that are simultaneously loaded in accordance with S4.2.4.

S5.2 *Seats with certain Type 2 or automatic seat belt assemblies.*

(a) Apply forces of 13,345 N (3,000 pounds) in the direction in which the seat faces simultaneously to a pelvic body block (as described in figure 2A to this standard) and an upper torso body block (as described in figure 3 to this standard) in a plane parallel to the seat reference plane with an initial force application angle of not less than 5 degrees or more than 15 degrees above the horizontal. Apply the forces at the onset rate of not more than 133,447 N (30,000 pounds) per second. Attain the 13,345 N (3,000 pound) force in not more than 30 seconds and maintain it for 10 seconds. At the manufacturer's option, the pelvic body block described in figure 2B to this standard may be substituted for the pelvic body block described in figure 2A to apply the specified force to the center set(s) of anchorages for any group of three or more sets of anchorages that are simultaneously loaded in accordance with S4.2.4.

(b) Choose the FAD(s) in accordance with S5.4 and position the FAD(s) in accordance with S5.5. Apply forces of 13,345 N (3,000 pounds) in the direction in which the seat faces simultaneously, to the eye bolt attached to the pull bracket of the torso pull yoke on the FAD and the thru hole on the pelvis of the FAD in a plane parallel to the seat reference plane with an initial force application angle of not less than 5 degrees or more than 15 degrees above the horizontal. Apply the forces at the onset rate of not more than 133,447 N (30,000 pounds) per second. Attain the 13,345 N (3,000 pound) force in not more than 30 seconds and maintain it for 10 seconds.

(c) Position a pelvic body block (as described in figure 2A to this standard) and an upper torso body block (as described in figure 3 to this standard) as described in S5.3. There shall be no contact between the pelvic and torso body blocks at the end of the preload force application (*i.e.*, before the test force is applied). Apply forces of 13,345 N (3,000 pounds) in the direction in which the seat faces simultaneously to the pelvic body block and the upper torso body block in a plane parallel to the seat reference plane with an initial force application angle of not less than 5 degrees or more than 15 degrees above the horizontal. Apply the forces at the onset rate of not more than 133,447 N (30,000 pounds) per second. Attain the 13,345 N (3,000 pound) force in not more than 30 seconds and maintain it for 10 seconds. At the manufacturer's option, the pelvic body block described in figure 2B to this standard may be substituted for the pelvic body block described in figure 2A to apply the specified force to the center set(s) of anchorages for any group of three or more sets of anchorages that are simultaneously loaded in accordance with S4.2.4.

S5.3 *Body Block Zones.*

S5.3.1 *Pelvic Body Block Zone.*

(a) With a 1,335 N (300 pound) force being applied to the pelvic body block in the direction in which the seat faces, the target depicted in figure 2A or figure 2B to this standard shall lie within the zone described in S5.3.1(a)(1) through (3) and in table 1 to this standard (and depicted in figure 6 to this standard):

(1) At or rearward of the transverse vertical plane of the vehicle located 50 mm longitudinally forward of the

SgRP and at or forward of the transverse vertical plane located 155 mm rearward of the SgRP.

(2) At or below the horizontal plane located 210 mm above the SgRP and at or above the horizontal plane 65 mm above the SgRP.

(3) At or rightward of the plane parallel to the seat reference plane and located 170 mm to the left of the SgRP and at or leftward of the plane parallel to the seat reference plane and located 170 mm to the right of the SgRP.

S5.3.2 *Torso Body Block Zone.*

(a) With a 1,335 N (300 pound) force being applied to the torso body block in the direction in which the seat faces, the target depicted in figure 3 to this standard shall lie within the zones described in S5.3.2(a)(1) through (3) and in table 1 to this standard (and depicted in figure 6 to this standard):

(1) At or rearward of the transverse vertical plane of the vehicle located 230 mm longitudinally forward of the SgRP and at or forward of the transverse vertical plane located 10 mm rearward of the SgRP.

(2) At or below the horizontal plane located 425 mm above the SgRP and at or above the horizontal plane 180 mm above the SgRP.

(3) At or rightward of the plane parallel to the seat reference plane and located 265 mm to the left of the SgRP and at or leftward of the plane parallel to the seat reference plane and located 265 mm to the right of the SgRP.

S5.4 *Choice of FAD.*

(a) If testing in accordance with S4.2.4, position a FAD1 in accordance with S5.5 at each DSP being simultaneously tested. If there is contact between adjacent FAD1s when positioned as required by S5.5, or if adjacent FAD1s cannot be positioned as required by S5.5 due to contact with each other, then replace the FAD1(s) according to the following hierarchy.

(1) For forward or rearward facing designated seating positions:

(i) If contact occurs between a FAD1 in an inboard seat and a FAD1 in an outboard seat, replace the FAD1 in the inboard seat with a FAD2.

(ii) If contact occurs between adjacent FAD1s in inboard seats, replace the FAD1 on the right-hand side (as viewed in the direction the seat is facing) with a FAD2. For multiple instances of contact between FAD1s, begin replacing FAD1s at the rightmost seating position.

(iii) If contact occurs between an inboard FAD1 and an inboard FAD2, replace the FAD1 with a FAD2.

(iv) If contact occurs between a FAD1 in an outboard seat and a FAD2 in an inboard seat, replace the FAD1 in the outboard seat with a FAD2.

(2) For non-forward and non-rearward facing designated seating positions:

(i) If contact occurs between adjacent FAD1s, replace the FAD1 on the right-hand side (as viewed in the direction the seat is facing) with a FAD2. If contact remains, replace the FAD1 on the left-hand side with a FAD2. For multiple instances of contact between FAD1s, begin replacing FAD1s at the rightmost seating position.

S5.5 *FAD Positioning Procedure.*

(a) Place the FAD1 or FAD2 on the seat such that the midsagittal plane is parallel to and within 10 mm of the seat reference plane, with the torso portion of the FAD contacting the seat back.

(b) While keeping the midsagittal plane within 10 mm of the seat reference plane, move the pelvis portion of the FAD toward the seat back until it contacts the seat back.

(c) If the torso is not in contact with the seat back, rotate the torso portion of the FAD while holding the pelvis in place until the back of the torso contacts the seat back.

(d) Buckle and position the seat belt so that the lap belt secures the pelvis portion of the FAD and the shoulder belt secures the torso portion of the FAD.

(e) Remove all slack from the seat belt.

(f) If testing a Type 2 or Type 2A seat belt assembly, attach one actuator to the eye bolt attached to the pull bracket of the torso pull yoke on the FAD and one to the thru hole on the pelvis of the FAD. If testing a Type 1 seat belt assembly, attach the actuator to the actuator attachment point on the bridged pull yoke attached to the FAD.

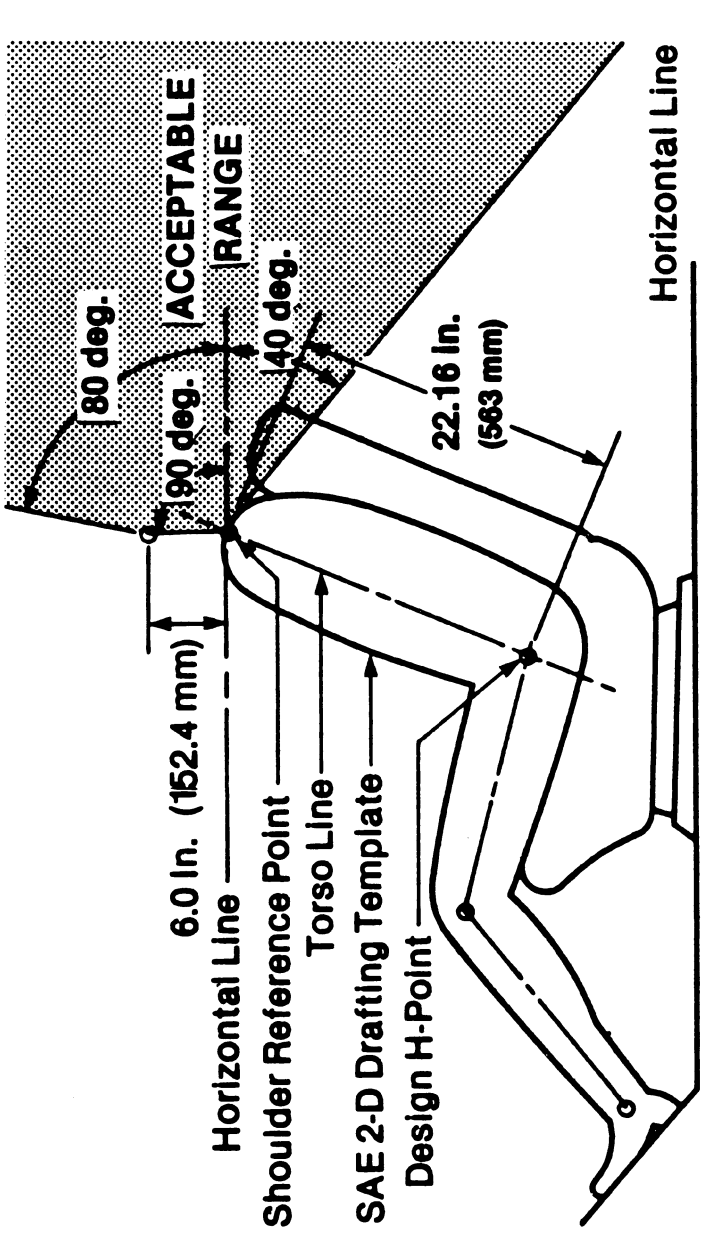


FIGURE 1 - LOCATION OF ANCHORAGE FOR UPPER TORSO RESTRAINT

S6. *Owner's Manual Information.* The owner's manual in each vehicle with a gross vehicle weight rating of 4,536 kg or less manufactured after September 1, 1987 shall include:

(a) A section explaining that all child restraint systems are designed to be secured in vehicle seats by lap belts or the lap belt portion of a lap-shoulder belt. The section shall also explain that children could be endangered in a crash if their child restraints are not properly secured in the vehicle.

(b) In a vehicle with rear designated seating positions, a statement alerting vehicle owners that, according to accident statistics, children are safer when properly restrained in the rear seating positions than in the front seating positions.

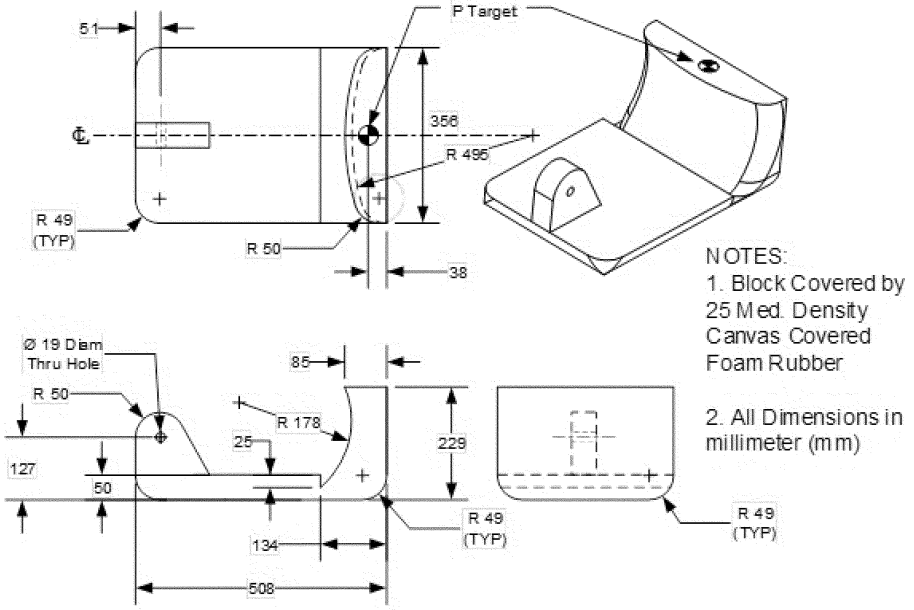


Figure 2A to §571.210—Body Block for Lap Belt Anchorage and Target Location

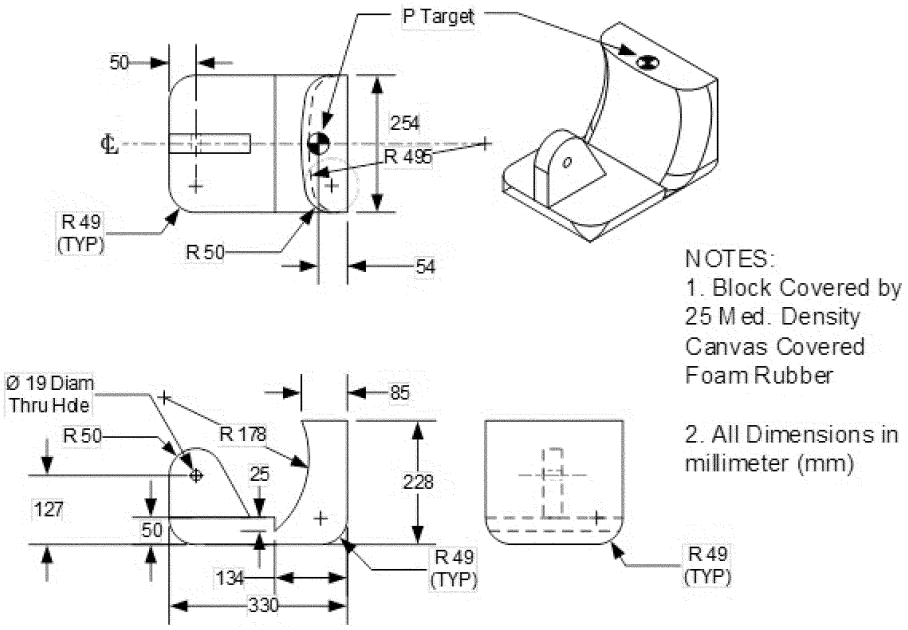


Figure 2B to § 571.210—Optional Body Block for Center Seating Positions Lap Belt Anchorage and Target Location

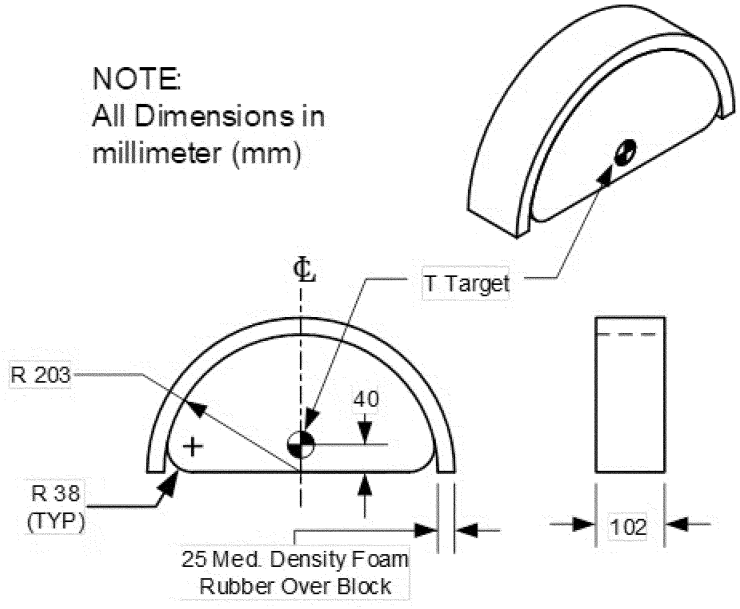


Figure 3 to § 571.210—Body Block for Combination Shoulder and Lap Belt Anchorage and Target Location

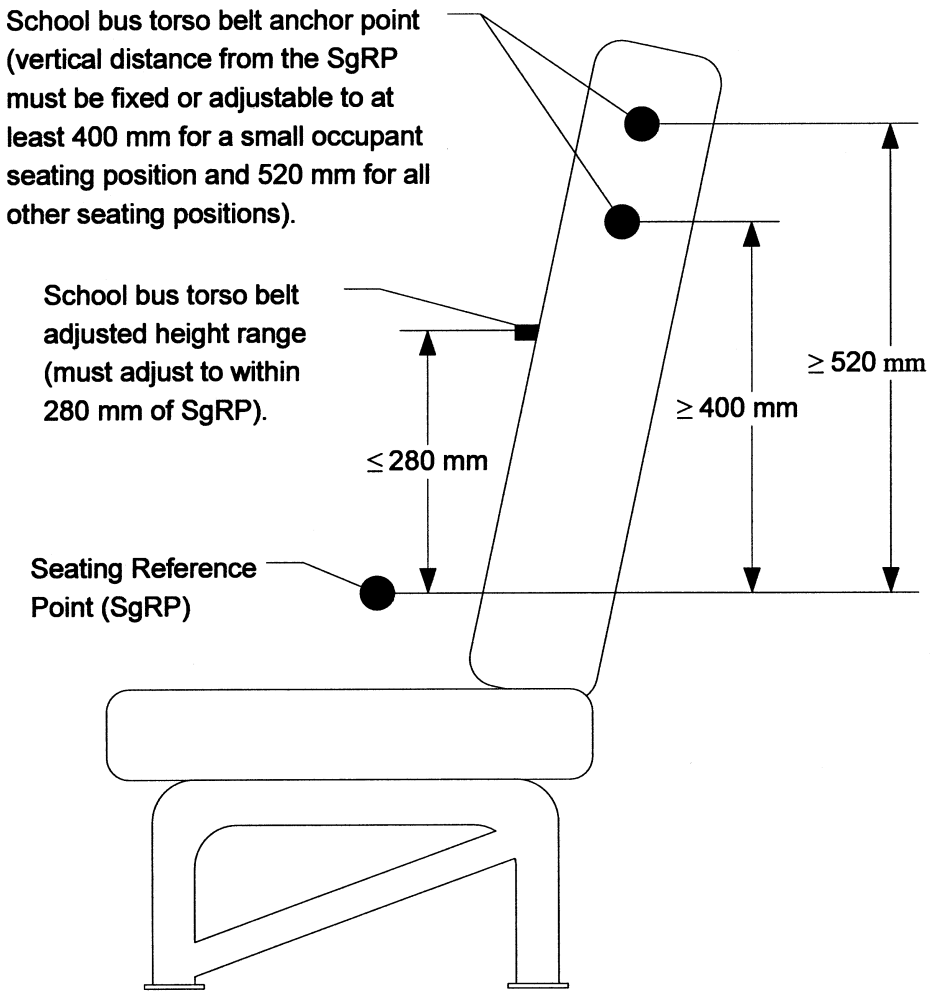


Figure 4 - Seat belt anchorage diagram

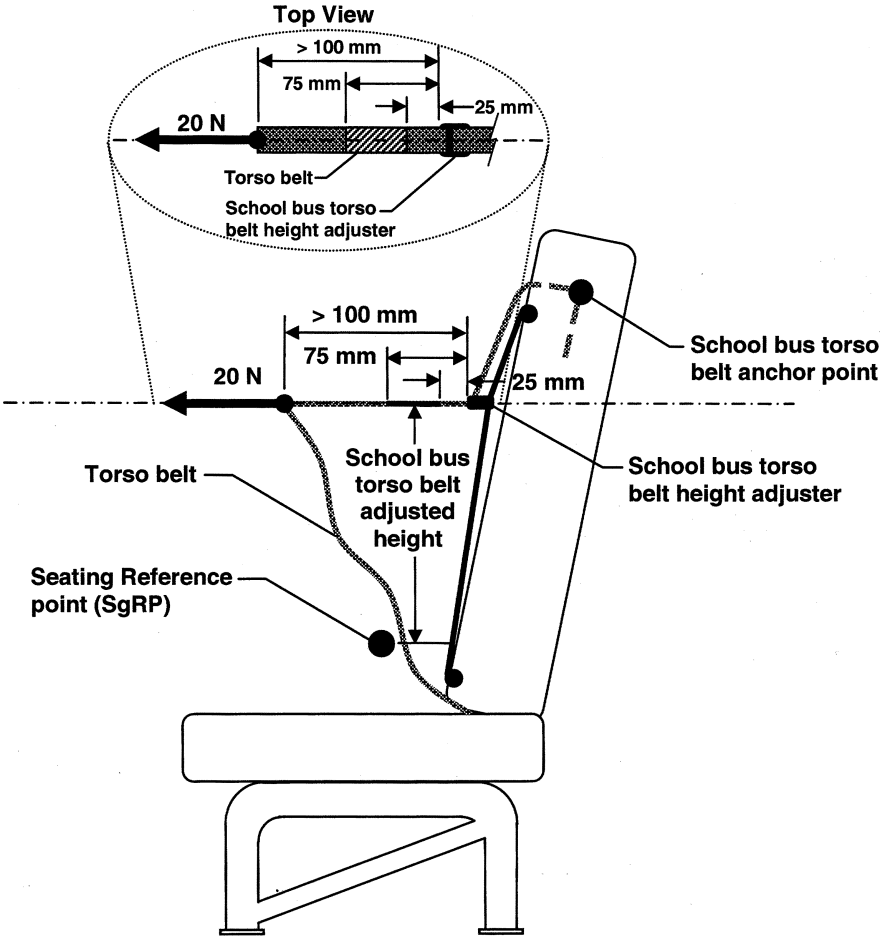


Figure 5 – Minimum school bus torso belt adjusted height measurement

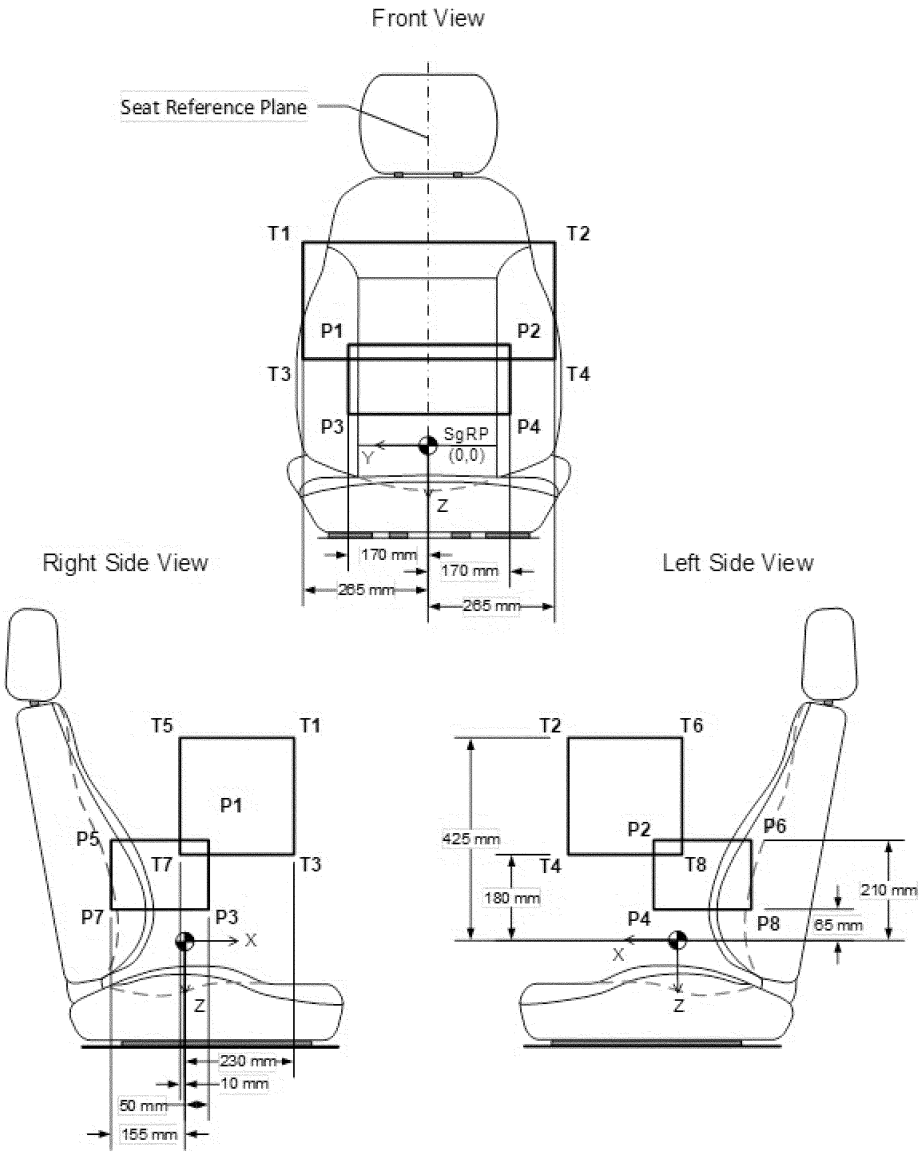


Figure 6 to §571.210—Body Block Zones (provided for illustration purposes)

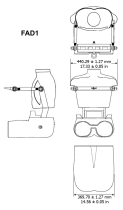


Figure 7 to § 571.210—FAD1 (provided for illustration purposes)

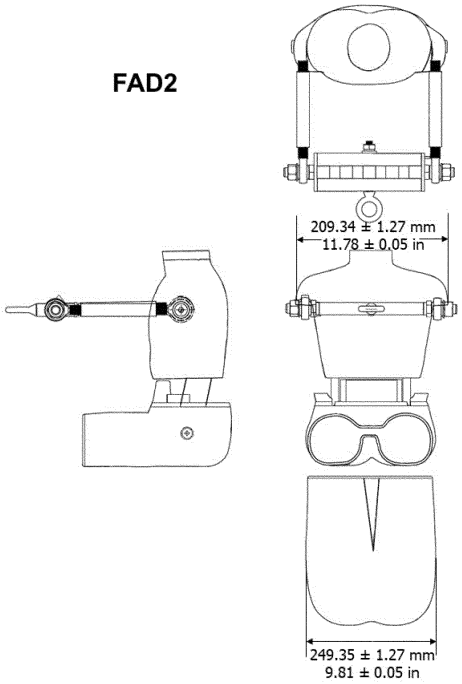


Figure 8 to § 571.210—FAD2 (provided for illustration purposes)

TABLE 1 TO § 571.210–COORDINATES OF THE VERTICES FROM THE SgRP

Coordinates of Zone Vertices from SgRP; [(X,Y,Z) in (mm) and *(in)*]					
Vertices of Torso Body Block Zone.	T1	(230, 265, −425) (9.1, 10.4, −16.7)	Vertices of Pelvic Body Block Zone.	P1	(50, 170, −210) (2, 6.7, −8.3)
	T2	(230, −265, −425) (9.1, −10.4, −16.7)		P2	(50, −170, −210) (2, −6.7, −8.3)
	T3	(230, 265, −180) (9.1, 10.4, −7.1)		P3	(50, 170, −65) (2, 6.7, −2.6)

TABLE 1 TO §571.210–COORDINATES OF THE VERTICES FROM THE SgRP—Continued

	T4	(230, −265, −180) (9.1, −10.4, −7.1)		P4	(50, −170, −65) (2, −6.7, −2.6)
	T5	(−10, 265, −425) (−.4, 10.4, −16.7)		P5	(−155, 170, −210) (−6.1, 6.7, −8.3)
	T6	(−10, −265, −425) (−.4, −10.4, −16.7)		P6	(−155, −170, −210) (−6.1, −6.7, −8.3)
	T7	(−10, 265, −180) (−.4, 10.4, −7.1)		P7	(−155, 170, −65) (−6.1, 6.7, −2.6)
	T8	(−10, −265, −180) (−.4, −10.4, −7.1)		P8	(−155, −170, −65) (−6.1, −6.7, −2.6)

[36 FR 22902, Dec. 2, 1971]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.210, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.211 [Reserved]

§571.212 Standard No. 212; Windshield mounting.

S1. *Scope*. This standard establishes windshield retention requirements for motor vehicles during crashes.

S2. *Purpose*. The purpose of this standard is to reduce crash injuries and fatalities by providing for retention of the vehicle windshield during a crash, thereby utilizing fully the penetration-resistance and injury-avoidance properties of the windshield glazing material and preventing the ejection of occupants from the vehicle.

S3. *Application*. This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks designed to carry at least one person, and buses having a gross vehicle weight rating of 4,536 kilograms or less. However, it does not apply to forward control vehicles, walk-in van-type vehicles, or to open-body type vehicles with fold-down or removable windshields.

S4. *Definition*. *Passive restraint system* means a system meeting the occupant crash protection requirements of S5. of Standard No. 208 by means that require no action by vehicle occupants.

S5. *Requirements*. When the vehicle travelling longitudinally forward at any speed up to and including 48 kilometers per hour impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, under the conditions of S6, the windshield mounting of the vehicle shall retain not less than the minimum portion of the windshield periphery specified in S5.1 and S5.2.

S5.1 *Vehicles equipped with passive restraints*. Vehicles equipped with passive restraint systems shall retain not less than 50 percent of the portion of the windshield periphery on each side of the vehicle longitudinal centerline.

S5.2 *Vehicles not equipped with passive restraints*. Vehicles not equipped with passive restraint systems shall retain not less than 75 percent of the windshield periphery.

S6. *Test conditions*. The requirements of S5. shall be met under the following conditions:

S6.1 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) Except as specified in S6.2, a passenger car is loaded to its unloaded vehicle weight plus its cargo and luggage capacity weight, secured in the luggage area, plus a 50th-percentile test dummy as specified in part 572 of this chapter at each front outboard designated seating position and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208. Each dummy is restrained only by means that are installed for protection at its seating position.

(b) Except as specified in S6.2, a multipurpose passenger vehicle, truck or bus is loaded to its unloaded vehicle weight, plus 136 kilograms or its rated cargo and luggage capacity, whichever is less, secured to the vehicle, plus a 50th-percentile test dummy as specified

in part 572 of this chapter at each front outboard designated seating position and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208. Each dummy is restrained only by means that are installed for protection at its seating position. The load is distributed so that the weight on each axle as measured at the tire-ground interface is in proportion to its GAWR. If the weight on any axle when the vehicle is loaded to its unloaded vehicle weight plus dummy weight exceeds the axle's proportional share of the test weight, the remaining weight is placed so that the weight on that axle remains the same. For the purposes of this section, unloaded vehicle weight does not include the weight of work-performing accessories. Vehicles are tested to a maximum unloaded vehicle weight of 2,495 kilograms.

S6.2 The fuel tank is filled to any level from 90 to 95 percent of capacity.

S6.3 The parking brake is disengaged and the transmission is in neutral.

S6.4 Tires are inflated to the vehicle manufacturer's specifications.

S6.5 The windshield mounting material and all vehicle components in direct contact with the mounting material are at any temperature between −9 degrees Celsius and + 43 degrees Celsius.

[41 FR 36494, Aug. 30, 1976, as amended at 42 FR 34289, July 5, 1977; 45 FR 22046, Apr. 3, 1980; 60 FR 13647, Mar. 14, 1995; 87 FR 18597, Mar. 30, 2022]

§ 571.213 Child restraint systems; Applicable unless a vehicle or child restraint system is certified to § 571.213b.

S1. *Scope*. This standard specifies requirements for child restraint systems used in motor vehicles and aircraft.

S2. *Purpose*. The purpose of this standard is to reduce the number of children killed or injured in motor vehicle crashes and in aircraft.

S3. *Application*. This standard applies to passenger cars, multipurpose passenger vehicles, trucks and buses, and to child restraint systems for use in motor vehicles and aircraft, manufactured before December 5, 2026. FMVSS No. 213b applies to child restraint systems manufactured on or after December 5, 2026.

S4. *Definitions*.

Add-on child restraint system means any portable child restraint system.

Backless child restraint system means a child restraint, other than a belt-positioning seat, that consists of a seating platform that does not extend up to provide a cushion for the child's back or head and has a structural element designed to restrain forward motion of the child's torso in a forward impact.

Belt-positioning seat means a child restraint system that positions a child on a vehicle seat to improve the fit of a vehicle Type II belt system on the child and that lacks any component, such as a belt system or a structural element, designed to restrain forward movement of the child's torso in a forward impact.

Booster seat means either a backless child restraint system or a belt-positioning seat.

Built-in child restraint system means a child restraint system that is designed to be an integral part of and permanently installed in a motor vehicle.

Car bed means a child restraint system designed to restrain or position a child in the supine or prone position on a continuous flat surface.

Child restraint anchorage system is defined in S3 of FMVSS No. 225 (§ 571.225).

Child restraint system means any device, except Type I or Type II seat belts, designed for use in a motor vehicle or aircraft to restrain, seat, or position children who weigh 36 kilograms (kg) (80 lb) or less.

Contactable surface means any child restraint system surface (other than that of a belt, belt buckle, or belt adjustment hardware) that may contact any part of the head or torso of the appropriate test dummy, specified in S7, when a child restraint system is tested in accordance with S6.1.

Factory-installed built-in child restraint system means a built-in child restraint system that has been or will be permanently installed in a motor vehicle before that vehicle is certified as a completed or altered vehicle in accordance with part 567 of this chapter.

Harness means a combination pelvic and upper torso child restraint system

that consists primarily of flexible material, such as straps, webbing or similar material, and that does not include a rigid seating structure for the child.

Rear-facing child restraint system means a child restraint system, except a car bed, that positions a child to face in the direction opposite to the normal direction of travel of the motor vehicle.

Representative aircraft passenger seat means either a Federal Aviation Administration approved production aircraft passenger seat or a simulated aircraft passenger seat conforming to Figure 6.

School bus child restraint system means an add-on child restraint system (including a harness) manufactured and sold only for use on school bus seats, that has a label conforming with S5.3.1(b). (This definition applies to child restraint systems manufactured on or after June 30, 2025.)

Seat orientation reference line or *SORL* means the horizontal line through Point Z as illustrated in Figure 1A.

Specific vehicle shell means the actual vehicle model part into which the built-in child restraint system is or is intended to be fabricated, including the complete surroundings of the built-in system. If the built-in child restraint system is or is intended to be fabricated as part of any seat other than a front seat, these surroundings include the back of the seat in front, the interior rear side door panels and trim, the floor pan, adjacent pillars (e.g., the B and C pillars), and the ceiling. If the built-in system is or is intended to be fabricated as part of the front seat, these surroundings include the dashboard, the steering mechanism and its associated trim hardware, any levers and knobs installed on the floor or on a console, the interior front side door panels and trim, the front seat, the floor pan, the A pillars and the ceiling.

Tether anchorage is defined in S3 of FMVSS No. 225 (§571.225).

Tether strap is defined in S3 of FMVSS No. 225 (§571.225).

Tether hook is defined in S3 of FMVSS No. 225 (§571.225).

Torso means the portion of the body of a seated anthropomorphic test dummy, excluding the thighs, that lies between the top of the child restraint system seating surface and the top of the shoulders of the test dummy.

S5. *Requirements.* (a) Each motor vehicle with a built-in child restraint system shall meet the requirements in this section when, as specified, tested in accordance with S6.1 and this paragraph.

(b) Each child restraint system manufactured for use in motor vehicles shall meet the requirements in this section when, as specified, tested in accordance with S6.1 and this paragraph. Each add-on system shall meet the requirements at each of the restraint's seat back angle adjustment positions and restraint belt routing positions, when the restraint is oriented in the direction recommended by the manufacturer (e.g., forward, rearward or laterally) pursuant to S5.6, and tested with the test dummy specified in S7.

(c) Each child restraint system manufactured for use in aircraft shall meet the requirements in this section and the additional requirements in S8.

(d) Each child restraint tested with a Part 572 Subpart S dummy need not meet S5.1.2 and S5.1.3.

(e) Each child restraint system tested with a part 572 subpart T dummy need not meet S5.1.2.1(a).

(f) Each child restraint system that is equipped with an internal harness or other internal components to restrain the child need not meet this standard when attached to the lower anchors of the child restraint anchorage system on the standard seat assembly if the sum of the weight of the child restraint system (in pounds) and the average weight of child represented by the test dummy used to test the child restraint in accordance with S7 of this standard, shown in the table below, exceeds 65 pounds. Such a child restraint must meet this standard when tested using its internal harness or components to restrain such a test dummy while installed using the standard seat belt assembly specified in S5.3.2 of this standard.

TABLE TO S5(f)—AVERAGE WEIGHT OF CHILD REPRESENTED BY VARIOUS TEST DUMMIES

Test dummy (specified in S7 of this standard)	Average weight of child represented by test dummy (pounds)
CRABI 12-month-old infant dummy (49 CFR Part 572, Subpart R)	22
Hybrid III 3-year-old dummy (49 CFR Part 572, Subpart P)	31
Hybrid III 6-year-old dummy 49 CFR Part 572, Subpart N)	45
Hybrid III 6-year-old weighted child test dummy (49 CFR Part 572 Subpart S)	62
Hybrid II 6-year-old dummy (49, CFR Part 572, Subpart I)	45

(g) Each add-on child restraint system manufactured for use in motor vehicles, that is recommended for children in a weight range that includes weights up to 18 kilograms (40 pounds), or for children in a height range that includes heights up to 1100 millimeters, shall meet the requirements in this standard and the additional side impact protection requirements in Standard No. 213a (§ 571.213a). Excepted from Standard No. 213a are harnesses and car beds.

S5.1 *Dynamic performance.*

S5.1.1 *Child restraint system integrity.* When tested in accordance with S6.1, each child restraint system shall meet the requirements of paragraphs (a) through (c) of this section.

(a) Exhibit no complete separation of any load bearing structural element and no partial separation exposing either surfaces with a radius of less than 6 mm or surfaces with protrusions greater than 9 mm above the immediate adjacent surrounding contactable surface of any structural element of the system.

(b)(1) If adjustable to different positions, remain in the same adjustment position during the testing that it was in immediately before the testing, except as otherwise specified in paragraph (b)(2).

(2)(i) Subject to paragraph (b)(2)(ii), a rear-facing child restraint system may have a means for repositioning the seating surface of the system that allows the system's occupant to move from a reclined position to an upright position and back to a reclined position during testing.

(ii) No opening that is exposed and is larger than ¼ inch before the testing shall become smaller during the testing as a result of the movement of the seating surface relative to the restraint system as a whole.

(c) If a front facing child restraint system, not allow the angle between the system's back support surfaces for the child and the system's seating surface to be less than 45 degrees at the completion of the test.

S5.1.2 *Injury criteria.* When tested in accordance with S6.1 and with the test dummies specified in S7, each child restraint system manufactured before August 1, 2005, that, in accordance with S5.5.2, is recommended for use by children whose mass is more than 10 kg shall—

(a) Limit the resultant acceleration at the location of the accelerometer mounted in the test dummy head as specified in part 572 such that the expression:

$$\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} a\,dt\right]^{2.5}(t_2 - t_1)$$

shall not exceed 1,000, where a is the resultant acceleration expressed as a multiple of g (the acceleration of gravity), and t_1 and t_2 are any two moments during the impacts.

(b) Limit the resultant acceleration at the location of the accelerometer mounted in the test dummy upper thorax as specified in part 572 to not more than 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S5.1.2.1 When tested in accordance with S6.1 and with the test dummies specified in S7, each child restraint system manufactured on or after August 1, 2005 shall'

(a) Limit the resultant acceleration at the location of the accelerometer mounted in the test dummy head such that, for any two points in time, t1 and t2, during the event which are separated by not more than a 36 millisecond time interval and where t1 is less than t2, the maximum calculated head injury criterion (HIC36) shall not exceed 1,000, determined using the resultant head acceleration at the center

of gravity of the dummy head, ar, expressed as a multiple of g (the acceleration of gravity), calculated using the expression:

$$HIC = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a\,dt \right]^{2.5} (t_2 - t_1)$$

(b) The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S5.1.2.2 At the manufacturer's option (with said option irrevocably selected prior to, or at the time of, certification of the restraint), child restraint systems manufactured before August 1, 2005 may be tested to the requirements of S5 while using the test dummies specified in S7.1.2 of this standard according to the criteria for selecting test dummies specified in that paragraph. That paragraph specifies the dummies used to test child restraint systems manufactured on or after August 1, 2005. If a manufacturer selects the dummies specified in S7.1.2 to test its product, the injury criteria specified by S5.1.2.1 of this standard must be met. Child restraints manufactured on or after August 1, 2005 must be tested using the test dummies specified in S7.1.2.

S5.1.3 *Occupant excursion.* When tested in accordance with S6.1 and the requirements specified in this section, each child restraint system shall meet the applicable excursion limit requirements specified in S5.1.3.1–S5.1.3.3.

S5.1.3.1 *Child restraint systems other than rear-facing ones and car beds.* Each child restraint system, other than a rear-facing child restraint system or a car bed, shall retain the test dummy's torso within the system.

(a) For each add-on child restraint system:

(1) No portion of the test dummy's head shall pass through a vertical transverse plane that is 720 mm or 813 mm (as specified in the table in this S5.1.3.1) forward of point Z on the standard seat assembly, measured along the center SORL (as illustrated in figure 1B of this standard); and

(2) Neither knee pivot point shall pass through a vertical transverse plane that is 915 mm forward of point Z on the standard seat assembly, measured along the center SORL.

TABLE 1 TO S5.1.3.1(a)—ADD–ON CHILD RESTRAINTS THAT CAN BE USED FORWARD-FACING MANUFACTURED BEFORE JUNE 30, 2025

When this type of child restraint	Is tested in accordance with—	These excursion limits apply	Explanatory note: in the test specified in 2nd column, the child restraint is attached to the test seat assembly in the manner described below, subject to certain conditions
Harnesses and restraints designed for use by children with physical disabilities.	S6.1.2(a)(1)(i)(A)	Head 813 mm; Knee 915 mm.	Attached with lap belt; in addition, if a tether is provided, it is attached.
Harnesses labeled per S5.3.1(b)(i) through S5.3.1(b)(iii) and Figure 12.	S6.1.2(a)(1)(i)(A)	Head 813 mm; Knee 915 mm.	Attached with seat back mount.
Belt-positioning seats	S6.1.2(a)(1)(ii)	Head 813 mm; Knee 915 mm.	Attached with lap and shoulder belt; no tether is attached.
All other child restraints (*i.e.,* other than harnesses, restraints designed for use by children with physical disabilities, harnesses manufactured exclusively for school buses, and belt-positioning seats).	S6.1.2(a)(1)(i)(B)	Head 813 mm; Knee 915 mm.	Attached with a lap belt, without a tether attached; and, Attached to lower anchorages of a child restraint anchorage system; no tether is attached.
All other child restraints (*i.e.,* other than harnesses, restraints designed for use by children with physical disabilities, harnesses labeled per S5.3.1(b)(i) through S5.3.1(b)(iii) and Figure 12, and belt-positioning seats).	S6.1.2(a)(1)(i)(A), S6.1.2(a)(1)(i)(C).	Head 720 mm; Knee 915 mm.	Attached with a lap belt, with a tether attached; and, Attached to lower anchorages of child restraint anchorage system, with a tether attached.

TABLE 2 TO S5.1.3.1(a)—ADD–ON CHILD RESTRAINTS THAT CAN BE USED FORWARD-FACING MANUFACTURED AFTER JUNE 30, 2025

When this type of child restraint	Is tested in accordance with—	These excursion limits apply	Explanatory note: in the test specified in 2nd column, the excursion requirement must be met when the child restraint system is attached to the test seat assembly in the manner described below, subject to certain conditions
Harnesses and restraints designed for use by children with physical disabilities.	S6.1.2(a)(1)(i)(A)	Head 813 mm; Knee 915 mm.	Attached with lap and shoulder belt; in addition, if a tether is provided, it is attached.
School bus child restraint systems	S6.1.2(a)(1)(i)(A)	Head 813 mm; Knee 915 mm.	Attached with seat back mount, or, seat back, and, seat pan mounts.
Booster seats	S6.1.2(a)(1)(ii)	Head 813 mm; Knee 915 mm.	Attached with lap and shoulder belt; no tether is attached.
Child restraints other than harnesses, restraints designed for use by children with physical disabilities, school bus child restraint systems, and booster seats.	S6.1.2(a)(1)(i)(B)	Head 813 mm; Knee 915 mm.	Attached with a lap belt; without a tether attached. Attached to lower anchorages of child restraint anchorage system; with no tether attached.
Child restraints other than harnesses, restraints designed for use by children with physical disabilities, and school bus child restraint systems.	S6.1.2(a)(1)(i)(A), S6.1.2(a)(1)(i)(C).	Head 720 mm; Knee 915 mm.	Attached with a lap belt, with a tether attached. Attached to lower anchorages of child restraint anchorage system, with a tether attached.
Child restraints equipped with a fixed or movable surface described in S5.2.2.2 that has belts that are not an integral part of that fixed or movable surface.	S6.1.2(a)(2)	Head 813 mm; Knee 915 mm.	Attached with lap belt, no tether is attached.

(b) In the case of a built-in child restraint system, neither knee pivot point shall, at any time during the dynamic test, pass through a vertical transverse plane that is 305 mm forward of the initial pre-test position of the respective knee pivot point, measured along a horizontal line that passes through the knee pivot point and is parallel to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline.

S5.1.3.2 *Rear-facing child restraint systems.* In the case of each rear-facing child restraint system, all portions of the test dummy's torso shall be retained within the system and neither of the target points on either side of the dummy's head and on the transverse axis passing through the center of mass of the dummy's head and perpendicular to the head's midsagittal plane, shall pass through the transverse orthogonal planes whose intersection contains the forward-most and top-most points on the child restraint system surfaces (illustrated in Figure 1C).

S5.1.3.3 *Car beds.* In the case of car beds, all portions of the test dummy's head and torso shall be retained within the confines of the car bed.

S5.1.4 *Back support angle.* When a rear-facing child restraint system is tested in accordance with S6.1, the angle between the system's back support surface for the child and the vertical shall not exceed 70 degrees.

S5.2 *Force distribution.*

S5.2.1 *Minimum head support surface—child restraints other than car beds.*

S5.2.1.1 Except as provided in S5.2.1.2, each child restraint system other than a car bed shall provide restraint against rearward movement of the head of the child (rearward in relation to the child) by means of a continuous seat back which is an integral part of the system and which—

(a) Has a height, measured along the system seat back surface for the child in the vertical longitudinal plane passing through the longitudinal centerline of the child restraint systems from the lowest point on the system seating surface that is contacted by the buttocks of the seated dummy, as follows:

TABLE TO S5.2.1.1(a)

Weight [1]	Height [2] (mm)
Not more than 18 kg	500
More than 18 kg	560

[1] When a child restraint system is recommended under S5.5 for use by children of the above weights.

[2] The height of the portion of the system seat back providing head restraint shall not be less than the above.

(b) Has a width of not less than 8 inches, measured in the horizontal plane at the height specified in paragraph (a) of this section. Except that a child restraint system with side supports extending at least 4 inches forward from the padded surface of the portion of the restraint system provided for support of the child's head may have a width of not less than 6 inches, measured in the horizontal plane at the height specified in paragraph (a) of this section.

(c) Limits the rearward rotation of the test dummy head so that the angle between the head and torso of the dummy specified in S7. when tested in accordance with S6.1 is not more than 45 degrees greater than the angle between the head and torso after the dummy has been placed in the system in accordance with S6.1.2.3 and before the system is tested in accordance with S6.1.

S5.2.1.2 The applicability of the requirements of S5.2.1.1 to a front-facing child restraint, and the conformance of any child restraint other than a car bed to those requirements, is determined using the largest of the test dummies specified in S7 for use in testing that restraint, provided that the 6-year-old dummy described in subpart I or subpart N of part 572 of this title and the 10-year-old dummy described in subpart T of part 572 of this title, are not used to determine the applicability of or compliance with S5.2.1.1. A front facing child restraint system is not required to comply with S5.2.1.1 if the target point on either side of the dummy's head is below a horizontal plane tangent to the top of—

(a) The standard seat assembly, in the case of an add-on child restraint system, when the dummy is positioned in the system and the system is installed on the assembly in accordance with S6.1.2.

(b) The vehicle seat, in the case of a built-in child restraint system, when the system is activated and the dummy is positioned in the system in accordance with S6.1.2.

S5.2.2 *Torso impact protection.* Each child restraint system other than a car bed shall comply with the applicable requirements of S5.2.2.1 and S5.2.2.2.

S5.2.2.1(a) The system surface provided for the support of the child's back shall be flat or concave and have a continuous surface area of not less than 85 square inches.

(b) Each system surface provided for support of the side of the child's torso shall be flat or concave and have a continuous surface of not less than 24 square inches for systems recommended for children weighing 20 pounds or more, or 48 square inches for systems recommended for children weighing less than 20 pounds.

(c) Each horizontal cross section of each system surface designed to restrain forward movement of the child's torso shall be flat or concave and each vertical longitudinal cross section shall be flat or convex with a radius of curvature of the underlying structure of not less than 2 inches.

S5.2.2.2 Each forward-facing child restraint system shall have no fixed or movable surface—

(a) Directly forward of the dummy and intersected by a horizontal line—

(1) Parallel to the SORL, in the case of the add-on child restraint system, or

(2) Parallel to a vertical plane through the longitudinal center line of the vehicle seat, in the case of a built-in child restraint system, and,

(b) Passing through any portion of the dummy, except for surfaces which restrain the dummy when the system is tested in accordance with S6.1.2(a)(2), so that the child restraint system shall conform to the requirements of S5.1.2 and S5.1.3.1.

S5.2.3 [Reserved]

S5.2.4 *Protrusion limitation.* Any portion of a rigid structural component within or underlying a contactable surface, or any portion of a child restraint system surface that is subject to the requirements of S5.2.3 shall, with any padding or other flexible overlay material removed, have a height above any immediately adjacent restraint system

surface of not more than 9 mm and no exposed edge with a radius of less than 6 mm.

S5.3 *Installation.*

S5.3.1 Add-on child restraints shall meet either (a) or (b), as appropriate.

(a) Except for components designed to attach to a child restraint anchorage system, each add-on child restraint system must not have any means designed for attaching the system to a vehicle seat cushion or vehicle seat back and any component (except belts) that is designed to be inserted between the vehicle seat cushion and vehicle seat back.

(b) School bus child restraint systems (including harnesses manufactured for use on school bus seats) must have a label that conforms in content to Figure 12 and to the requirements of S5.3.1(b)(1) through S5.3.1(b)(3) of this standard. The label must be permanently affixed to the part of the school bus child restraint system, that attaches the system to a vehicle seat back.

(1) The label must be plainly visible when installed and easily readable.

(2) The message area must be white with black text. The message area must be no less than 20 square centimeters.

(3) The pictogram shall be gray and black with a red circle and slash on a white background. The pictogram shall be no less than 20 mm in diameter.

(c) The provision that add-on child restraint systems shall meet the requirements of this standard when installed solely by a Type 1 belt applies to child restraint systems manufactured before September 1, 2029. Except for harnesses, the requirement sunsets for child restraint systems manufactured on or after September 1, 2029. For harnesses, the requirement does not sunset and continues to apply to harnesses manufactured on or after September 1, 2029.

S5.3.2 Each add-on child restraint system shall be capable of meeting the requirements of this standard when installed solely by each of the means indicated in the following table for the particular type of child restraint system:

TABLE TO S5.3.2

Type of add-on child restraint system	Means of installation				
	Type 1 seat belt assembly	Type 1 seat belt assembly plus a tether anchorage, if needed	Child restraint anchorage system (effective September 1, 2002)	Type II seat belt assembly	Seat back mount
Harnesses labeled per S5.3.1(b)(1) through S5.3.1(b)(3) and Figure 12					X
Other harnesses		X			
Car beds	X				
Rear-facing restraints	X		X		
Belt-positioning seats				X	
All other child restraints	X	X	X		

S5.3.2.1 School bus child restraint systems manufactured on or after June 30, 2025, shall be capable of meeting the requirements of this standard when installed by seat back mount, or, seat back mount and seat pan mount.

S5.3.3 *Car beds.* Each car bed shall be designed to be installed on a vehicle seat so that the car bed's longitudinal axis is perpendicular to a vertical longitudinal plane through the longitudinal axis of the vehicle.

S5.4 *Belts, belt buckles, and belt webbing.*

S5.4.1 *Performance requirements.*

S5.4.1.1 *Child restraint systems manufactured before September 1, 2007.* The webbing of belts provided with a child restraint system and used to attach the system to the vehicle or to restrain the child within the system shall—

(a) After being subjected to abrasion as specified in S5.1(d) or S5.3(c) of FMVSS 209 (§ 571.209), have a breaking

strength of not less than 75 percent of the strength of the unabraded webbing when tested in accordance with S5.1(b) of FMVSS 209. A mass of 2.35 ±.05 kg shall be used in the test procedure in S5.1(d) of FMVSS 209 for webbing, including webbing used to secure a child restraint system to the tether and lower anchorages of a child restraint anchorage system, except that a mass of 1.5 ±.05 kg shall be used for webbing in pelvic and upper torso restraints of a belt assembly used in a child restraint system. The mass is shown as (B) in Figure 2 of FMVSS 209.

(b) Meet the requirements of S4.2 (e) and (f) of FMVSS No. 209 (§571.209); and

(c) If contactable by the test dummy torso when the system is tested in accordance with S6.1, have a width of not less than 1½ inches when measured in accordance with S5.4.1.3.

S5.4.1.2 *Child restraint systems manufactured on or after September 1, 2007.* The webbing of belts provided with a child restraint system and used to attach the system to the vehicle or to restrain the child within the system shall—

(a) Have a minimum breaking strength for new webbing of not less than 15,000 N in the case of webbing used to secure a child restraint system to the vehicle, including the tether and lower anchorages of a child restraint anchorage system, and not less than 11,000 N in the case of the webbing used to secure a child to a child restraint system when tested in accordance with S5.1 of FMVSS No. 209. Each value shall be not less than the 15,000 N and 11,000 N applicable breaking strength requirements, but the median value shall be used for determining the retention of breaking strength in paragraphs (b)(1), (c)(1), and (c)(2) of this section S5.4.1.2. ''New webbing'' means webbing that has not been exposed to abrasion, light or micro-organisms as specified elsewhere in this section.

(b)(1) After being subjected to abrasion as specified in S5.1(d) or S5.3(c) of FMVSS 209 (§571.209), have a breaking strength of not less than 75 percent of the new webbing strength, when tested in accordance with S5.1(b) of FMVSS 209.

(2) A mass of 2.35 ±.05 kg shall be used in the test procedure in S5.1(d) of FMVSS 209 for webbing, including webbing to secure a child restraint system to the tether and lower anchorages of a child restraint anchorage system, except that a mass of 1.5 ±.05 kg shall be used for webbing in pelvic and upper torso restraints of a belt assembly used in a child restraint system. The mass is shown as (B) in Figure 2 of FMVSS 209.

(c)(1) After exposure to the light of a carbon arc and tested by the procedure specified in S5.1(e) of FMVSS 209 (§571.209), have a breaking strength of not less than 60 percent of the new webbing, and shall have a color retention not less than No. 2 on the AATCC Gray Scale for Evaluating Change in Color (incorporated by reference, see §571.5).

(2) After being subjected to micro-organisms and tested by the procedures specified in S5.1(f) of FMVSS 209 (§571.209), shall have a breaking strength not less than 85 percent of the new webbing.

(d) If contactable by the test dummy torso when the system is tested in accordance with S6.1, have a width of not less than 1½ inches when measured in accordance with S5.4.1.3.

S5.4.1.3 *Width test procedure.* Condition the webbing for 24 hours in an atmosphere of any relative humidity between 48 and 67 percent, and any ambient temperature between 70° and 77 °F. Measure belt webbing width under a tension of 5 pounds applied lengthwise.

S5.4.2 *Belt buckles and belt adjustment hardware.* Each belt buckle and item of belt adjustment hardware used in a child restraint system shall conform to the requirements of S4.3(a) and S4.3(b) of FMVSS No. 209 (§571.209).

S5.4.3 *Belt Restraint.*

S5.4.3.1 *General.* Each belt that is part of a child restraint system and that is designed to restrain a child using the system shall be adjustable to snugly fit any child whose height and weight are within the ranges recommended in accordance with S5.5.2(f) and who is positioned in the system in accordance with the instructions required by S5.6.

S5.4.3.2 *Direct restraint.* Except for belt-positioning seats, each belt that is part of a child restraint system and that is designed to restrain a child using the system and to attach the system to the vehicle, and each Type I and

lap portion of a Type II vehicle belt that is used to attach the system to the vehicle shall, when tested in accordance with S6.1, impose no loads on the child that result from the mass of the system, or—

(a) In the case of an add-on child restraint system, from the mass of the seat back of the standard seat assembly specified in S6.1, or

(b) In the case of a built-in child restraint system, from the mass of any part of the vehicle into which the child restraint system is built.

S5.4.3.3 *Seating systems.* Except for child restraint systems subject to S5.4.3.4, each child restraint system that is designed for use by a child in a seated position and that has belts designed to restrain the child, shall, with the test dummy specified in S7 positioned in the system in accordance with S10 provide:

(a) Upper torso restraint in the form of:

(i) Belts passing over each shoulder of the child, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c), and

(b) Lower torso restraint in the form of:

(i) A lap belt assembly making an angle between 45° and 90° with the child restraint seating surface at the lap belt attachment points, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c), and

(c) In the case of each seating system recommended for children whose masses are more than 10 kg, crotch restraint in the form of:

(i) A crotch belt connectable to the lap belt or other device used to restrain the lower torso, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c).

S5.4.3.4 *Harnesses.* Each child harness shall:

(a) Provide upper torso restraint, including belts passing over each shoulder of the child;

(b) Provide lower torso restraint by means of lap and crotch belt; and

(c) Prevent a child of any height for which the restraint is recommended for use pursuant to S5.5.2(f) from standing upright on the vehicle seat when the child is placed in the device in accordance with the instructions required by S5.6.

S5.4.3.5 *Buckle release.* Any buckle in a child restraint system belt assembly designed to restrain a child using the system shall:

(a) When tested in accordance with S6.2.1 prior to the dynamic test of S6.1, not release when a force of less than 40 newtons (N) is applied and shall release when a force of not more than 62 N is applied;

(b) After the dynamic test of S6.1, when tested in accordance with the appropriate sections of S6.2, release when a force of not more than 71 N is applied, provided, however, that the conformance of any child restraint to this requirement is determined using the largest of the test dummies specified in S7 for use in testing that restraint when the restraint is facing forward, rearward, and/or laterally;

(c) Meet the requirements of S4.3(d)(2) of FMVSS No. 209 (§ 571.209), except that the minimum surface area for child restraint buckles designed for push button application shall be 0.6 square inch;

(d) Meet the requirements of S4.3(g) of FMVSS No. 209 (§ 571.209) when tested in accordance with S5.2(g) of FMVSS No. 209; and

(e) Not release during the testing specified in S6.1.

S5.5 *Labeling.* Any labels or written instructions provided in addition to those required by this section shall not obscure or confuse the meaning of the required information or be otherwise misleading to the consumer. Any labels or written instructions other than in the English language shall be an accurate translation of English labels or written instructions.

S5.5.1 Each add-on child restraint system shall be permanently labeled with the information specified in S5.5.2 (a) through (m).

S5.5.2 The information specified in paragraphs (a) through (m) of this section shall be stated in the English language and lettered in letters and numbers that are not smaller than 10 point type. Unless otherwise specified, the information shall be labeled on a white background with black text. Unless written in all capitals, the information

shall be stated in sentence capitalization.

(a) The model name or number of the system.

(b) The manufacturer's name. A distributor's name may be used instead if the distributor assumes responsibility for all duties and liabilities imposed on the manufacturer with respect to the system by the National Traffic and Motor Vehicle Safety Act, as amended.

(c) The statement: ''Manufactured in ____,'' inserting the month and year of manufacture.

(d) The place of manufacture (city and State, or foreign country). However, if the manufacturer uses the name of the distributor, then it shall state the location (city and State, or foreign country) of the principal offices of the distributor.

(e) The statement: ''This child restraint system conforms to all applicable Federal motor vehicle safety standards.''

(f) For child restraint systems manufactured before June 30, 2025, paragraph (f)(1) of this section applies. For child restraint systems manufactured on or after June 30, 2025, paragraph (f)(2) of this section applies.

(1) One of the following statements, as appropriate, inserting the manufacturer's recommendations for the maximum mass of children who can safely occupy the system, except that booster seats shall not be recommended for children whose masses are less than 13.6 kg. For child restraint systems that can only be used as belt-positioning seats, manufacturers must include the maximum and minimum recommended height, but may delete the reference to weight:

(i) Use only with children who weigh ____ pounds (____ kg) or less and whose height is (*insert values in English and metric units; use of word ''mass'' in label is optional*) or less; or

(ii) Use only with children who weigh between ____ and ____ pounds (*insert appropriate English and metric values; use of word ''mass'' is optional*) and whose height is (*insert appropriate values in English and metric units*) or less and who are capable of sitting upright alone; or

(iii) Use only with children who weigh between ____ and ____ pounds (*insert appropriate English and metric values; use of word ''mass'' is optional*) and whose height is (*insert appropriate values in English and metric units*) or less.

(iv) Use only with children who weigh between ____ and ____ pounds (*insert appropriate English and metric values; use of word ''mass'' is optional*) and whose height is between ____ and ____ (*insert appropriate values in English and metric units*).

(2) For child restraint systems manufactured on or after June 30, 2025: Statements or a combination of statements and pictograms specifying the manufacturer's recommendations for the mass and height ranges (in English and metric units) of children who can safely occupy the system in each applicable mode (rear-facing, forward facing, booster), except manufacturers shall not recommend forward-facing use for child restraint systems with internal harnesses for children of masses less than 12 kg (26.5 lb), and shall not recommend booster seats for children of masses less than 18 kg (40 lb).

(g) The statements specified in paragraphs (1) and (2):

(1) A heading as specified in S5.5.2(k)(3)(i), with the statement ''WARNING! DEATH or SERIOUS INJURY can occur,'' capitalized as written and followed by bulleted statements in the following order:

(i) As appropriate, the statements required by the following sections will be bulleted and placed after the statement required by 5.5.2(g)(1) in the following order: 5.5.2(k)(1), 5.5.2(h), 5.5.2(j), and 5.5.2(i). For child restraint systems manufactured on or after June 30, 2025, the statements required by 5.5.2(f) and 5.5.2(k)(2) need not be included.

(ii) Secure this child restraint with the vehicle's child restraint anchorage system, if available, or with a vehicle belt. [For car beds, harnesses, and belt positioning seats, the first part of the statement regarding attachment by the child restraint anchorage system is optional.] [For belt-positioning seats, the second part of the statement regarding attachment by the vehicle belt does not apply.]

(iii) Follow all instructions on this child restraint and in the written instructions located (*insert storage location on the restraint for the manufacturer's installation instruction booklet or sheet*).

(iv) Register your child restraint with the manufacturer.

(2) At the manufacturer's option, the phrase ''DEATH or SERIOUS INJURY can occur'' in the heading can be on either a white or yellow background.

(3) More than one label may be used for the required bulleted statements. Multiple labels shall be placed one above the other unless that arrangement is precluded by insufficient space or shape of the child restraint. In that case, multiple labels shall be placed side by side. When using multiple labels, the mandated warnings must be in the correct order when read from top to bottom. If the labels are side-by-side, then the mandated warnings must appear top to bottom of the leftmost label, then top to bottom of the next label to its right, and so on. There shall be no intervening labels and the required heading shall only appear on the first label in the sequence.

(h) In the case of each child restraint system that has belts designed to restrain children using them and which do not adjust automatically to fit the child: Snugly adjust the belts provided with this child restraint around your child.

(i)(1) For a booster seat that is recommended for use with either a vehicle's Type I or Type II seat belt assembly, one of the following statements, as appropriate:

(i) Use only the vehicle's lap and shoulder belt system when restraining the child in this booster seat; or,

(ii) Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child in this seat.

(2)(i) Except as provided in paragraph (i)(2)(ii) of this section, for a booster seat which is recommended for use with both a vehicle's Type I and Type II seat belt assemblies, the following statement: Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child with the (*insert description of the system element provided to restrain forward movement of the child's torso when used with a lap belt* (*e.g., shield*)), and only the vehicle's lap and shoulder belt system when using the booster without the (*insert above description*).

(ii) A booster seat which is recommended for use with both a vehicle's Type I and Type II seat belt assemblies is not subject to S5.5.2(i)(2)(i) if, when the booster is used with the shield or similar component, the booster will cause the shoulder belt to be located in a position other than in front of the child when the booster is installed. However, such a booster shall be labeled with a warning to use the booster with the vehicle's lap and shoulder belt system when using the booster without a shield.

(j) In the case of each child restraint system equipped with a top anchorage strap, the statement: Secure the top anchorage strap provided with this child restraint.

(k) (1) In the case of each rear-facing child restraint system that is designed for infants only, the statement: Use only in a rear-facing position when using it in the vehicle.

(2) In the case of a child restraint system that is designed to be used rearward-facing for infants and forward-facing for older children, the statement: Use only in a rear-facing position when using it with an infant weighing less than (*insert a recommended weight that is not less than 20 pounds*).

(3) Except as provided in (k)(4) of this section, each child restraint system that can be used in a rear-facing position shall have a label that conforms in content to Figure 10 and to the requirements of S5.5.2(k)(3)(i) through S5.5.2(k)(3)(iii) of this standard permanently affixed to the outer surface of the cushion or padding in or adjacent to the area where a child's head would rest, so that the label is plainly visible and easily readable.

(i) The heading area shall be yellow with the word ''warning'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 square cm.

(iii) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 30 mm in diameter.

(4) If a child restraint system is equipped with a device that deactivates the passenger-side air bag in a vehicle when and only when the child restraint is installed in the vehicle and provides a signal, for at least 60 seconds after deactivation, that the air bag is deactivated, the label specified in Figure 10 may include the phrase ''unless air bag is off'' after ''on front seat with air bag.''

(l) An installation diagram showing the child restraint system installed in:

(1) A seating position equipped with a continuous-loop lap/shoulder belt;

(2) A seating position equipped with only a lap belt, as specified in the manufacturer's instructions; and

(3) A seating position equipped with a child restraint anchorage system. For child restraint systems manufactured on or after February 27, 2015, the following paragraphs (l)(3)(i) and (ii) apply, as appropriate.

(i) If the child restraint system is designed to meet the requirements of this standard when installed by the child restraint anchorage system according to S5.3.2, and if the sum of the weight of the child restraint system and the maximum child weight recommended for the child restraint when used with the restraint's internal harness or components is greater than 65 lb when used forward-facing or rear-facing, include the following statement on this installation diagram: ''Do not install by this method for a child weighing more than *.'' At the manufacturer's option, ''*'' is the child weight limit in English units in accordance with S5.5.2(l)(3)(i)(A), (B) or (C). The corresponding child weight limit in metric units may also be included in the statement at the manufacturer's option.

(A) For forward-facing and rear-facing child restraints, * is less than or equal to 65 minus child restraint weight (pounds).

(B) For forward-facing child restraints, * is the child weight limit specified in the following table corresponding to the value CW, calculated as 65 minus child restraint weight (pounds).

TABLE TO S5.5.2(l)(3)(i)(B)—MAXIMUM CHILD WEIGHT LIMIT FOR LOWER ANCHOR USE FOR FORWARD-FACING CHILD RESTRAINT SYSTEM—ROUNDING

CW = 65—child restaint weight (pounds)	Child weight limit "*" (pounds)
20 < CW ≤ 25	25
25 < CW ≤ 30	30
30 < CW ≤ 35	35
35 < CW ≤ 40	40
40 < CW ≤ 45	45
45 < CW ≤ 50	50
50 < CW ≤ 55	55
55 < CW ≤ 60	60

(C) For rear-facing child restraints, * is the child weight limit specified in the following table corresponding to the value CW, calculated as 60 minus child restraint weight (pounds).

TABLE TO S5.5.2(l)(3)(i)(C)—MAXIMUM CHILD WEIGHT LIMIT FOR LOWER ANCHOR USE FOR REAR-FACING CHILD RESTRAINT SYSTEM—ROUNDING

CW = 60—child restraint weight (pounds)	Child weight limit "*" (pounds)
15 < CW ≤ 20	20
20 < CW ≤ 25	25
25 < CW ≤ 30	30
30 < CW ≤ 35	35
35 < CW ≤ 40	40
40 < CW ≤ 45	45
45 < CW ≤ 50	50
50 < CW ≤ 55	55

(ii) For child restraints designed to meet the requirements of this standard when installed forward-facing and rear-facing by the child restraint anchorage system according to S5.3.2, the following applies:

(A) If separate installation diagrams are provided for the child restraint installed forward-facing and rear-facing, S5.5.2(l)(3)(i) applies to each of the installation diagrams.

(B) If only one installation diagram is provided and if a statement specifying a child weight limit is required in only rear-facing or forward-facing mode pursuant to S5.5.2(l)(3)(i), then the diagram shall depict installation in that mode along with the corresponding child weight limit in accordance with S5.5.2(l)(3)(i).

(C) If a statement specifying a child weight limit is required for the child restraint installed forward-facing and rear-facing pursuant to S5.5.2(l)(3)(i)

and only one installation diagram is provided, then the child weight limit shall be in accordance with S5.5.2(l)(3)(i)(A) or the lesser of the child weight limits described in S5.5.2(l)(3)(i)(B) and (C).

(m) One of the following statements, inserting an address and a U.S. telephone number. If a manufacturer opts to provide a Web site on the registration card as permitted in Figure 9a of this section, the manufacturer must include the statement in part (ii):

(i) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, e-mail address if available (preceding four words are optional) and the restraint's model number and manufacturing date to (*insert address*) or call (*insert a U.S. telephone number*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *http://www.NHTSA.gov*.''

(ii) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, e-mail address if available [preceding four words are optional], and the restraint's model number and manufacturing date to (*insert address*) or call (*insert a U.S. telephone number*) or register online at (*insert Web site for electronic registration form*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *http://www.NHTSA.gov*.''

(n) Child restraint systems, other than belt-positioning seats, harnesses and backless child restraint systems, may be certified as complying with the provisions of S8. Child restraints that are so certified shall be labeled with the statement ''This Restraint is Certified for Use in Motor Vehicles and Aircraft.'' Belt-positioning seats, harnesses and backless child restraint systems shall be labeled with the statement ''This Restraint is Not Certified for Use in Aircraft.'' The statement required by this paragraph shall be in red lettering and shall be placed after the certification statement required by S5.5.2(e).

S5.5.3 The information specified in S5.5.2(f) through (l) shall be located on the add-on child restraint system so that it is visible when the system is installed as specified in S5.6.1, except that for child restraints with a detachable base, the installation diagrams specified in S5.5.2(l) are required to be visible only when the base alone is installed.

S5.5.4 (a) Each built-in child restraint system other than a factory-installed built-in restraint shall be permanently labeled with the information specified in S5.5.5 (a) through (l). The information specified in S5.5.5(a) through (j) and in S5.5.5(l) shall be visible when the system is activated for use.

(b) Each factory-installed built-in child restraint shall be permanently labeled with the information specified in S5.5.5(f) through (j) and S5.5.5(l), so that the information is visible when the restraint is activated for use. The information shall also be included in the vehicle owner's manual.

S5.5.5 The information specified in paragraphs (a) through (l) of this section that is required by S5.5.4 shall be in English and lettered in letters and numbers using a not smaller than 10 point type. Unless specified otherwise, the information shall be labeled on a white background with black text. Unless written in all capitals, the information shall be stated in sentence capitalization.

(a) The model name or number of the system.

(b) The manufacturer's name. A distributor's or dealer's name may be used instead if the distributor or dealer assumes responsibility for all duties and liabilities imposed on the manufacturer with respect to the system by the National Traffic and Motor Vehicle Safety Act, as amended.

(c) The statement: ''Manufactured in _____,'' inserting the month and year of manufacture.

(d) The place of manufacture (city and State, or foreign country). However, if the manufacturer uses the name of the distributor or dealer, then it shall state the location (city and State, or foreign country) of the principal offices of the distributor or dealer.

(e) The statement: ''This child restraint system conforms to all applicable Federal motor vehicle safety standards.''

(f) One of the following statements, inserting the manufacturer's recommendations for the maximum mass of children who can safely occupy the system, except that booster seats shall not be recommended for children whose masses are less than 13.6 kg. For seats that can only be used as belt-positioning seats, manufacturers must include the maximum and minimum recommended height, but may delete the reference to weight:

(1) Use only with children who weigh ____ pounds (____ kg) or less and whose height is (*insert values in English and metric units; use of word ''mass'' in label is optional*) or less; or

(2) Use only with children who weigh between ____ and ____ pounds (____ and ____ kg) and whose height is (*insert appropriate values in English and metric units; use of word ''mass'' in label is optional*) or less and who are capable of sitting upright alone; or

(3) Use only with children who weigh between ____ and ____ pounds (____ and ____ kg) and whose height is (*insert appropriate values in English and metric units; use of word ''mass'' in label is optional*) or less.

(4) Use only with children who weigh between ____ and ____ pounds (*insert appropriate English and metric values; use of word ''mass'' is optional*) and whose height is between ____ and ____ (*insert appropriate values in English and metric units*).

(g) The heading and statement specified in paragraph (1), and if appropriate, the statements in paragraph (2) and (3). If used, the statements in paragraphs (2) and (3) shall be bulleted and precede the bulleted statement required by paragraph (1) after the heading.

(1) A heading as specified in S5.5.2(k)(3)(i), with the statement ''WARNING! DEATH or SERIOUS INJURY can occur,'' capitalized as written and followed by the bulleted statement: Follow all instructions on the child restraint and in the vehicle's owner's manual. At the manufacturer's option, the phrase ''DEATH or SERIOUS INJURY can occur'' in the heading can be on either a white or yellow background.

(2) In the case of each built-in child restraint system which is not intended for use in motor vehicles in certain adjustment positions or under certain circumstances, an appropriate statement of the manufacturers restrictions regarding those positions or circumstances.

(3) As appropriate, the statements required by the following sections will be bulleted and placed after the statement required by 5.5.5(g)(1) in the following order: 5.5.5(g)(2), 5.5.5(f), S5.5.5(h) and S5.5.5(i).

(h) In the case of each built-in child restraint system that has belts designed to restrain children using them and which do not adjust automatically to fit the child: Snugly adjust the belts provided with this child restraint around your child.

(i) In the case of each built-in child restraint which can be used in a rear-facing position, the following statement: Place an infant in a rear-facing position in this child restraint.

(j) A diagram or diagrams showing the fully activated child restraint system in infant and/or child configurations.

(k) One of the following statements, inserting an address and a U.S. telephone number. If a manufacturer opts to provide a Web site on the registration card as permitted in Figure 9a of this section, the manufacturer must include the statement in part (ii):

(i) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, e-mail address if available (preceding four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (*insert a U.S. telephone number*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *http://www.NHTSA.gov*.''

(ii) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, e-mail address if available (preceding

four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (*insert telephone number*) or register online at (*insert Web site for electronic registration form*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *http://www.NHTSA.gov*.''

(l) In the case of a built-in belt-positioning seat that uses either the vehicle's Type I or Type II belt systems or both, a statement describing the manufacturer's recommendations for the maximum height and weight of children who can safely occupy the system and how the booster should be used (e.g., with or without shield) with the different vehicle belt systems.

S5.6 *Printed Instructions for Proper Use.* Any labels or written instructions provided in addition to those required by this section shall not obscure or confuse the meaning of the required information or be otherwise misleading to the consumer. Any labels or written instructions other than in the English language shall be an accurate translation of English labels or written instructions. Unless written in all capitals, the information required by S5.6.1 through S5.6.3 shall be stated in sentence capitalization.

S5.6.1 *Add-on child restraint systems.* Each add-on child restraint system shall be accompanied by printed installation instructions in English that provide a step-by-step procedure, including diagrams, for installing the system in motor vehicles, securing the system in the vehicles, positioning a child in the system, and adjusting the system to fit the child. For each child restraint system that has components for attaching to a tether anchorage or a child restraint anchorage system, the installation instructions shall include a step-by-step procedure, including diagrams, for properly attaching to that anchorage or system.

S5.6.1.1 In a vehicle with rear designated seating positions, the instructions shall alert vehicle owners that, according to accident statistics, children are safer when properly restrained in the rear seating positions than in the front seating positions.

S5.6.1.2 The instructions shall specify in general terms the types of vehicles, the types of seating positions, and the types of vehicle safety belts with which the add-on child restraint system can or cannot be used.

S5.6.1.3 The instructions shall explain the primary consequences of not following the warnings required to be labeled on the child restraint system in accordance with S5.5.2 (g) through (k).

S5.6.1.4 The instructions for each car bed shall explain that the car bed should position in such a way that the child's head is near the center of the vehicle.

S5.6.1.5 The instructions shall state that add-on child restraint systems should be securely belted to the vehicle, even when they are not occupied, since in a crash an unsecured child restraint system may injure other occupants.

S5.6.1.6 Each add-on child restraint system shall have a location on the restraint for storing the manufacturer's instructions.

S5.6.1.7 (a) For child restraint systems manufactured before June 30, 2025, one of the following statements, inserting an address and a U.S. telephone number. If a manufacturer opts to provide a website on the registration card as permitted in Figure 9a of this section, the manufacturer must include the statement in paragraph S5.6.1.7(a)(2):

(1) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, email address if available (preceding four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (*insert a U.S. telephone number*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

(2) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, email address if available (preceding four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (*insert telephone number*) or register online at (*insert*

website for electronic registration form). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

(b) For child restraint systems manufactured on or after June 30, 2025, the child restraint system shall include statements informing the owner of the importance of registering the child restraint for recall purposes and instructing the owner how to register the child restraint at least by mail and by telephone, providing a U.S. telephone number. The following statement must also be provided: ''For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

S5.6.1.8 In the case of each child restraint system that can be used in a position so that it is facing the rear of the vehicle, the instructions shall provide a warning against using rear-facing restraints at seating positions equipped with air bags, and shall explain the reasons for, and consequences of not following the warning. The instructions shall also include a statement that owners of vehicles with front passenger side air bags should refer to their vehicle owner's manual for child restraint installation instructions.

S5.6.1.9 In the case of each rear-facing child restraint system that has a means for repositioning the seating surface of the system that allows the system's occupant to move from a reclined position to an upright position during testing, the instructions shall include a warning against impeding the ability of the restraint to change adjustment position.

S5.6.1.10(a) For instructions for a booster seat that is recommended for use with either a vehicle's Type I or Type II seat belt assembly, one of the following statements, as appropriate, and the reasons for the statement:

(1) Warning! Use only the vehicle's lap and shoulder belt system when restraining the child in this booster seat; or,

(2) Warning! Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child in this seat.

(b)(1) Except as provided in S5.6.1.10(b)(2), the instructions for a booster seat that is recommended for use with both a vehicle's Type I and Type II seat belt assemblies shall include the following statement and the reasons therefor: Warning! Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child with the (*insert description of the system element provided to restrain forward movement of the child's torso when used with a lap belt (e.g., shield)*), and only the vehicle's lap and shoulder belt system when using this booster without the (*insert above description*).

(2) A booster seat which is recommended for use with both a vehicle's Type I and Type II seat belt assemblies is not subject to S5.6.1.10(b)(1) if, when the booster is used with the shield or similar component, the booster will cause the shoulder belt to be located in a position other than in front of the child when the booster is installed. However, the instructions for such a booster shall include a warning to use the booster with the vehicle's lap and shoulder belt system when using the booster without a shield.

(c) The instructions for belt-positioning seats shall include the statement, ''This restraint is not certified for aircraft use,'' and the reasons for this statement.

S5.6.1.11 (a) For harnesses that are manufactured before June 30, 2025, for use on school bus seats, the instructions must include the following statement: ''WARNING! This restraint must only be used on school bus seats. Entire seat directly behind must be unoccupied or have restrained occupants.'' The labeling requirement refers to a restrained occupant as: an occupant restrained by any user appropriate vehicle restraint or child restraint system (*e.g.*, lap belt, lap and shoulder belt, booster, child seat, harness . . .).

(b) For school bus child restraint systems manufactured on or after June 30, 2025, the instructions must include the following statement: ''WARNING! This restraint must only be used on school bus seats. Entire seat directly behind

must be unoccupied or have restrained occupants.'' (The instruction's reference to a ''restrained occupant'' refers to an occupant restrained by any user-appropriate vehicle restraint or child restraint system (*e.g.*, lap belt, lap and shoulder belt, booster seat or other child restraint system.)

S5.6.1.12 (a) *Child restraint systems manufactured from February 27, 2014 to February 26, 2015.* The instructions for child restraint systems equipped with an internal harness to restrain the child and with components to attach to a child restraint anchorage system, and for which the combined weight of the child restraint system and the maximum recommended child weight for use with the internal harness exceeds 65 pounds, must include the following statement: ''Do not use the lower anchors of the child restraint anchorage system (LATCH system) to attach this child restraint when restraining a child weighing more than ''*'' [*insert a recommended weight value in English and metric units such that the sum of the recommended weight value and the weight of the child restraint system does not exceed 65 pounds (29.5 kg)] with the internal harness of the child restraint.''

(b) *Child restraint systems manufactured on or after February 27, 2015.* If the child restraint is designed to meet the requirements of this standard when installed by the child restraint anchorage system according to S5.3.2, the installation diagram showing the child restraint system installed using a child restraint anchorage system must meet the specifications in S5.5.2(l)(3).

S5.6.2 *Built-in child restraint systems.* (a) Each built-in child restraint system shall be accompanied by printed instructions in English that provide a step-by-step procedure, including diagrams, for activating the restraint system, positioning a child in the system, adjusting the restraint and, if provided, the restraint harness to fit the child. The instructions for each built-in car bed shall explain that the child should be positioned in the bed in such a way that the child's head is near the center of the vehicle.

(b) Each motor vehicle equipped with a factory-installed built-in child restraint shall have the information specified in paragraph (a) of this section included in its vehicle owner's manual.

S5.6.2.1 The instructions shall explain the primary consequences of not following the manufacturer's warnings for proper use of the child restraint system in accordance with S5.5.5 (f) through (i).

S5.6.2.2 (a) For child restraint systems manufactured before June 30, 2025, the instructions for each built in child restraint system other than a factory-installed restraint, shall include one of the following statements, inserting an address and a U.S. telephone number. If a manufacturer opts to provide a website on the registration card as permitted in Figure 9a of this section, the manufacturer must include the statement in S5.6.2.2(a)(2):

(1) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, email address if available (preceding four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (*insert a U.S. telephone number*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

(2) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, email address if available (preceding four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (insert U.S. telephone number) or register online at (*insert website for electronic registration form*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

(b) For child restraint systems manufactured on or after June 30, 2025, the instructions for each built-in child restraint system other than a factory-installed restraint shall include statements informing the owner of the importance of registering the child restraint for recall purposes and instructing the owner how to register the child restraint at least by mail and by telephone, providing a U.S. telephone

number. The following statement must also be provided: ''For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

S5.6.2.3. Each built-in child restraint system other than a factory-installed built-in restraint, shall have a location on the restraint for storing the instructions.

S5.6.2.4 Each built-in child restraint system, other than a system that has been installed in a vehicle or a factory-installed built-in system that is designed for a specific vehicle model and seating position, shall be accompanied by instructions in English that provide a step-by-step procedure for installing the system in a motor vehicle. The instructions shall specify the types of vehicles and the seating positions into which the restraint can or cannot be installed. The instructions for each car bed shall explain that the bed should be installed so that the child's head will be near the center of the vehicle.

S5.6.2.5 In the case of a built-in belt-positioning seat that uses either the vehicle's Type I or Type II belt systems or both, the instructions shall include a statement describing the manufacturer's recommendations for the maximum height and weight of children who can safely occupy the system and how the booster must be used with the vehicle belt systems appropriate for the booster seat. The instructions shall explain the consequences of not following the directions. The instructions shall specify that, if the booster seat is recommended for use with only the lap-belt part of a Type II assembly, the shoulder belt portion of the assembly must be placed behind the child.

S5.6.3 *Add-on and built-in child restraint systems.* In the case of each child restraint system that has belts designed to restrain children using them and which do not adjust automatically to fit the child, the printed instructions shall include the following statement: A snug strap should not allow any slack. It lies in a relatively straight line without sagging. It does not press on the child's flesh or push the child's body into an unnatural position.

S5.7 *Flammability.* Each material used in a child restraint system shall conform to the requirements of S4 of FMVSS No. 302 (571.302). In the case of a built-in child restraint system, the requirements of S4 of FMVSS No. 302 shall be met in both the ''in-use'' and ''stowed'' positions.

S5.8 Information requirements—attached registration form and electronic registration form.

S5.8.1 *Attached registration form.* (a) For child restraint systems manufactured before June 30, 2025, each child restraint system, except a factory-installed built-in restraint system, shall have a registration form attached to any surface of the restraint that contacts the dummy when the dummy is positioned in the system in accordance with S6.1.2 of Standard 213.

(b) Each attached form shall:

(1) Consist of a postcard that is attached at a perforation to an informational card;

(2) Conform in size, content and format to Figures 9a and 9b of this section; and

(3) Have a thickness of at least 0.007 inches and not more than 0.0095 inches.

(c) Each postcard shall provide the model name or number and date of manufacture (month, year) of the child restraint system to which the form is attached, shall contain space for the purchaser to record his or her name, mailing address, and at the manufacturer's option, e-mail address, shall be addressed to the manufacturer, and shall be postage paid. No other information shall appear on the postcard, except identifying information that distinguishes a particular child restraint system from other systems of that model name or number may be preprinted in the shaded area of the postcard, as shown in figure 9a.

(d) Manufacturers may voluntarily provide a web address on the informational card enabling owners to register child restraints online, provided that the Web address is a direct link to the electronic registration form meeting the requirements of S5.8.2 of this section.

S5.8.1.1 *Upgraded attached registration form.* For child restraint systems manufactured on or after June 30, 2025, each child restraint system, except a

factory-installed built-in restraint system, shall have a registration form attached to any surface of the restraint that contacts the dummy when the dummy is positioned in the system in accordance with S6.1.2 of Standard 213. The form shall not have advertising or any information other than that related to registering the child restraint system.

(a) Each attached registration form shall provide a mail-in postcard that conforms in size, and in basic content and format to the forms depicted in Figures 9a' and 9b' of this section.

(1) The mail-in postcard shall:

(i) Have a thickness of at least 0.007 inches and not more than 0.0095 inches;

(ii) Be pre-printed with the information identifying the child restraint system for recall purposes, such as the model name or number and date of manufacture (month, year) of the child restraint system to which the form is attached;

(iii) Contain space for the owner to record his or her name, mailing address, email address (optional), telephone number (optional), and other pertinent information;

(iv) Be addressed to the manufacturer, and be postage paid.

(v) Be detachable from the information card without the use of scissors or other tools.

(c) The registration form attached to the child restraint system shall also provide an information card with the following:

(1) Informing the owner of the importance of registering the child restraint system; and,

(2) Instructing the owner how to register the CRS.

(3) Manufacturers must provide statements informing the purchaser that the registration card is pre-addressed and that postage has been paid.

(4) Manufacturers may provide instructions to register the child restraint system electronically. If an electronic registration form is used or referenced, it must meet the requirements of S5.8.2 of this section.

(5) Manufacturers may optionally provide statements to the owner explaining that the registration card is not a warranty card, and that the information collected from the owner will not be used for marketing purposes.

S5.8.2 *Electronic registration form.* (a) Each electronic registration form provided for child restraint systems manufactured before June 30, 2025, shall:

(1) Contain the following statements at the top of the form:

(i) ''FOR YOUR CHILD'S CONTINUED SAFETY'' (Displayed in bold type face, caps, and minimum 12 point type.)

(ii) ''Although child restraint systems undergo testing and evaluation, it is possible that a child restraint could be recalled.'' (Displayed in bold typeface, caps and lower case, and minimum 12 point type.)

(iii) ''In case of a recall, we can reach you only if we have your name and address, so please fill in the registration form to be on our recall list.'' (Displayed in bold typeface, caps and lower case, and minimum 12 point type.)

(iv) ''In order to properly register your child restraint system, you will need to provide the model number, serial number and date of manufacture. This information is printed on the registration card and can also be found on a white label located on the back of the child restraint system.'' (Displayed in bold typeface, caps and lower case, and minimum 12 point type.)

(v) ''This registration is only applicable to child restraint systems purchased in the United States.'' (Displayed in bold typeface, caps and lower case, and minimum 12 point type.)

(2) Provide as required registration fields, space for the purchaser to record the model name or number and date of manufacture (month, year) of the child restraint system, and space for the purchaser to record his or her name and mailing address. At the manufacturer's option, a space is provided for the purchaser to record his or her e-mail address.

(b) No other information shall appear on the electronic registration form, except for information identifying the manufacturer or a link to the manufacturer's home page, a field to confirm submission, and a prompt to indicate any incomplete or invalid fields prior to submission. Accessing the web page that contains the electronic registration form shall not cause additional

screens or electronic banners to appear.

(c) The electronic registration form shall be accessed directly by the web address that the manufacturer printed on the attached registration form. The form must appear on screen when the consumer has inputted the web address provided by the manufacturer, without any further keystrokes on the keyboard or clicks of the mouse.

S5.8.2.1 *Upgraded electronic registration form.* (a) Each electronic registration form provided for child restraint systems manufactured on or after June 30, 2025, shall:

(1) Contain statements at the top of the form:

(i) Informing the owner of the importance of registering the CRS; and,

(ii) Instructing the owner how to register the CRS.

(2) Provide as required registration fields, space for the purchaser to record the model name or number and date of manufacture (month, year) of the child restraint system, and space for the purchaser to record his or her name and mailing address. At the manufacturer's option, a space is provided for the purchaser to optionally record his or her email address. At the manufacturer's option, a space is provided for the purchaser to optionally record his or her telephone number.

(b) No advertising or other information shall appear on the electronic registration form. However, manufacturers may optionally provide a statement to the owner explaining that the registration is not a warranty card, and that the information collected from the owner will not be used for marketing purposes.

(c) The electronic registration form may provide information identifying the manufacturer or a link to the manufacturer's home page, a field to confirm submission, and a prompt to indicate any incomplete or invalid fields prior to submission.

(d) If a manufacturer printed the electronic address (in form of a website (printed URL)) on the attached registration form provided pursuant to S5.8.1, the electronic registration form shall be accessed directly by the electronic address. Accessing the electronic address (in form of a website (printed URL) that contains the electronic registration form shall not cause additional screens or electronic banners to appear. In addition to the electronic address in form of a website, manufacturers may include a code (such as a QR code or similar) to access the electronic address.

S5.9 *Attachment to child restraint anchorage system.* (a) Each add-on child restraint system other than a car bed, harness and belt-positioning seat, shall have components permanently attached to the system that enable the restraint to be securely fastened to the lower anchorages of the child restraint anchorage system specified in Standard No. 225 (§571.225) and depicted in Drawing Package SAS–100–1000, Standard Seat Belt Assembly with Addendum A or in Drawing Package, ''NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2003'' (both incorporated by reference, see §571.5). The components must be attached by use of a tool, such as a screwdriver. In the case of rear-facing child restraints with detachable bases, only the base is required to have the components.

(b) In the case of each child restraint system that is manufactured on or after September 1, 1999 and that has components for attaching the system to a tether anchorage, those components shall include a tether hook that conforms to the configuration and geometry specified in Figure 11 of this standard.

(c) In the case of each child restraint system that is manufactured on or after September 1, 1999 and that has components, including belt webbing, for attaching the system to a tether anchorage or to a child restraint anchorage system, the belt webbing shall be adjustable so that the child restraint can be tightly attached to the vehicle.

(d) Beginning September 1, 1999, each child restraint system with components that enable the restraint to be securely fastened to the lower anchorages of a child restraint anchorage system, other than a system with hooks for attaching to the lower anchorages, shall provide either an indication when each attachment to the lower anchorages becomes fully latched or attached,

or a visual indication that all attachments to the lower anchorages are fully latched or attached. Visual indications shall be detectable under normal daylight lighting conditions.

S6. *Test conditions and procedures.*

S6.1 *Dynamic systems test for child restraint systems.*

The test conditions described in S6.1.1 apply to the dynamic systems test. The test procedure for the dynamic systems test is specified in S6.1.2. The test dummy specified in S7 is placed in the test specimen (child restraint), clothed as described in S9 and positioned according to S10.

S6.1.1 *Test conditions.*

(a) *Test devices.*

(1) Add-on child restraints.

(i) [Reserved]

(ii) The test device for add-on restraint systems manufactured on or after August 1, 2005 is a standard seat assembly consisting of a simulated vehicle bench seat, with three seating positions, which is depicted in Drawing Package, ''NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2003,'' (consisting of drawings and a bill of materials) dated June 3, 2003 (incorporated by reference; see §571.5). The assembly is mounted on a dynamic test platform so that the center SORL of the seat is parallel to the direction of the test platform travel and so that movement between the base of the assembly and the platform is prevented.

(2) The test device for built-in child restraint systems is either the specific vehicle shell or the specific vehicle.

(i) *Specific vehicle shell.*

(A) The specific vehicle shell, if selected for testing, is mounted on a dynamic test platform so that the longitudinal center line of the shell is parallel to the direction of the test platform travel and so that movement between the base of the shell and the platform is prevented. Adjustable seats are in the adjustment position midway between the forwardmost and rearmost positions, and if separately adjustable in a vertical direction, are at the lowest position. If an adjustment position does not exist midway between the forwardmost and rearmost position, the closest adjustment position to the rear of the midpoint is used. Adjustable seat backs are in the manufacturer's nominal design riding position. If such a position is not specified, the seat back is positioned so that the longitudinal center line of the child test dummy's neck is vertical, and if an instrumented test dummy is used, the accelerometer surfaces in the dummy's head and thorax, as positioned in the vehicle, are horizontal. If the vehicle seat is equipped with adjustable head restraints, each is adjusted to its highest adjustment position.

(B) The platform is instrumented with an accelerometer and data processing system having a frequency response of 60 Hz channel frequency class as specified in SAE Recommended Practice J211/1, (incorporated by reference, see §571.5). The accelerometer sensitive axis is parallel to the direction of test platform travel.

(ii) *Specific vehicle.* For built-in child restraint systems, an alternate test device is the specific vehicle into which the built-in system is fabricated. The following test conditions apply to this alternate test device.

(A) The vehicle is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the appropriate child test dummy and, at the vehicle manufacturer's option, an anthropomorphic test dummy which conforms to the requirements of subpart B or subpart E of part 572 of this title for a 50th percentile adult male dummy placed in the front outboard seating position. If the built-in child restraint system is installed at one of the seating positions otherwise requiring the placement of a part 572 test dummy, then in the frontal barrier crash specified in (c), the appropriate child test dummy shall be substituted for the part 572 adult dummy, but only at that seating position. The fuel tank is filled to any level from 90 to 95 percent of capacity.

(B) Adjustable seats are in the adjustment position midway between the forward-most and rearmost positions, and if separately adjustable in a vehicle direction, are at the lowest position. If an adjustment position does not exist midway between the forwardmost and rearmost positions, the closest adjustment position to the rear of the midpoint is used.

(C) Adjustable seat backs are in the manufacturer's nominal design riding position. If a nominal position is not specified, the seat back is positioned so that the longitudinal center line of the child test dummy's neck is vertical, and if an anthropomorphic test dummy is used, the accelerometer surfaces in the test dummy's head and thorax, as positioned in the vehicle, are horizontal. If the vehicle is equipped with adjustable head restraints, each is adjusted to its highest adjustment position.

(D) Movable vehicle windows and vents are, at the manufacturer's option, placed in the fully closed position.

(E) Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

(F) Doors are fully closed and latched but not locked.

(G) All instrumentation and data reduction are in conformance with SAE Recommended Practice J211/1 (1995), ''Instrumentation for Impact Tests,'' (incorporated by reference, see §571.5).

(b) The tests are frontal barrier impact simulations of the test platform or frontal barrier crashes of the specific vehicles as specified in S5.1 of §571.208 and for:

(1) Test Configuration I, are at a velocity change of 48 km/h with the acceleration of the test platform entirely within the curve shown in Figure 2 (for child restraints manufactured before August 1, 2005) or in Figure 2A (for child restraints manufactured on or after August 1, 2005), or for the specific vehicle test with the deceleration produced in a 48 km/h frontal barrier crash.

(2) Test Configuration II, are set at a velocity change of 32 km/h with the acceleration of the test platform entirely within the curve shown in Figure 3, or for the specific vehicle test, with the deceleration produced in a 32 km/h frontal barrier crash.

(c) As illustrated in Figures 1A and 1B of this standard, attached to the seat belt anchorage points provided on the standard seat assembly are Type 1 seat belt assemblies in the case of add-on child restraint systems other than belt-positioning seats, or Type 2 seat belt assemblies in the case of belt-positioning seats. These seat belt assemblies meet the requirements of Standard No. 209 (§571.209) and have webbing with a width of not more than 2 inches, and are attached to the anchorage points without the use of retractors or reels of any kind. As illustrated in Figures 1A'' and 1B'' of this standard, attached to the standard seat assembly is a child restraint anchorage system conforming to the specifications of Standard No. 225 (§571.225), in the case of add-on child restraint systems other than belt-positioning booster seats.

(d)(1) When using the test dummy specified in 49 CFR part 572, subparts I and K, performance tests under S6.1 are conducted at any ambient temperature from 19 °C to 26 °C and at any relative humidity from 10 percent to 70 percent.

(2) When using the test dummies specified in 49 CFR part 572, subparts N, P, R or T, performance tests under S6.1 are conducted at any ambient temperature from 20.6 °C to 22.2 °C and at any relative humidity from 10 percent to 70 percent.

(e) In the case of add-on child restraint systems, the restraint shall meet the requirements of S5 at each of its seat back angle adjustment positions and restraint belt routing positions, when the restraint is oriented in the direction recommended by the manufacturer (e.g., forward, rearward or laterally) pursuant to S5.6, and tested with the test dummy specified in S7.

S6.1.2 *Dynamic test procedure.*

(a) Activate the built-in child restraint or attach the add-on child restraint to the seat assembly as described below:

(1) *Test configuration I.*

(i) *Child restraints other than belt-positioning seats.* Attach the child restraint in any of the following manners specified in S6.1.2(a)(1)(i)(A) through (D), unless otherwise specified in this standard.

(A) Install the child restraint system at the center seating position of the standard seat assembly, in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1, except that the standard lap belt is used and, if provided, a tether strap may be used. For harnesses that bear the label shown in Figure 12 and that

meet S5.3.1(b)(1) through S5.3.1(b)(3), attach the harness in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1, *i.e.*, the seat back mount is used.

(B) Except for a child harness, a school bus child restraint system, and a restraint designed for use by children with physical disabilities, install the child restraint system at the center seating position of the standard seat assembly as in S6.1.2(a)(1)(i)(A), except that no tether strap (or any other supplemental device) is used.

(C) Install the child restraint system using the child restraint anchorage system at the center seating position of the standard seat assembly in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1. The tether strap, if one is provided, is attached to the tether anchorage.

(D) Install the child restraint system using only the lower anchorages of the child restraint anchorage system as in S6.1.2(a)(1)(i)(C). No tether strap (or any other supplemental device) is used.

(ii) *Belt-positioning seats.* A belt-positioning seat is attached to either outboard seating position of the standard seat assembly in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1 using only the standard vehicle lap and shoulder belt and no tether (or any other supplemental device). Place the belt-positioning seat on the standard seat assembly such that the center plane of the belt-positioning seat is parallel and aligned to the center plane of the outboard seating positions on the standard seat assembly and the base of the belt-positioning seat is flat on the standard seat assembly cushion. Move the belt-positioning seat rearward on the standard seat assembly until some part of the belt-positioning seat touches the standard seat assembly back. Keep the belt-positioning seat and the seating position center plane aligned as much as possible. Apply 133 N (30 pounds) of force to the front of the belt-positioning seat rearward into the standard seat assembly and release.

(iii) In the case of each built-in child restraint system, activate the restraint in the specific vehicle shell or the specific vehicle, in accordance with the manufacturer's instructions provided in accordance with S5.6.2.

(2) *Test configuration II.* (i) In the case of each add-on child restraint system which is equipped with a fixed or movable surface described in S5.2.2.2, or a backless child restraint system with a top anchorage strap, install the add-on child restraint system at the center seating position of the standard seat assembly using only the standard seat lap belt to secure the system to the standard seat.

(ii) In the case of each built-in child restraint system which is equipped with a fixed or movable surface described in S5.2.2.2, or a built-in booster seat with a top anchorage strap, activate the system in the specific vehicle shell or the specific vehicle in accordance with the manufacturer's instructions provided in accordance with S5.6.2.

(b) Select any dummy specified in S7 for testing systems for use by children of the heights and weights for which the system is recommended in accordance with S5.5. The dummy is assembled, clothed and prepared as specified in S7 and S9 and Part 572 of this chapter, as appropriate.

(c) Place the dummy in the child restraint. Position it, and attach the child restraint belts, if appropriate, as specified in S10.

(d) *Belt adjustment.*

(1) *Add-on systems other than belt-positioning seats.*

(i) If appropriate, shoulder and pelvic belts that directly restrain the dummy shall be adjusted as follows: Tighten the belts until a 9 N force applied (as illustrated in figure 5) to the webbing at the top of each dummy shoulder and to the pelvic webbing 50 mm on either side of the torso midsagittal plane pulls the webbing 7 mm from the dummy.

(ii) All Type I belt systems used to attach an add-on child restraint system to the standard seat assembly, and any provided additional anchorage belt (tether), are tightened to a tension of not less than 53.5 N and not more than 67 N, as measured by a load cell used on the webbing portion of the belt. All belt systems used to attach a harness that bears the label shown in Figure 12

and that meets S5.3.1(b)(i) through S5.3.1(b)(iii) are also tightened to a tension of not less than 53.5 N and not more than 67 N, by measurement means specified in this paragraph.

(iii) When attaching a child restraint system to the tether anchorage and the child restraint anchorage system on the standard seat assembly, tighten all belt systems used to attach the restraint to the standard seat assembly to a tension of not less than 53.5 N and not more than 67 N, as measured by a load cell or other suitable means used on the webbing portion of the belt.

(2) *Add-on belt-positioning seats.*

(i) The lap portion of Type II belt systems used to restrain the dummy is tightened to a tension of not less than 9 N (2 pounds) and not more than 18 N (4 pounds).

(ii) The shoulder portion of Type II belt systems used to restrain the dummy is tightened to a tension of not less than 9 N (2 pounds) and not more than 18 N (4 pounds).

(3) *Built-in child restraint systems.*

(i) The lap portion of Type II belt systems used to secure a dummy to the built-in child restraint system is tightened to a tension of not less than 53.5 N and not more than 67 N, as measured by a load cell used on the webbing portion of the belt.

(ii) The shoulder portion of Type II belt systems used to secure a child is tightened to a tension of not less than 9 N and not more than 18 N, as measured by a load cell used on the webbing portion of the belt.

(iii) If provided, and if appropriate to attach the child restraint belts under S10, shoulder (other than the shoulder portion of a Type II vehicle belt system) and pelvic belts that directly restrain the dummy shall be adjusted as follows: Tighten the belts until a 9 N force applied (as illustrated in figure 5) to the webbing at the top of each dummy shoulder and to the pelvic webbing 50 mm on either side of the torso midsagittal plane pulls the webbing 7 mm from the dummy.

(e) Accelerate the test platform to simulate frontal impact in accordance with Test Configuration I or II, as appropriate.

(f) Determine conformance with the requirements in S5.1.

S6.2 *Buckle release test procedure.*

The belt assembly buckles used in any child restraint system shall be tested in accordance with S6.2.1 through S6.2.4 inclusive.

S6.2.1 Before conducting the testing specified in S6.1, place the loaded buckle on a hard, flat, horizontal surface. Each belt end of the buckle shall be pre-loaded in the following manner. The anchor end of the buckle shall be loaded with a 9 N force in the direction away from the buckle. In the case of buckles designed to secure a single latch plate, the belt latch plate end of the buckle shall be pre-loaded with a 9 N force in the direction away from the buckle. In the case of buckles designed to secure two or more latch plates, the belt latch plate ends of the buckle shall be loaded equally so that the total load is 9 N, in the direction away from the buckle. For pushbutton-release buckles, the release force shall be applied by a conical surface (cone angle not exceeding 90 degrees). For pushbutton-release mechanisms with a fixed edge (referred to in Figure 7 as ''hinged button''), the release force shall be applied at the centerline of the button, 3 mm away from the movable edge directly opposite the fixed edge, and in the direction that produces maximum releasing effect. For pushbutton-release mechanisms with no fixed edge (referred to in Figure 7 as ''floating button''), the release force shall be applied at the center of the release mechanism in the direction that produces the maximum releasing effect. For all other buckle release mechanisms, the force shall be applied on the centerline of the buckle lever or finger tab in the direction that produces the maximum releasing effect. Measure the force required to release the buckle. Figure 7 illustrates the loading for the different buckles and the point where the release force should be applied, and Figure 8 illustrates the conical surface used to apply the release force to pushbutton-release buckles.

S6.2.2 After completion of the testing specified in S6.1 and before the buckle is unlatched, tie a self-adjusting sling to each wrist and ankle of the test dummy in the manner illustrated in Figure 4, without disturbing the

belted dummy and the child restraint system.

S6.2.3 Pull the sling tied to the dummy restrained in the child restraint system and apply the following force: 50 N for a system tested with a newborn dummy (49 CFR part 572, subpart K); 90 N for a system tested with a 12-month-old dummy (49 CFR part 572, subpart R); 200 N for a system tested with a 3-year-old dummy (49 CFR part 572, subpart P); 270 N for a system tested with a 6-year-old dummy (49 CFR part 572, subpart N or I); 350 N for a system tested with a weighted 6-year-old dummy (49 CFR part 572, subpart S); or 437 N for a system tested with a 10-year-old dummy (49 CFR part 572, subpart T). The force is applied in the manner illustrated in Figure 4 and as follows:

(a) *Add-on Child Restraints.* For an add-on child restraint other than a car bed, apply the specified force by pulling the sling horizontally and parallel to the SORL of the standard seat assembly. For a car bed, apply the force by pulling the sling vertically.

(b) *Built-in Child Restraints.* For a built-in child restraint other than a car bed, apply the force by pulling the sling parallel to the longitudinal centerline of the specific vehicle shell or the specific vehicle. In the case of a car bed, apply the force by pulling the sling vertically.

S6.2.4 While applying the force specified in S6.2.3, and using the device shown in Figure 8 for pushbutton-release buckles, apply the release force in the manner and location specified in S6.2.1, for that type of buckle. Measure the force required to release the buckle.

S6.3 [Reserved]

S7 *Test dummies.* (Subparts referenced in this section are of part 572 of this chapter.) S7.1 *Dummy selection.* Select any dummy specified in S7.1.1, S7.1.2 or S7.1.3, as appropriate, for testing systems for use by children of the height and mass for which the system is recommended in accordance with S5.5. A child restraint that meets the criteria in two or more of the following paragraphs in S7 may be tested with any of the test dummies specified in those paragraphs.

S7.1.1 [Reserved]

S7.1.2 Child restraints that are manufactured on or after August 1, 2005, are subject to the following provisions and S7.1.3.

(a) A child restraint that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified mass range that includes any children having a mass of not greater than 5 kg, or by children in a specified height range that includes any children whose height is not greater than 650 mm, is tested with a newborn test dummy conforming to part 572 subpart K.

(b) A child restraint that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified mass range that includes any children having a mass greater than 5 but not greater than 10 kg, or by children in a specified height range that includes any children whose height is greater than 650 mm but not greater than 850 mm, is tested with a newborn test dummy conforming to part 572 subpart K, and a 12-month-old test dummy conforming to part 572 subpart R.

(c) A child restraint that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified mass range that includes any children having a mass greater than 10 kg but not greater than 18 kg, or by children in a specified height range that includes any children whose height is greater than 850 mm but not greater than 1100 mm, is tested with a 12-month-old test dummy conforming to part 572 subpart R, and a 3-year-old test dummy conforming to part 572 subpart P and S7.2, provided, however, that the 12-month-old dummy is not used to test a booster seat.

(d) A child restraint that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified mass range that includes any children having a mass greater than 18 kg (40 lb) but not greater than 22.7 (50 lb), or by children in a specified height range that includes any children whose height is greater than 1100 mm but not greater than 1250 mm is tested with a 49 CFR part 572, subpart N dummy (Hybrid III 6-year-old dummy).

(e) A child restraint that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified mass range that includes any children having a mass greater than 22.7 kg (50 lb) but not greater than 30 kg (65 lb) or by children in a specified height range that includes any children whose height is greater than 1100 mm but not greater than 1250 mm is tested with a 49 CFR part 572, subpart N dummy (Hybrid III 6-year-old dummy) and with a part 572, subpart S dummy (Hybrid III 6-year-old weighted dummy).

(f) A child restraint that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified mass range that includes any children having a mass greater than 30 kg (65 lb) or by children in a specified height range that includes any children whose height is greater than 1250 mm is tested with a 49 CFR part 572, subpart T dummy (Hybrid III 10-year-old dummy).

S7.1.3 *Voluntary use of alternative dummies.* At the manufacturer's option (with said option irrevocably selected prior to, or at the time of, certification of the restraint), when this section specifies use of the 49 CFR part 572, subpart N (Hybrid III 6-year-old dummy) test dummy, the test dummy specified in 49 CFR part 572, subpart I (Hybrid II 6-year-old dummy) may be used in place of the subpart N test dummy.

S8 *Requirements, test conditions, and procedures for child restraint systems manufactured for use in aircraft.* Each child restraint system manufactured for use in both motor vehicles and aircraft must comply with all of the applicable requirements specified in Section S5 and with the additional requirements specified in S8.1 and S8.2.

S8.1 *Installation instructions.* Each child restraint system manufactured for use in aircraft shall be accompanied by printed instructions in English that provide a step-by-step procedure, including diagrams, for installing the system in aircraft passenger seats, securing a child in the system when it is installed in aircraft, and adjusting the system to fit the child.

S8.2 *Inversion test.* When tested in accordance with S8.2.1 through S8.2.5, each child restraint system manufactured for use in aircraft shall meet the requirements of S8.2.1 through S8.2.6. The manufacturer may, at its option, use any seat which is a representative aircraft passenger seat within the meaning of S4. Each system shall meet the requirements at each of the restraint's seat back angle adjustment positions and restraint belt routing positions, when the restraint is oriented in the direction recommended by the manufacturer (e.g., facing forward, rearward or laterally) pursuant to S8.1, and tested with the test dummy specified in S7. If the manufacturer recommendations do not include instructions for orienting the restraint in aircraft when the restraint seat back angle is adjusted to any position, position the restraint on the aircraft seat by following the instructions (provided in accordance with S5.6) for orienting the restraint in motor vehicles.

S8.2.1 A standard seat assembly consisting of a representative aircraft passenger seat shall be positioned and adjusted so that its horizontal and vertical orientation and its seat back angle are the same as shown in Figure 6.

S8.2.2 The child restraint system shall be attached to the representative aircraft passenger seat using, at the manufacturer's option, any Federal Aviation Administration approved aircraft safety belt, according to the restraint manufacturer's instructions for attaching the restraint to an aircraft seat. No supplementary anchorage belts or tether straps may be attached; however, Federal Aviation Administration approved safety belt extensions may be used.

S8.2.3 In accordance with S10, place in the child restraint any dummy specified in S7 for testing systems for use by children of the heights and weights for which the system is recommended in accordance with S5.5 and S8.1.

S8.2.4 If provided, shoulder and pelvic belts that directly restrain the dummy shall be adjusted in accordance with S6.1.2.

S8.2.5 The combination of representative aircraft passenger seat, child restraint, and test dummy shall be rotated forward around a horizontal axis which is contained in the median

transverse vertical plane of the seating surface portion of the aircraft seat and is located 25 mm below the bottom of the seat frame, at a speed of 35 to 45 degrees per second, to an angle of 180 degrees. The rotation shall be stopped when it reaches that angle and the seat shall be held in this position for three seconds. The child restraint shall not fall out of the aircraft safety belt nor shall the test dummy fall out of the child restraint at any time during the rotation or the three second period. The specified rate of rotation shall be attained in not less than one half second and not more than one second, and the rotating combination shall be brought to a stop in not less than one half second and not more than one second.

S8.2.6 Repeat the procedures set forth in S8.2.1 through S8.2.4. The combination of the representative aircraft passenger seat, child restraint, and test dummy shall be rotated sideways around a horizontal axis which is contained in the median longitudinal vertical plane of the seating surface portion of the aircraft seat and is located 25 mm below the bottom of the seat frame, at a speed of 35 to 45 degrees per second, to an angle of 180 degrees. The rotation shall be stopped when it reaches that angle and the seat shall be held in this position for three seconds. The child restraint shall not fall out of the aircraft safety belt nor shall the test dummy fall out of the child restraint at any time during the rotation or the three second period. The specified rate of rotation shall be attained in not less than one half second and not more than one second, and the rotating combination shall be brought to a stop in not less than one half second and not more than one second.

S9 *Dummy clothing and preparation.*

S9.1 *Type of clothing.*

(a) *Newborn dummy.* When used in testing under this standard, the dummy is unclothed.

(b) [Reserved]

(c) *12-month-old dummy (49 CFR part 572, subpart R).* When used in testing under this standard, the dummy specified in 49 CFR part 572, subparts R, is clothed in a cotton-polyester based tight fitting sweat shirt with long sleeves and ankle long pants whose combined weight is not more than 0.25 kg.

(d) *Hybrid II three-year-old and Hybrid II six-year-old dummies (49 CFR part 572, subparts C and I).* When used in testing under this standard, the dummies specified in 49 CFR part 572, subparts C and I, are clothed in thermal knit, waffle-weave polyester and cotton underwear or equivalent, a size 4 long-sleeved shirt (3-year-old dummy) or a size 5 long-sleeved shirt (6-year-old dummy) having a mass of 0.090 kg, a size 4 pair of long pants having a mass of 0.090 kg, and cut off just far enough above the knee to allow the knee target to be visible, and size 7M sneakers (3-year-old dummy) or size 12½M sneakers (6-year-old dummy) with rubber toe caps, uppers of dacron and cotton or nylon and a total mass of 0.453 kg.

(e) *Hybrid III 3-year-old dummy (49 CFR part 572, subpart P).* When used in testing under this standard, the dummy specified in 49 CFR Part 572, Subpart P, is clothed as specified in that subpart, except that the shoes are children's size 8 canvas oxford style sneakers weighing not more than 0.26 kg each.

(f) *Hybrid III 6-year-old dummy (49 CFR part 572, subpart N) and Hybrid III 6-year-old weighted dummy (49 CFR part 572, subpart S), and Hybrid III 10-year-old dummy (49 CFR part 572, subpart T).* When used in testing under this standard, the dummies specified in 49 CFR part 572, subparts N and S, are clothed as specified in subpart N and with child or youth size 13 M sneakers weighing not more than 0.45 kg each. When used in testing under this standard, the dummy specified in 49 CFR part 572, subpart T, is clothed as specified in subpart T and with youth size 3 sneakers weighing not more than 0.6 kg each.

S9.2 *Preparing clothing.* Clothing other than the shoes is machined-washed in 71 °C to 82 °C and machine-dried at 49 °C to 60 °C for 30 minutes.

S9.3 *Preparing dummies.* (Subparts referenced in this section are of Part 572 of this chapter.)

S9.3.1 When using the test dummies conforming to part 572 C, I, or K, prepare the dummies as specified in this paragraph. Before being used in testing under this standard, dummies must be

conditioned at any ambient temperature from 19 °C to 25.5 °C and at any relative humidity from 10 percent to 70 percent, for at least 4 hours.

S9.3.2 When using the test dummies conforming to part 572 subparts N, P, R, S or T, prepare the dummies as specified in this paragraph. Before being used in testing under this standard, dummies must be conditioned at any ambient temperature from 20.6° to 22.2°C and at any relative humidity from 10 percent to 70 percent, for at least 4 hours.

S10 *Positioning the dummy and attaching the system belts.*

S10.1 *Car beds.* Place the test dummy in the car bed in the supine position with its midsagittal plane perpendicular to the center SORL of the standard seat assembly, in the case of an add-on car bed, or perpendicular to the longitudinal axis of the specific vehicle shell or the specific vehicle, in the case of a built-in car bed. Position the dummy within the car bed in accordance with the instructions for child positioning that the bed manufacturer provided with the bed in accordance with S5.6.

S10.2 *Restraints other than car beds.*

S10.2.1 *Newborn dummy and 12-month-old dummy.* Position the test dummy according to the instructions for child positioning that the manufacturer provided with the system under S5.6.1 or S5.6.2, while conforming to the following:

(a) [Reserved]

(b)(1) [Reserved]

(2) When testing rear-facing child restraint systems, place the newborn, or 12-month-old dummy in the child restraint system so that the back of the dummy torso contacts the back support surface of the system. For a child restraint system which is equipped with a fixed or movable surface described in S5.2.2.2 which is being tested under the conditions of test configuration II, do not attach any of the child restraint belts unless they are an integral part of the fixed or movable surface. For all other child restraint systems and for a child restraint system with a fixed or movable surface which is being tested under the conditions of test configuration I, attach all appropriate child restraint belts and tighten them as specified in S6.1.2. Attach all appropriate vehicle belts and tighten them as specified in S6.1.2. Position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2. If the dummy's head does not remain in the proper position, tape it against the front of the seat back surface of the system by means of a single thickness of 6 mm-wide paper masking tape placed across the center of the dummy's face.

(c)(1)(i) When testing forward-facing child restraint systems, extend the arms of the 12-month old test dummy as far as possible in the upward vertical direction. Extend the legs of the 12-month-old test dummy as far as possible in the forward horizontal direction, with the dummy feet perpendicular to the centerline of the lower legs. Using a flat square surface with an area of 2,580 square mm, apply a force of 178 N, perpendicular to:

(A) The plane of the back of the standard seat assembly, in the case of an add-on system, or

(B) The back of the vehicle seat in the specific vehicle shell or the specific vehicle, in the case of a built-in system, first against the dummy crotch and then at the dummy thorax in the midsagittal plane of the dummy. For a child restraint system with a fixed or movable surface described in S5.2.2.2, which is being tested under the conditions of test configuration II, do not attach any of the child restraint belts unless they are an integral part of the fixed or movable surface. For all other child restraint systems and for a child restraint system with a fixed or movable surface which is being tested under the conditions of test configuration I, attach all appropriate child restraint belts and tighten them as specified in S6.1.2. Attach all appropriate vehicle belts and tighten them as specified in S6.1.2. Position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2.

(ii) After the steps specified in paragraph (c)(1)(i) of this section, rotate each dummy limb downwards in the plane parallel to the dummy's midsagittal plane until the limb contacts a surface of the child restraint

system or the standard seat assembly, in the case of an add-on system, or the specific vehicle shell or specific vehicle, in the case of a built-in system, as appropriate. Position the limbs, if necessary, so that limb placement does not inhibit torso or head movement in tests conducted under S6.

(2) When testing rear-facing child restraint systems, extend the dummy's arms vertically upwards and then rotate each arm downward toward the dummy's lower body until the arm contacts a surface of the child restraint system or the standard seat assembly in the case of an add-on child restraint system, or the specific vehicle shell or the specific vehicle, in the case of a built-in child restraint system. Ensure that no arm is restrained from movement in other than the downward direction, by any part of the system or the belts used to anchor the system to the standard seat assembly, the specific shell, or the specific vehicle.

S10.2.2 *Other dummies generally.* When using: (1) the Hybrid III 3-year-old (part 572, subpart P), Hybrid II 6-year-old (part 572, subpart I), and Hybrid III weighted 6-year-old (part 572, subpart S) in child restraint systems including belt-positioning seats; (2) the Hybrid III 6-year-old (part 572, subpart N) and the Hybrid III 10-year-old (part 572, subpart T) in child restraint systems other than belt-positioning seats, position the dummy in accordance with S5.6.1 or S5.6.2, while conforming to the following:

(a) Holding the test dummy torso upright until it contacts the system's design seating surface, place the test dummy in the seated position within the system with the midsagittal plane of the test dummy head—

(1) Coincident with the center SORL of the standard seating assembly, in the case of the add-on child restraint system, or

(2) Vertical and parallel to the longitudinal center line of the specific vehicle, in the case of a built-in child restraint system.

(b) Extend the arms of the test dummy as far as possible in the upward vertical direction. Extend the legs of the dummy as far as possible in the forward horizontal direction, with the dummy feet perpendicular to the center line of the lower legs.

(c) Using a flat square surface with an area of 2580 square millimeters, apply a force of 178 N, perpendicular to:

(1) The plane of the back of the standard seat assembly, in the case of an add-on system, or

(2) The back of the vehicle seat in the specific vehicle shell or the specific vehicle, in the case of a built-in system, first against the dummy crotch and then at the dummy thorax in the midsagittal plane of the dummy. For a child restraint system with a fixed or movable surface described in S5.2.2.2, which is being tested under the conditions of test configuration II, do not attach any of the child restraint belts unless they are an integral part of the fixed or movable surface. For all other child restraint systems and for a child restraint system with a fixed or movable surface which is being tested under the conditions of test configuration I, attach all appropriate child restraint belts and tighten them as specified in S6.1.2. Attach all appropriate vehicle belts and tighten them as specified in S6.1.2. Position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2.

(d) After the steps specified in paragraph (c) of this section, rotate each dummy limb downwards in the plane parallel to the dummy's midsagittal plane until the limb contacts a surface of the child restraint system or the standard seat assembly, in the case of an add-on system, or the specific vehicle shell or specific vehicle, in the case of a built-in system, as appropriate. Position the limbs, if necessary, so that limb placement does not inhibit torso or head movement in tests conducted under S6.

S10.2.3 *Hybrid III 6-year-old in belt-positioning seats, Hybrid III weighted 6-year-old in belt-positioning seats, and Hybrid III 10-year-old in belt-positioning seats.* When using the Hybrid III 6-year-old (part 572, subpart N), the Hybrid III weighted 6-year-old (part 572, subpart S), or the Hybrid III 10-year-old (part 572, subpart T) in belt-positioning seats, position the dummy in accordance with S5.6.1 or S5.6.2, while conforming to the following:

(a) *Prepare the dummy.* (1) When using the Hybrid III 10-year-old dummy, prepare the dummy according to the following:

(i) Set the dummy's neck angle at the SP–16 setting (''SP'' means standard procedure), see Figure 14a.

(ii) Set the dummy's lumbar angle at the SP–12 setting, see Figure 14b. This is done by aligning the notch on the lumbar adjustment bracket with the SP–12 notch on the lumbar attachment.

(iii) Adjust the limb joints to 1–2 g while the torso is in the seated position.

(iv) Apply double-sided tape to the surface of a lap shield, which is a piece of translucent silicone rubber 3 mm ±0.5 mm thick (50A durometer) cut to the dimensions specified in Figure 13. Place the lap shield on the pelvis of the dummy. Align the top of the lap shield with the superior anterior edge of the pelvis skin. Attach the lap shield to the dummy.

(v) Apply double-sided tape to one side of a pelvis positioning pad, which is a 125 × 95 × 20 mm (±2 mm tolerance in each of the three dimensions) piece of closed cell (Type 2 according to ASTM D–1056–07) (incorporated by reference; see §571.5) foam or rubber cut from material having the following specifications: compression resistance between 9 to 17 psi in a compression-deflection test specified in ASTM D–1056–07 (incorporated by reference; see §571.5), and a density of 7 to 12.5 lb/ft^3. Center the long axis of the pad on the posterior of the pelvis with the top edge of the foam aligned with the superior edge of the pelvis skin. Attach the pelvis positioning pad to the dummy.

(vi) Dress and prepare the dummy according to S9.

(2) When using the Hybrid III 6-year-old dummy, prepare the dummy according to the following:

(i) If necessary, adjust the limb joints to 1–2 g while the torso is in the seated position.

(ii) Apply double-sided tape to the surface of a lap shield, which is a piece of translucent silicone rubber 3 mm thick ±0.5 mm thick (50A durometer) cut to the dimensions specified in Figure 13. Place the lap shield on the pelvis of the dummy. Align the top of the lap shield with the superior anterior edge of the pelvis skin. Attach the lap shield to the dummy.

(iii) Dress and prepare the dummy according to S9.

(b) Position the belt-positioning seat according to S6.1.2(a)(1)(ii).

(c) Position the dummy in the belt-positioning seat.

(1) Place the dummy on the seat cushion of the belt-positioning seat such that the plane of the posterior pelvis is parallel to the plane of the seat back of the belt-positioning seat, standard seat assembly or vehicle seat back, but not touching. Pick up and move the dummy rearward, maintaining the parallel planes, until the pelvis positioning pad, if used, or the pelvis or back of the dummy and the back of the belt-positioning seat or the back of the standard seat assembly, are in minimal contact.

(2) Straighten and align the arm segments horizontally, then rotate the arms upward at the shoulder as far as possible without contacting the belt-positioning seat. Straighten and align the legs horizontally and extend the lower legs as far as possible in the forward horizontal direction, with the feet perpendicular to the centerline of the lower legs.

(3) Using a flat square surface with an area of 2580 square millimeters, apply a force of 178 N (40 lb) first against the dummy crotch and then against the dummy thorax on the midsagittal plane of the dummy, perpendicular to:

(i) The plane of the back of the belt-positioning seat, in the case of a belt-positioning seat with a back, or,

(ii) The plane of the back of the standard seat assembly or vehicle seat, in the case of a backless belt-positioning seat or built-in booster.

(4) Rotate the arms of the dummy down so that they are perpendicular to the torso.

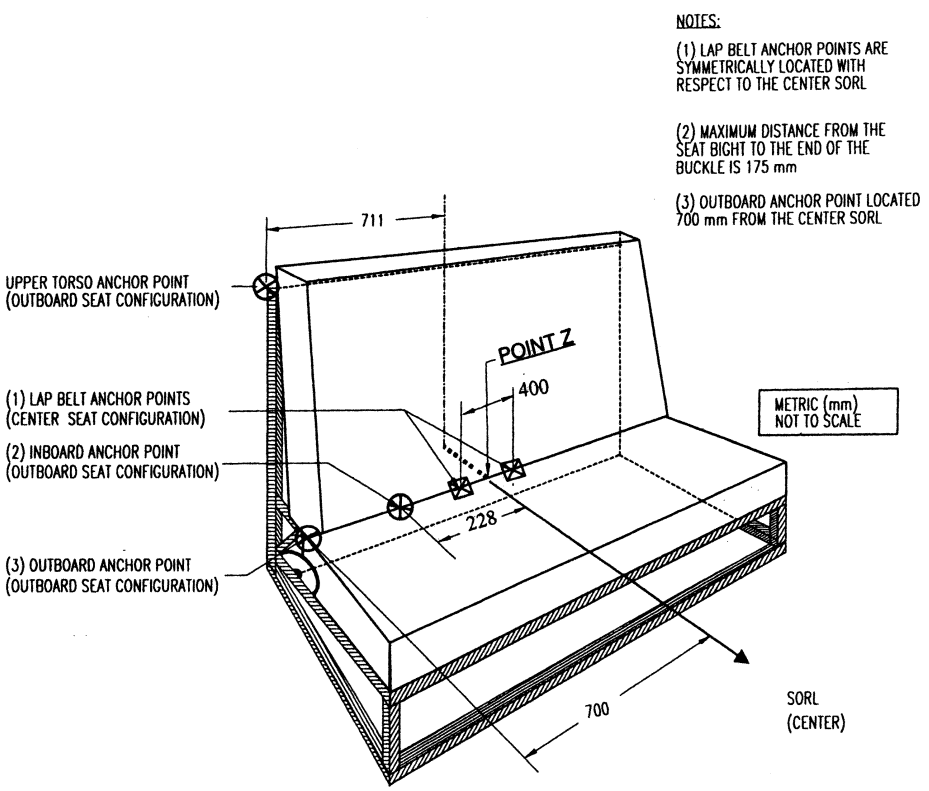
(5) Bend the knees until the back of the lower legs are in minimal contact with the belt-positioning seat, standard seat assembly or vehicle seat. Position the legs such that the outer edges of the knees are 180 ±10 mm apart for the Hybrid III 6-year-old dummy and 220 ±10 mm apart for the Hybrid III 10-year-old dummy. Position the feet such

that the soles are perpendicular to the centerline of the lower legs. In the case of a belt-positioning seat with a back, adjust the dummy so that the shoulders are parallel to a line connecting the shoulder belt guides. This can be accomplished by leaning the torso such that the dummy's head and neck are centered on the backrest components of the belt-positioning seat. In case of a backless child restraint, adjust the dummy's torso so that the head is as close to laterally level as possible.

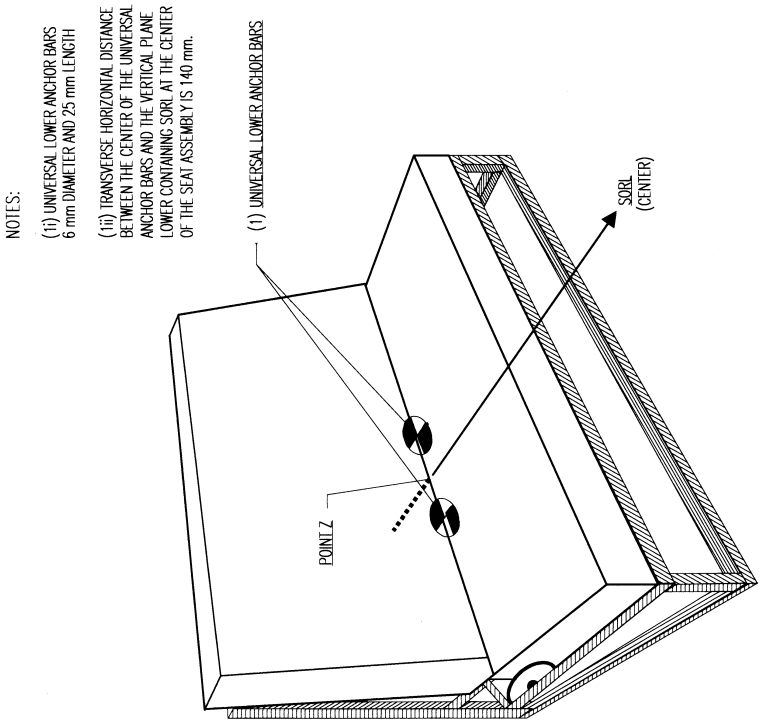
(d) *Apply the belt.* Attach the vehicle belts and tighten them as specified in S6.1.2.

(e) *Dummy final positioning.* (1) Check the leg, feet, thorax and head positions and make any necessary adjustments to achieve the positions described in S10.2.3(c)(5). Position the legs, if necessary, so that the leg placement does not inhibit thorax movement in tests conducted under S6.

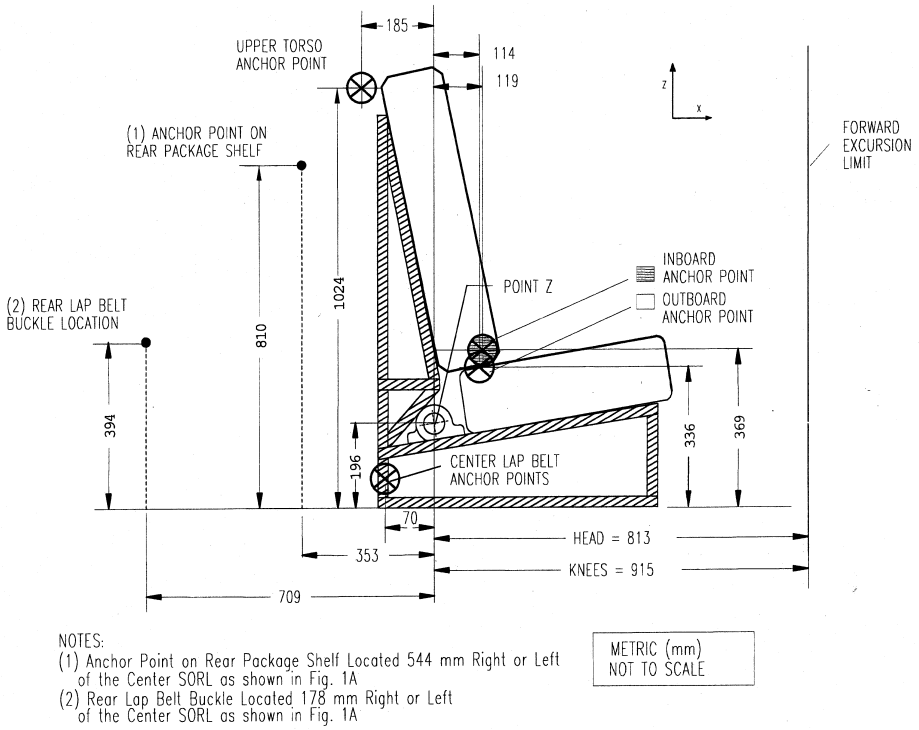
(2) Rotate each dummy arm downwards in the plane parallel to the dummy's midsagittal plane until the arm contacts a surface of the child restraint system or the standard seat assembly, in the case of an add-on system, or the specific vehicle shell or specific vehicle, in the case of a built-in system, as appropriate. Position the arms, if necessary, so that the arm placement does not inhibit torso or head movement in tests conducted under S6.



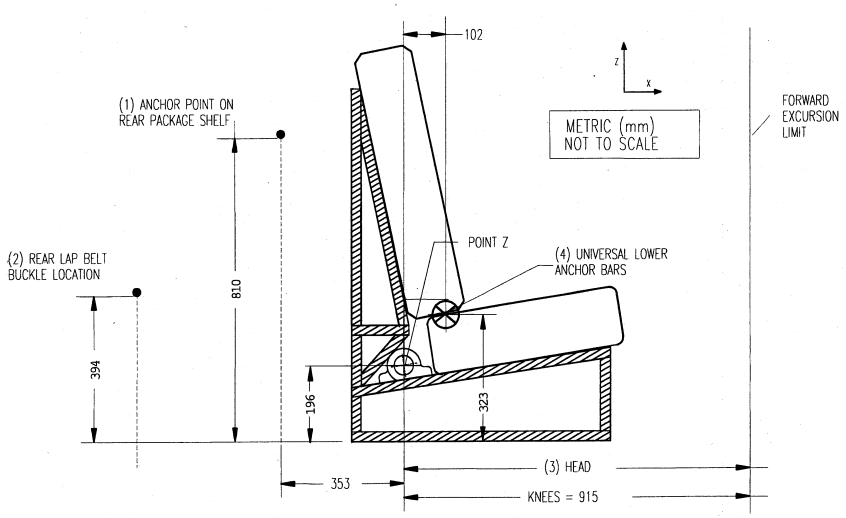
SEAT ORIENTATION REFERENCE LINE AND BELT ANCHORAGE POINT LOCATIONS ON THE STANDARD SEAT ASSEMBLY
Figure 1A



SEAT ORIENTATION REFERENCE LINE AND LOCATION OF UNIVERSAL CHILD RESTRAINT ANCHORAGE SYSTEM ON THE STANDARD SEAT ASSEMBLY
Figure 1A'

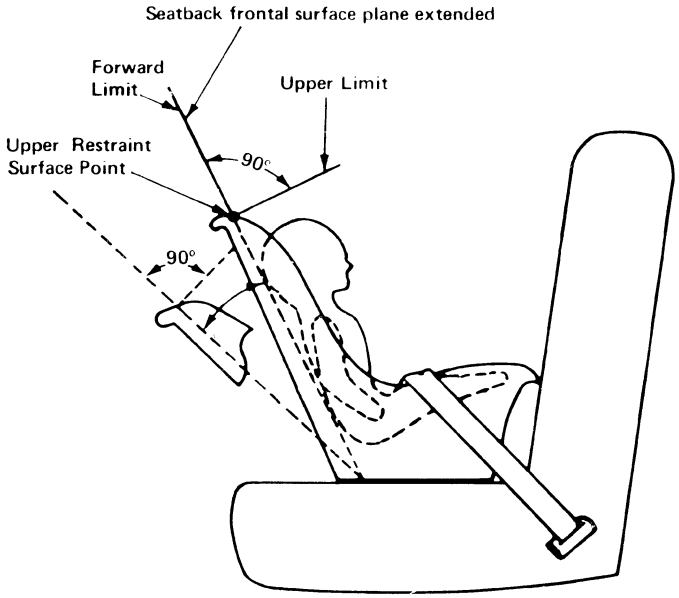


LOCATION OF BELT ANCHORAGE POINTS AND FORWARD EXCURSION LIMITS ON THE STANDARD SEAT ASSEMBLY
Figure 1B



NOTES:
(1) Anchor Point on Rear Package Shelf Located 544 mm Right or Left of the Center SORL as shown in Fig. 1A'
(2) Rear Lap Belt Buckle Located 178 mm Right or Left of the Center SORL as shown in Fig. 1A'
(3) Head Excursion Limit is: (i) 720 mm with Tether Attached and (ii) 813 mm with Tether Unattached
(4) Universal Lower Anchor Bars Located 102 mm Forward of Pt Z and 279 mm Upward from Floor

LOCATION OF UNIVERSAL CHILD RESTRAINT ANCHORAGE SYSTEM AND FORWARD EXCURSION LIMITS FOR THE STANDARD SEAT ASSEMBLY
Figure 1B'



REAR FACING CHILD RESTRAINT
FORWARD AND UPPER HEAD EXCURSION LIMITS

FIGURE 1C

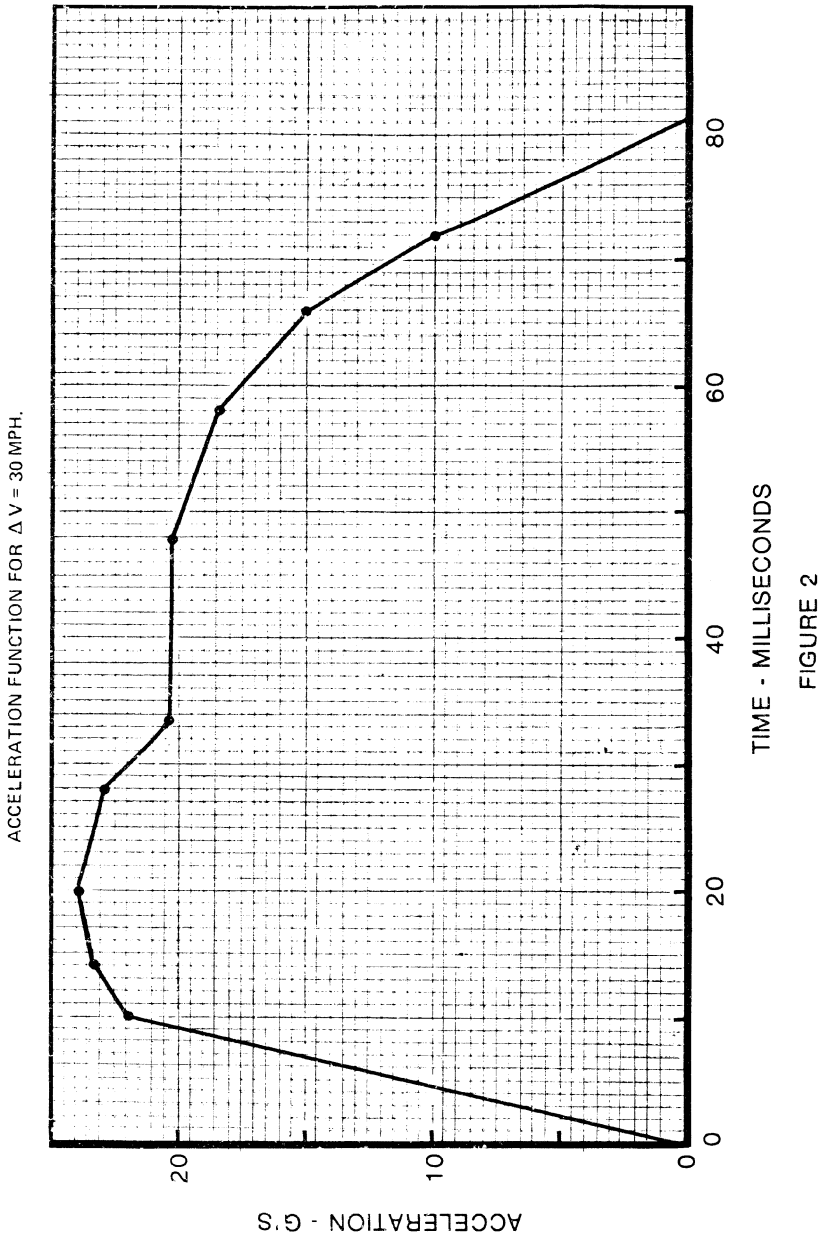
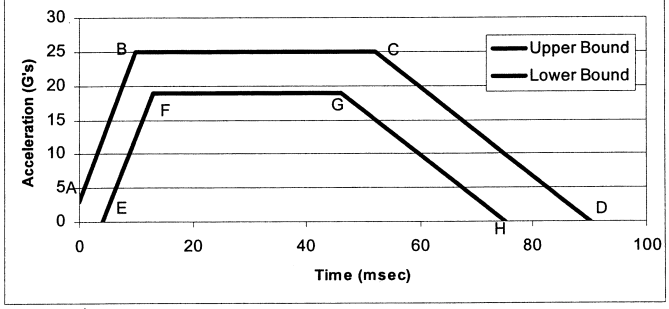

ACCELERATION FUNCTION FOR Δ V = 30 MPH.
ACCELERATION - G'S
0
10
20
0
20
40
60
80
TIME - MILLISECONDS

FIGURE 2



Upper Bound			Lower Bound		
Point	**Time**	**Acceleration**	**Point**	**Time**	**Acceleration**
A	0	3	**E**	4	0
B	10	25	**F**	13	19
C	52	25	**G**	46	19
D	90	0	**H**	75	0

Figure 2A

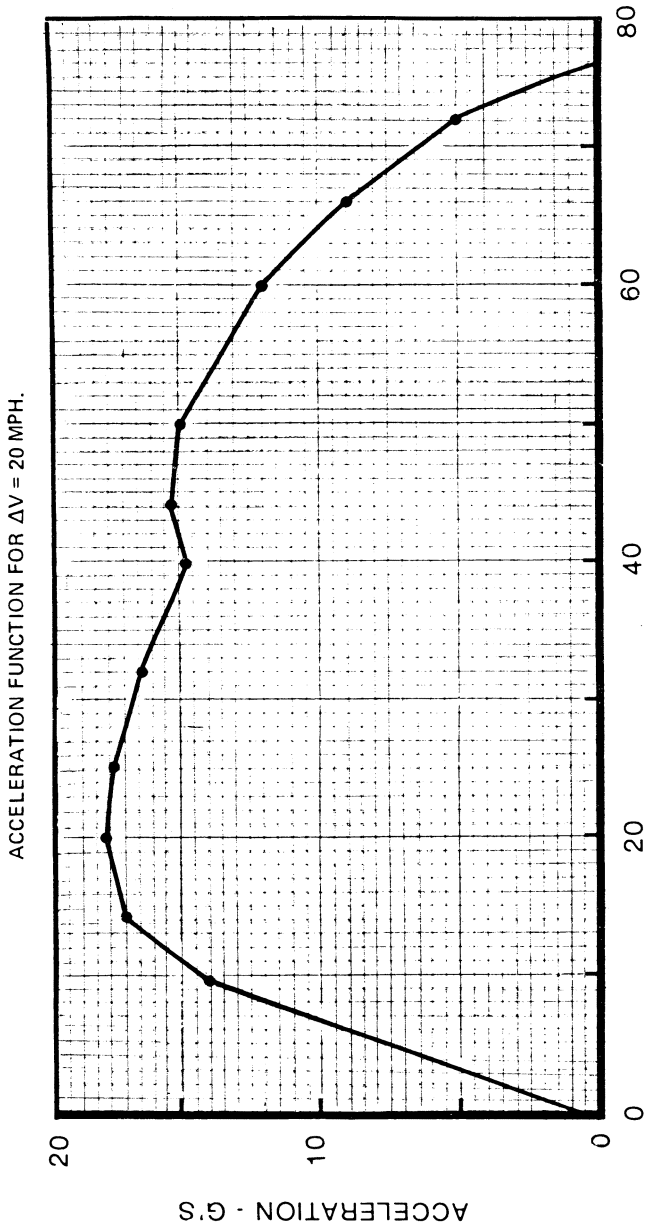
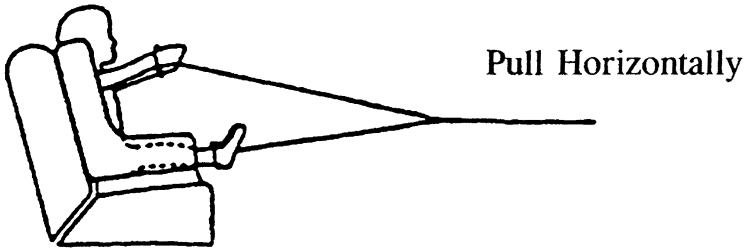

ACCELERATION FUNCTION FOR ΔV = 20 MPH.
ACCELERATION - G'S
20
10
0
0
20
40
60
80
TIME - MILLISECONDS

FIGURE 3

a)



b)

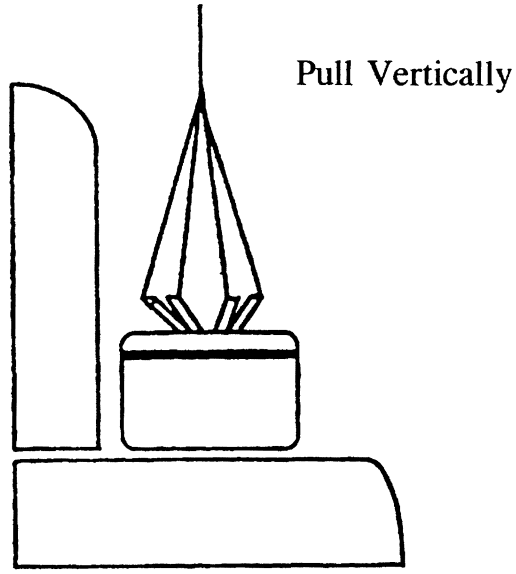
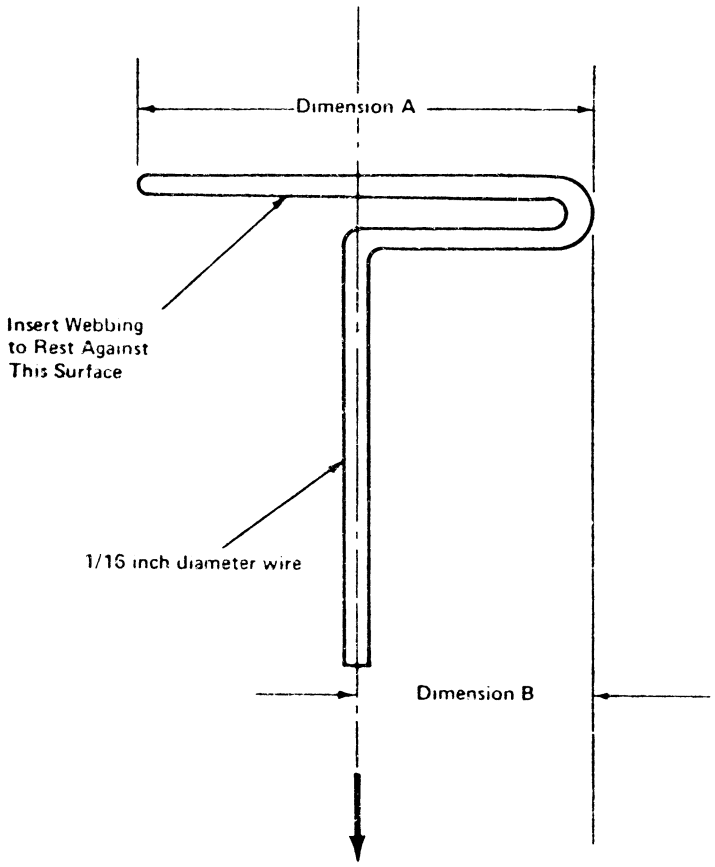


FIGURE 4 - Buckle Release Test

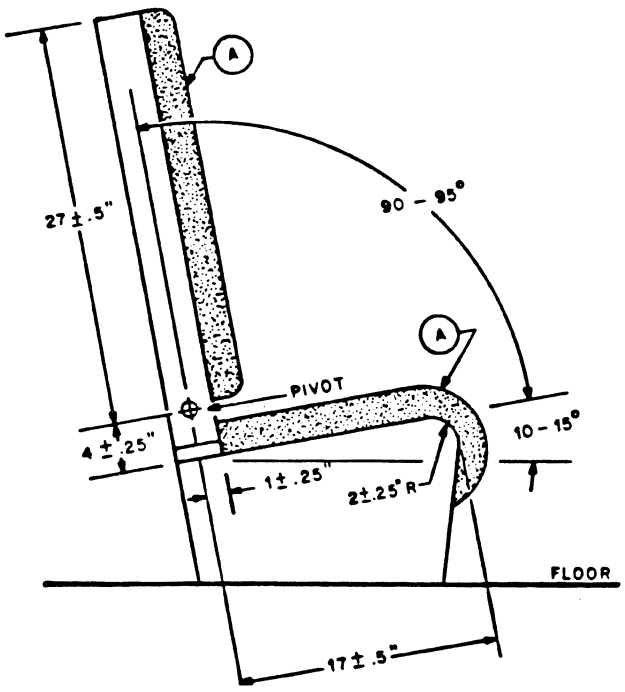


Dimension A - Width of Webbing Plus 1/8 inch

Dimension B - 1/2 of Dimension A

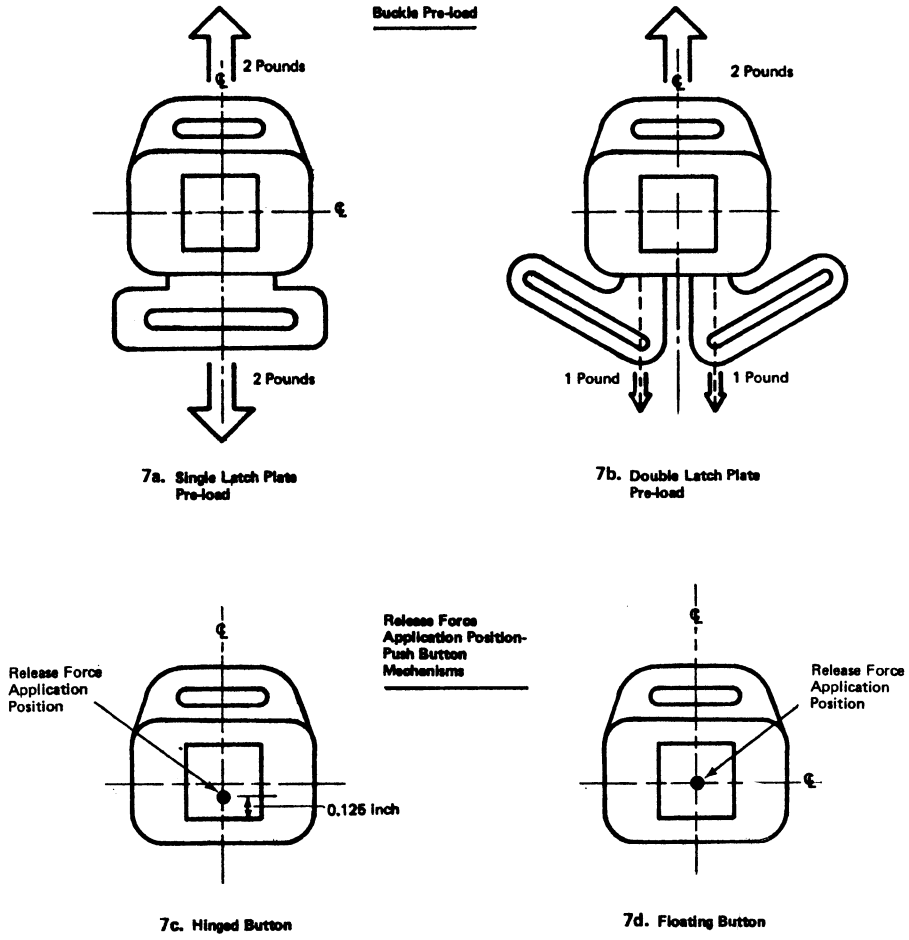
WEBBING TENSION PULL DEVICE

FIGURE 5



"A" represents a 2- to 3-inch thick polyurethane foam pad, 1.5-2.0 pounds per cubic foot density, over 0.020-inch-thick aluminum pan, and covered by 12- to 14-ounce marine canvas. The sheet aluminum pan is 20 inches wide and supported on each side by a rigid structure. The seat back is a rectangular frame covered with the aluminum sheet and weighing between 14 and 15 pounds, with a center of mass 13 to 16 inches above the seat pivot axis. The mass moment of inertia of the seat back about the seat pivot axis is between 195 and 220 ounce-inch-second^2. The seat back is free to fold forward about the pivot, but a stop prevents rearward motion. The passenger safety belt anchor points are spaced 21 to 22 inches apart and are located in line with the seat pivot axis.

FIGURE 6: SIMULATED AIRCRAFT PASSENGER SEAT



7a. Single Latch Plate Pre-load

7b. Double Latch Plate Pre-load

7c. Hinged Button

7d. Floating Button

Figure 7. Pre-impact Buckle Release Force Test Set-up

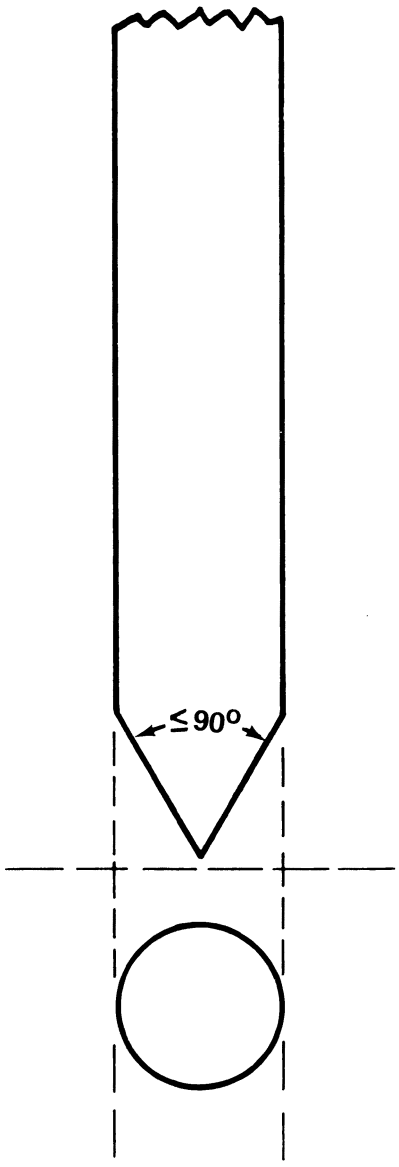


Figure 8. Release Force Application Device--
Push Button Release Buckles

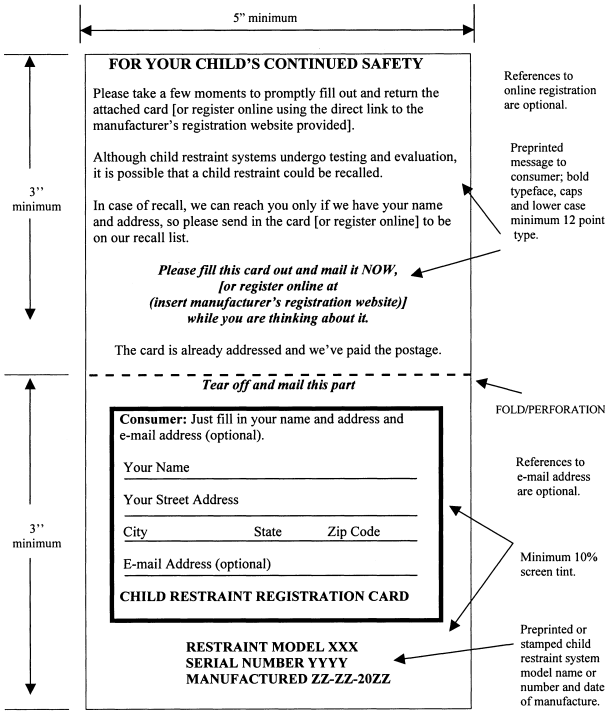


Figure 9a – Registration form for child restraint systems – product identification number and purchaser information side.

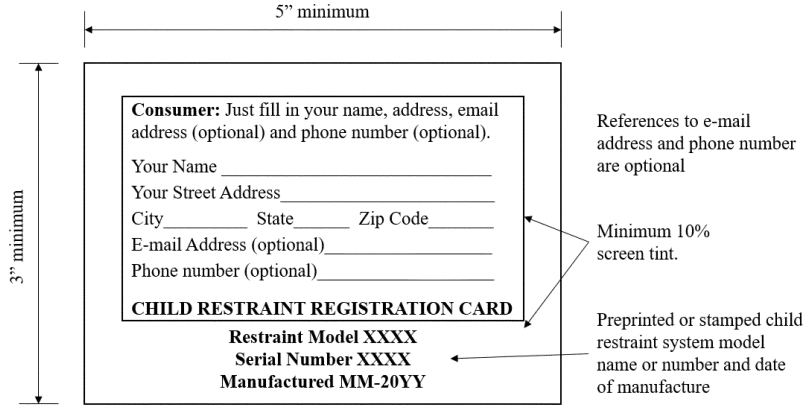


FIGURE 9A–2 TO § 571.213

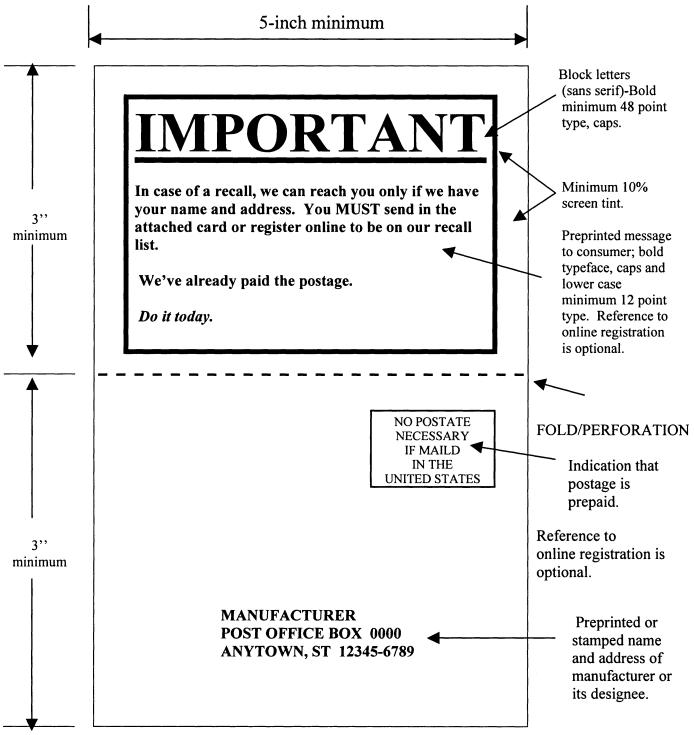


Figure 9b - Registration form for child restraint systems — address side.

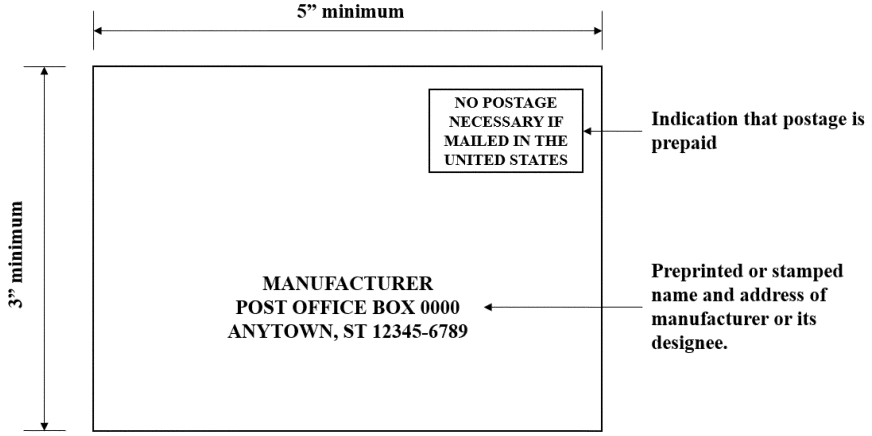


FIGURE 9B–2 TO §571.213

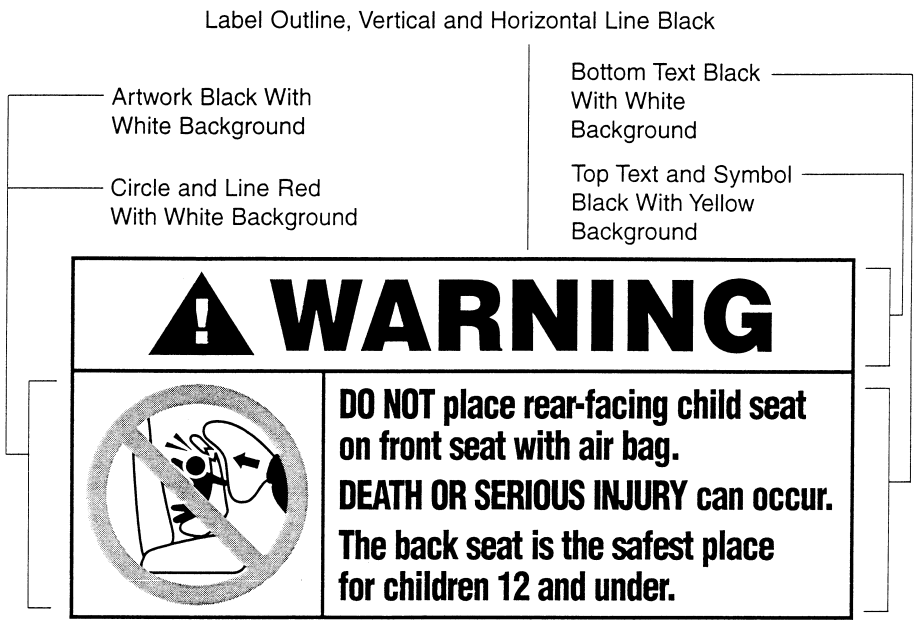
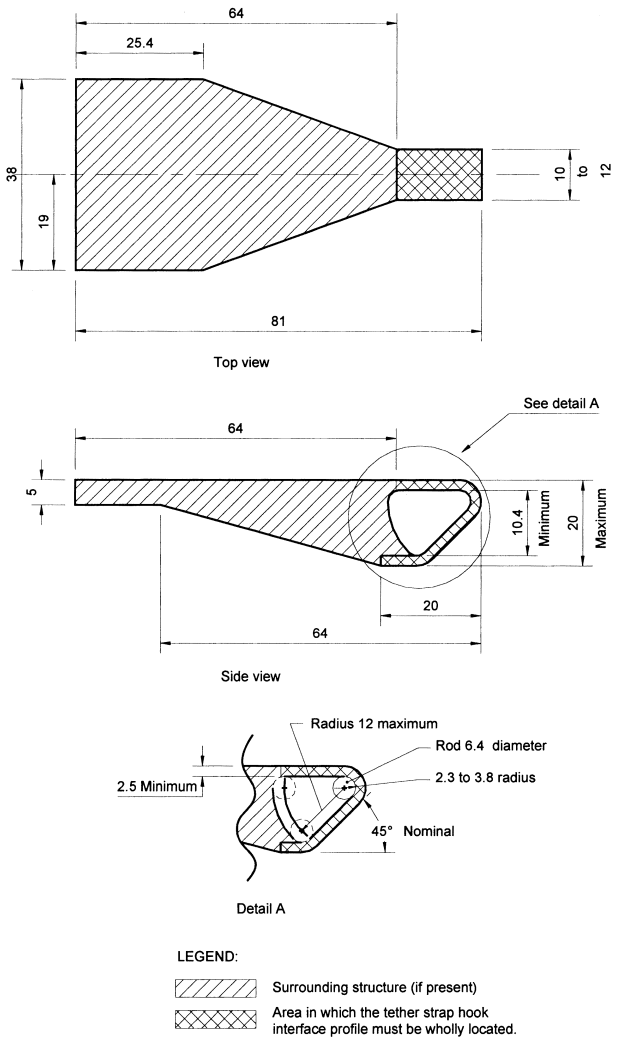


Figure 10. Label on Child Seat Where Child's Head Rests.



Notes

1. Dimensions in mm, except where otherwise indicated
2. Drawing not to scale

Figure 11 -- Interface Profile of Tether Hook

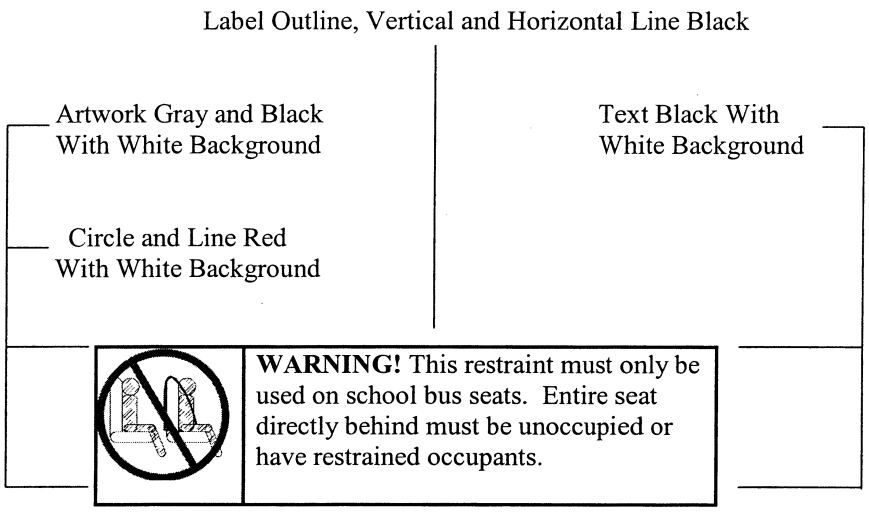


Figure 12. Label on Harness Component That Attaches to School Bus Seat Back.

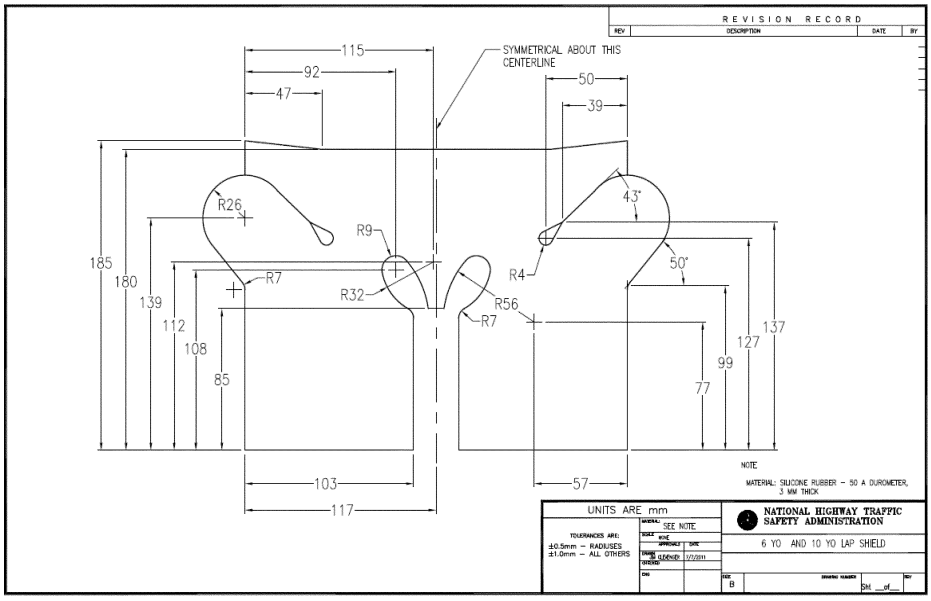


Figure 13 – Lap Shield

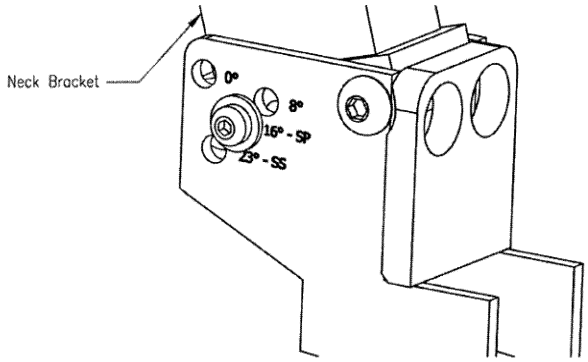


Figure 14a. HIII-10C Dummy Neck Angle Setting is SP-16 Degrees

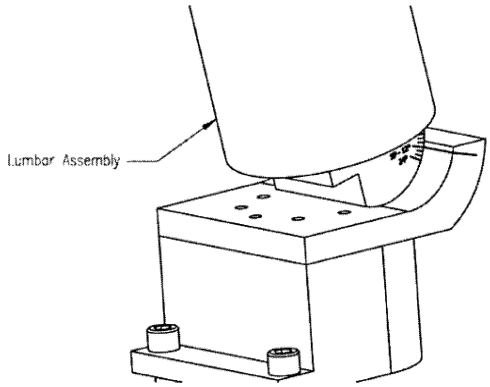


Figure 14b. HIII-10C Dummy Lumbar Angle Setting is SP-12 Degrees

[44 FR 72147, Dec. 13, 1979]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.213, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.213a Standard No. 213a; Child restraint systems—side impact protection.

S1. *Scope*. This standard specifies side impact protection requirements for child restraint systems recommended for children in a weight range that includes weights up to 18 kilograms (40 pounds) or by children in a height range that includes heights up to 1100 millimeters (43 inches).

S2. *Purpose*. The purpose of this standard is to reduce the number of children killed or injured in motor vehicle side impacts. Each child restraint system subject to this standard shall also meet all applicable requirements in FMVSS No. 213 (§ 571.213).

S3. *Application.* This standard applies to add-on child restraint systems that are either recommended for use by children in a weight range that includes weights up to 18 kilograms (40 pounds) *regardless of height,* or by children in a height range that includes heights up to 1100 millimeters *regardless of weight,* except for car beds and harnesses.

S4. *Definitions.*

Add-on child restraint system means any portable child restraint system.

Belt-positioning seat means a child restraint system that positions a child on a vehicle seat to improve the fit of a vehicle Type II belt system on the child and that lacks any component, such as a belt system or a structural element, designed to restrain forward movement of the child's torso in a forward impact.

Car bed means a child restraint system designed to restrain or position a child in the supine or prone position on a continuous flat surface.

Child restraint anchorage system is defined in S3 of FMVSS No. 225 (§ 571.225).

Child restraint system is defined in S4 of FMVSS No. 213 (§ 571.213).

Contactable surface means any child restraint system surface (other than that of a belt, belt buckle, or belt adjustment hardware) that may contact any part of the head or torso of the appropriate test dummy, specified in S7, when a child restraint system is tested in accordance with S6.1.

Harness means a combination pelvic and upper torso child restraint system that consists primarily of flexible material, such as straps, webbing or similar material, and that does not include a rigid seating structure for the child.

Rear-facing child restraint system means a child restraint system that positions a child to face in the direction opposite to the normal (forward) direction of travel of the motor vehicle.

Seat orientation reference line or *SORL* means the horizontal line through Point Z as illustrated in Figure 1 to § 571.213a.

Tether anchorage is defined in S3 of FMVSS No. 225 (§ 571.225).

Tether strap is defined in S3 of FMVSS No. 225 (§ 571.225).

Torso means the portion of the body of a seated anthropomorphic test dummy, excluding the thighs, that lies between the top of the child restraint system seating surface and the top of the shoulders of the test dummy.

S5. *Requirements.* (a) Each child restraint system subject to this section shall meet the requirements in this section when, as specified, tested in accordance with S6 and this paragraph. Each child restraint system shall meet the requirements when oriented in each direction recommended by the manufacturer (*i.e.,* forward, rearward), using any of the seat back angle adjustment positions and restraint belt routing positions designated for that direction, pursuant to S5.6 of FMVSS No. 213 (§ 571.213), and tested with the test dummy specified in S7 of this section.

(b) Each child restraint system subject to this section shall also meet all applicable requirements in FMVSS No. 213 (§ 571.213).

S5.1 *Dynamic performance.*

S5.1.1 *Child restraint system integrity.* When tested in accordance with S6.1, each child restraint system shall meet the requirements of paragraphs (a) through (c) of this section.

(a) With any padding or other flexible overlay material removed, exhibit no complete separation of any load bearing structural element and no partial separation exposing either surfaces with a radius of less than 6 millimeters or surfaces with protrusions greater than 9 millimeters above the immediate adjacent surrounding contactable surface of any structural element of the child restraint system.

(b)(1) If adjustable to different positions, remain in the same adjustment position during the testing that it was in immediately before the testing, except as otherwise specified in paragraph (b)(2).

(2)(i) Subject to paragraph (b)(2)(ii), a rear-facing child restraint system may have a means for repositioning the seating surface of the system that allows the system's occupant to move from a reclined position to an upright position and back to a reclined position during testing.

(ii) No opening that is exposed and is larger than 6 millimeters before the testing shall become smaller during the testing as a result of the movement

of the seating surface relative to the child restraint system as a whole.

(c) If a front facing child restraint system, not allow the angle between the system's back support surfaces for the child and the system's seating surface to be less than 45 degrees at the completion of the test.

S5.1.2 *Injury criteria.* When tested in accordance with S6.1 and with the test dummy specified in S7, each child restraint system that, in accordance with S5.5.2 of Standard No. 213 (§ 571.213), is recommended for use by children whose mass is more than 13.6 kilograms or whose height is more than 870 mm shall—

(a) Limit the resultant acceleration at the location of the accelerometer mounted in the test dummy head as specified in Part 572 such that, for any two points in time, t1 and t2, during the event which are separated by not more than a 15 millisecond time interval and where t1 is less than t2, the maximum calculated head injury criterion (HIC) shall not exceed 570, determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity), calculated using the expression:

$$HIC = \left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2} a_r\, dt\right]^{2.5}(t_2 - t_1)$$

(b) The maximum chest compression (or deflection) from the output of the thoracic InfraRed Telescoping Rod for Assessment of Chest Compression (IR–TRACC) shall not exceed 23 millimeters.

S5.1.3 *Occupant containment.* When tested in accordance with S6.1 and the requirements specified in this section, each child restraint system recommended for use by children in a specified mass range that includes any children having a mass greater than 5 kilograms but not greater than 13.6 kilograms (30 lb), shall retain the test dummy's head such that there is no direct contact of the head to any part of the side impact seat assembly described in S6.1.1(a).

S5.1.4 *Protrusion limitation.* Any portion of a rigid structural component within or underlying a contactable surface shall, with any padding or other flexible overlay material removed, have a height above any immediately adjacent restraint system surface of not more than 9 millimeters and no exposed edge with a radius of less than 6 millimeters.

S5.1.5 *Belt buckle release.* Any buckle in a child restraint system belt assembly designed to restrain a child using the system shall:

(a) When tested in accordance with the appropriate sections of S6.2, after the dynamic test of S6.1, release when a force of not more than 71 Newtons is applied.

(b) Not release during the testing specified in S6.1.

S5.1.6 *Installation.* Each add-on child restraint system shall be capable of meeting the requirements of this standard when installed solely by each of the means indicated in the following table:

TABLE 1 TO S5.1.6

Type of add-on child restraint system	Means of installation			
	Type II seat belt assembly	Type II seat belt assembly plus a tether if needed	Lower anchorages of the child restraint anchorage system	Lower anchorages of the child restraint anchorage system plus a tether if needed
Rear-facing restraints	X		X	
Forward-facing restraints		X		X

S6. *Test conditions and procedures.*

S6.1 *Dynamic side impact test for child restraint systems.* The test conditions and test procedure for the dynamic side impact test are specified in S6.1.1 and S6.1.2, respectively.

S6.1.1 *Test conditions.*

(a) *Test device.* (1) The test device is a SISA consisting of a sliding seat, with one seating position, and a simulated door assembly as described in ''NHTSA Standard Seat Assembly; FMVSS No. 213a—Side impact No. NHTSA–213a–2021'' (incorporated by reference, see §571.5). The simulated door assembly is rigidly attached to the floor of the SISA and the sliding seat is mounted on rails to allow it to move relative to the floor of the SISA in the direction perpendicular to the SORL. The SISA is mounted on a dynamic test platform so that the SORL of the seat is 10 ±1 degrees from the perpendicular direction of the test platform travel.

(2) As illustrated in the SISA drawing package, attached to the seat belt anchorage points provided on the SISA is a Type II seat belt assembly. These seat belt assemblies are certified to meet the requirements of Standard No. 209 (§571.209) and have webbing with a width of not more than 2 inches, and are attached to the anchorage points without the use of retractors or reels of any kind. As illustrated in the SISA drawing package, attached to the SISA is a child restraint anchorage system conforming to the specifications of Standard No. 225 (§ 571.225).

(b) Accelerate the test platform to achieve a relative velocity of 31.3 ± 0.64 km/h in the direction perpendicular to the SORL between the SISA sliding seat and the door assembly at the time they come in contact (time = T_0). The front face of the armrest on the door is 38 ± 6 millimeters from the edge of the seat towards the SORL at time = T_0. The test platform velocity in the direction perpendicular to the SORL during the time of interaction of the door with the child restraint system is no lower than 2.5 km/h less than its velocity at time = T_0.

(c) The sliding seat acceleration perpendicular to the SORL is any pulse within the acceleration corridor shown in Figure 3 and the change in relative velocity perpendicular to the SORL between the SISA sliding seat and the door assembly is any velocity within the relative velocity corridor shown in Figure 4.

(d) Performance tests under S6.1 are conducted at any ambient temperature from 20.6 °C to 22.2 °C and at any relative humidity from 10 percent to 70 percent.

(e) The child restraint shall meet the requirements of S5 when oriented in each direction recommended by the manufacturer (*i.e.*, forward, rearward), using any of the seat back angle adjustment positions and restraint belt routing positions designated for that direction, pursuant to S5.6 of FMVSS No. 213 (§ 571.213), and tested with the test dummy specified in S7 of this section.

S6.1.2 *Dynamic test procedure.*

(a) The child restraint centerline is positioned 300 ± 2 millimeters from the SISA sliding seat edge (impact side). The child restraint system is attached in any of the following manners, at NHTSA's option.

(1) Install the child restraint system using the child restraint anchorage system in accordance with the manufacturer's instructions provided with the child restraint system pursuant to

S5.6 of Standard No. 213 (§ 571.213), except as provided in this paragraph. For forward-facing restraints, attach the tether strap, if provided, to the tether anchorage on the SISA. No supplemental device is used to install the child restraint system. Tighten belt systems of the lower anchorage attachments used to attach the restraint to the SISA sliding seat to any tension of not less than 53.5 Newtons and not more than 67 Newtons. Tighten the belt of the top tether attachment used to attach the restraint to the SISA sliding seat to any tension of not less than 45 Newtons and not more than 53.5 Newtons.

(2) For forward-facing and rear-facing child restraint systems, install the child restraint system using the Type II belt system in accordance with the manufacturer's instructions provided with the child restraint system pursuant to S5.6 of Standard No. 213 (§571.213), except as provided in this paragraph. For forward-facing restraints, attach the top tether strap, if provided, to the top tether anchorage on the SISA. For all child restraints, no supplemental device to install the child restraint system is used. Tighten the Type II belt used to attach the restraint to the SISA sliding seat to any tension of not less than 53.5 Newtons and not more than 67 Newtons. Tighten the belt of the top tether attachment used to attach the forward-facing restraint to the SISA sliding seat to any tension of not less than 45 Newtons and not more than 53.5 Newtons. Rear-facing infant carriers with a detachable base shall only be tested using the base.

(3) For rear-facing restraints, install the child restraint system using only the lower anchorages of the child restraint anchorage system in accordance with the manufacturer's instructions provided with the child restraint system pursuant to S5.6 of Standard No. 213 (§ 571.213). No tether strap is used. No supplemental device is used to install the child restraint system. Tighten belt systems used to attach the restraint to the SISA-sliding seat to any tension of not less than 53.5 Newtons and not more than 67 Newtons. Rear-facing infant carriers with a detachable base shall only be tested using the base.

(b) Select any dummy specified in S7 for testing child restraint systems for use by children of the heights or weights for which the system is recommended in accordance with S5.5 of Standard No. 213 (§ 571.213). The dummy is assembled, clothed and prepared as specified in S8 and part 572 of this chapter, as appropriate.

(c) The dummy is placed and positioned in the child restraint system as specified in S9. Attach the child restraint belts used to restrain the child within the system, if appropriate, as specified in S9.

(d) Shoulder and pelvic belts that directly restrain the dummy are adjusted as follows: Tighten the belt system used to restrain the child within the child restraint system to any tension of not less than 9 Newtons and not more than 18 Newtons on the webbing at the top of each dummy shoulder and the pelvic region. Tighten the belt systems used to attach the restraint to the SISA sliding seat to any tension of not less than 53.5 Newtons and not more than 67 Newtons.

(e) Accelerate the test platform in accordance with S6.1.1(b).

(f) All instrumentation and data reduction is in conformance with SAE J211/1 (1995) (incorporated by reference, see § 571.5).

S6.2 *Buckle release test procedure.*

(a) After completion of the testing specified in S6.1 and before the buckle is unlatched, tie a self-adjusting sling to each wrist and ankle of the test dummy in the manner illustrated in Figure 4 to Standard No. 213 (§ 571.213), without disturbing the belted dummy and the child restraint system.

(b) Pull the sling that is tied to the dummy restrained in the child restraint system and apply the following force: 90 Newtons for a system tested with a 12-month-old dummy; 200 Newtons for a system tested with a 3-year-old dummy. For an add-on child restraint, the force is applied in the manner illustrated in Figure 4 to Standard No. 213 (§ 571.213) and by pulling the sling horizontally and parallel to the SORL of the SISA.

(c) While applying the force specified in S6.2(b), and using the device shown

in Figure 8 of Standard No. 213 (§ 571.213) for pushbutton-release buckles, apply the release force in the manner and location specified in S6.2.1 of Standard No. 213 (§ 571.213), for that type of buckle. Measure the force required to release the buckle.

S7 *Test dummies.*

S7.1 *Dummy selection.* At NHTSA's option, any dummy specified in S7.1(a) or S7.1(b) may be selected for testing child restraint systems for use by children of the height or mass for which the system is recommended in accordance with S5.5 of Standard No. 213 (§ 571.213). A child restraint that meets the criteria in two or more of the following paragraphs may be tested with any of the test dummies specified in those paragraphs.

(a) A child restraint that is recommended by its manufacturer in accordance with S5.5 of Standard No. 213 (§ 571.213) for use either by children in a specified mass range that includes any children having a mass greater than 5 kilograms but not greater than 13.6 kilograms, or by children in a specified height range that includes any children whose height is greater than 650 millimeters but not greater than 870 millimeters, is tested with a CRABI 12-month-old test dummy conforming to 49 CFR part 572 subpart R.

(b) A child restraint that is recommended by its manufacturer in accordance with S5.5 of Standard No. 213 (§ 571.213) for use either by children in a specified mass range that includes any children having a mass greater than 13.6 kilograms but not greater than 18 kilograms, or by children in a specified height range that includes any children whose height is greater than 870 millimeters but not greater than 1100 millimeters, is tested with a 3-year-old test dummy (Q3s) conforming to 49 CFR part 572 subpart W.

S8 *Dummy clothing and preparation.*

S8.1 *Type of clothing.*

(a) *12-month-old dummy (CRABI) (49 CFR part 572, subpart R).* When used in testing under this standard, the dummy specified in 49 CFR part 572, subpart R, is clothed in a cotton-polyester based tight fitting sweat shirt with long sleeves and ankle long pants whose combined weight is not more than 0.25 kilograms.

(b) *3-year-old side impact dummy (Q3s) (49 CFR part 572, subpart W).* When used in testing under this standard, the dummy specified in 49 CFR part 572, subpart W, is clothed as specified in that subpart, except without shoes.

S8.2 *Preparing dummies.* When using the Q3s dummy, install the IR–TRACC on the test impact side according to 49 CFR part 572, subpart W. Before being used in testing under this standard, test dummies must be conditioned at any ambient temperature from 20.6° to 22.2 °C and at any relative humidity from 10 percent to 70 percent, for at least 4 hours.

S9 *Positioning the dummy and attaching the belts used to restrain the child within the child restraint system and/or to attach the system to the SISA sliding seat.*

S9.1 *12-month-old dummy (CRABI) (49 CFR part 572, subpart R).* Position the test dummy according to the instructions for child positioning that the manufacturer provided with the child restraint system under S5.6.1 or S5.6.2 of Standard No. 213 (§ 571.213), while conforming to the following:

(a) When testing rear-facing child restraint systems, place the 12-month-old dummy in the child restraint system so that the back of the dummy torso contacts the back support surface of the system. Attach all appropriate child restraint belts used to restrain the child within the child restraint system and tighten them as specified in S6.1.2 of this standard. Attach all appropriate belts used to attach the child restraint system to the SISA sliding seat and tighten them as specified in S6.1.2.

(b) When testing forward-facing child restraint systems, extend the dummy's arms vertically upwards and then rotate each arm downward toward the dummy's lower body until the arm contacts a surface of the child restraint system or the SISA. Ensure that no arm is restrained from movement in other than the downward direction, by any part of the system or the belts used to anchor the system to the SISA sliding seat.

(c) When testing forward-facing child restraint systems, extend the arms of the 12-month-old test dummy as far as possible in the upward vertical direction. Extend the legs of the test

dummy as far as possible in the forward horizontal direction, with the dummy feet perpendicular to the centerline of the lower legs. Using a flat square surface with an area of 2,580 square mm, apply a force of 178 Newtons, perpendicular to the plane of the back of the standard seat assembly, first against the dummy crotch and then at the dummy thorax in the midsagittal plane of the dummy. Attach all appropriate child restraint belts used to restrain the child within the child restraint system and tighten them as specified in S6.1.2(d). Attach all appropriate belts used to attach the child restraint system (per S5.1.6) to the SISA sliding seat and tighten them as specified in S6.1.2.

(d) After the steps specified in paragraph (c), rotate each dummy limb downwards in the plane parallel to the dummy's midsagittal plane until the limb contacts a surface of the child restraint system or the standard seat assembly. Position the limbs, if necessary, so that limb placement does not inhibit torso or head movement in tests conducted under S6.

S9.2 *3-year-old side impact dummy (Q3s) (49 CFR part 572, subpart W) in forward-facing child restraints.* Position the test dummy according to the instructions for child positioning that the restraint manufacturer provided with the child restraint system in accordance with S5.6.1 or S5.6.2 of Standard No. 213 (§ 571.213), while conforming to the following:

(a) Holding the test dummy torso upright until it contacts the child restraint system's design seating surface, place the test dummy in the seated position within the child restraint system with the midsagittal plane of the test dummy head coincident with the center of the child restraint system.

(b) Extend the arms of the test dummy as far as possible in the upward vertical direction. Extend the legs of the dummy as far as possible in the forward horizontal direction, with the dummy feet perpendicular to the center line of the lower legs.

(c) For a child restraint system with a fixed or movable surface, position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2 of Standard No. 213 (§ 571.213). For forward-facing restraints, attach all appropriate child restraint belts used to restrain the child within the child restraint system and tighten them as specified in S6.1.2(d). Attach all appropriate belts or lower anchorage attachments used to attach the child restraint system to the SISA or to restrain the child and tighten them as specified in S6.1.2. For belt-positioning seats, attach all appropriate vehicle belts used to restrain the child within the child restraint system and tighten them as specified in S6.1.2(d).

(d) After the steps specified in paragraph (c) of this section, rotate each of the dummy's legs downwards in the plane parallel to the dummy's midsagittal plane until the limb contacts a surface of the child restraint or the SISA. Rotate each of the dummy's arms downwards in the plane parallel to the dummy's midsagittal plane until the arm is engaged on the detent that positions the arm at a 25-degree angle with respect to the thorax. For child restraint systems with a fixed or movable surface that does not allow the dummy's arm to be positioned at a 25-degree angle, rotate each dummy arm downwards in the plane parallel to the dummy's midsagittal plane until the arm contacts a surface of the child restraint system or the standard seat assembly.

S9.3 *3-year-old side impact dummy (Q3s) (49 CFR part 572, subpart W) in rear-facing child restraints.* Position the test dummy according to the instructions for child positioning that the restraint manufacturer provided with the child restraint system in accordance with S5.6.1 or S5.6.2 of Standard No. 213 (§ 571.213), while conforming to the following:

(a) Extend the arms of the test dummy as far as possible in the upward vertical direction. Extend the legs of the dummy as far as possible in the forward horizontal direction, with the dummy feet perpendicular to the center line of the lower legs.

(b) Place the Q3s dummy in the child restraint system so that the back of the dummy torso contacts the back support surface of the system. Place the test dummy in the child restraint system with the midsagittal plane of

the test dummy head coincident with the center of the child restraint system. Rotate each of the dummy's legs downwards in the plane parallel to the dummy's midsagittal plane until the leg or feet of the dummy contacts the seat back of the SISA or a surface of the child restraint system.

(c) For a child restraint system with a fixed or movable surface, position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2 of Standard No. 213 (§ 571.213). Attach all appropriate child restraint belts used to restrain a child within the child restraint system and tighten them as specified in S6.1.2(d). Attach all appropriate belts or lower anchorage attachments used to attach the child restraint system to the SISA and tighten them as specified in S6.1.2.

(d) After the steps specified in paragraph (c) of this section, rotate each dummy arm downwards in the plane parallel to the dummy's midsagittal plane until the limb is positioned at a 25-degree angle with respect to the thorax. For child restraint systems with a fixed or movable surface that does not allow the dummy's arm to be positioned at a 25-degree angle, rotate each dummy arm downwards in the plane parallel to the dummy's midsagittal plane until the arm contacts a surface of the child restraint system or the standard seat assembly.

Figure 1 to § 571.213a. Side Impact Seat Assembly

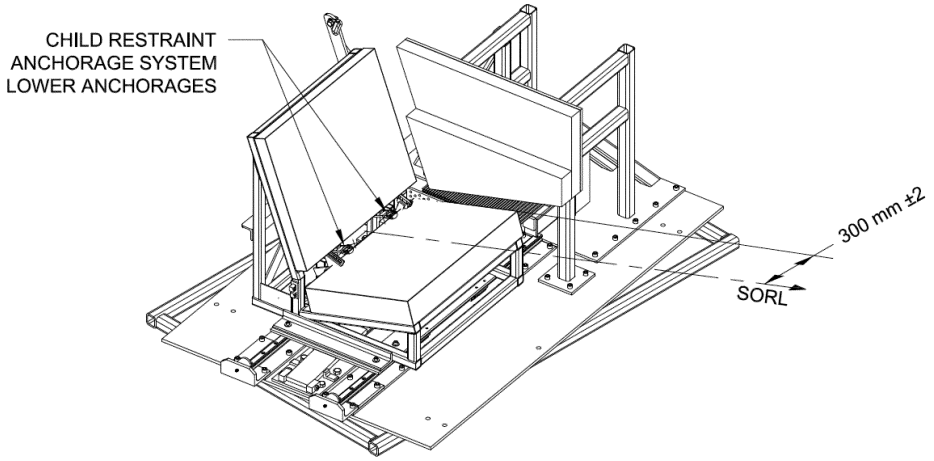


Figure 2A to § 571.213a. Side Impact Seat Assembly Plan View

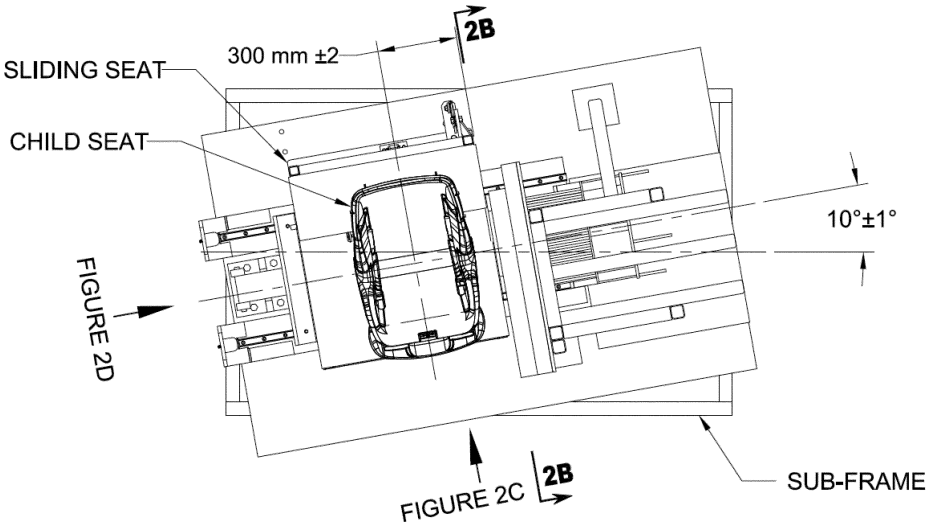


Figure 2B to § 571.213a. Side Impact Seat Assembly Door Panel View

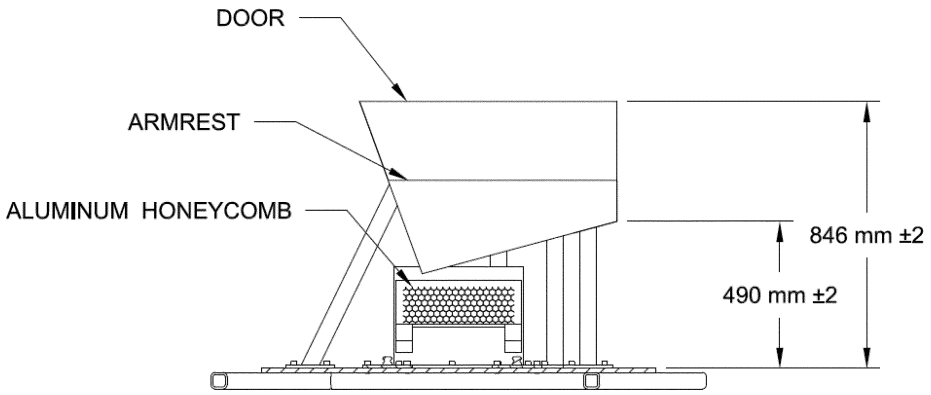


Figure 2C to § 571.213a. Side Impact Seat Assembly Frontal View

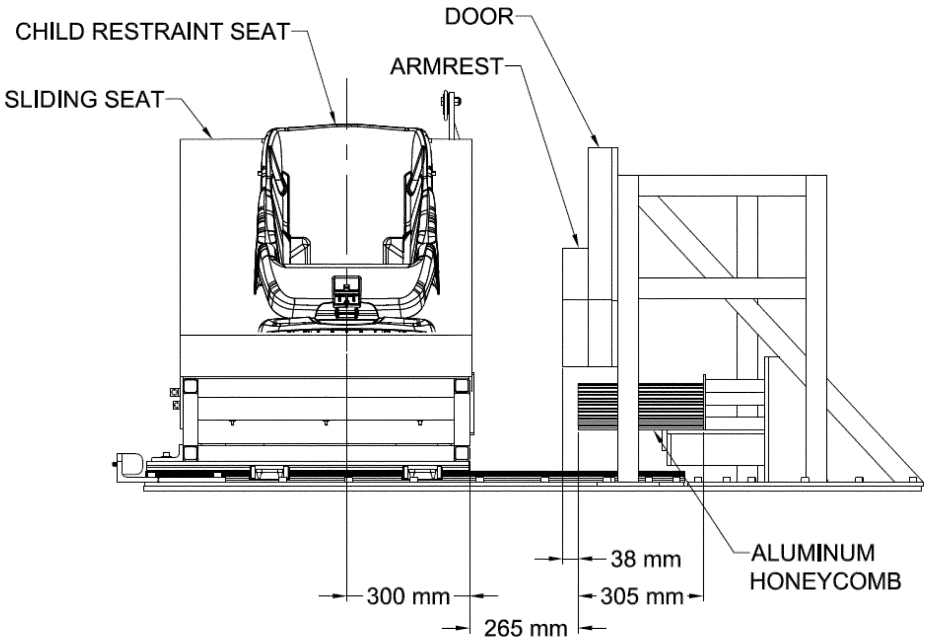


Figure 2D to § 571.213a. Side Impact Seat Assembly Side View

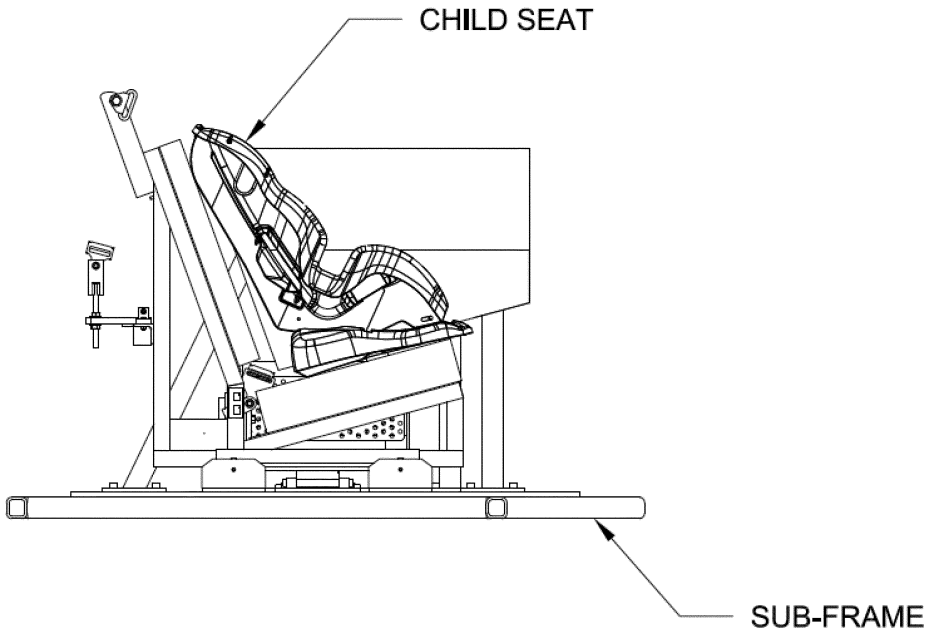
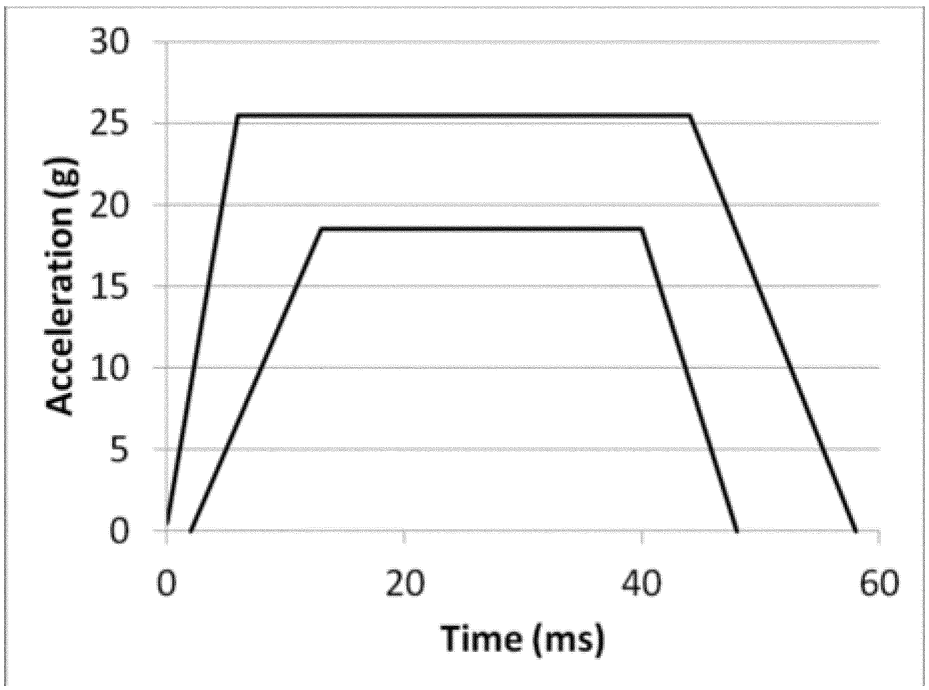
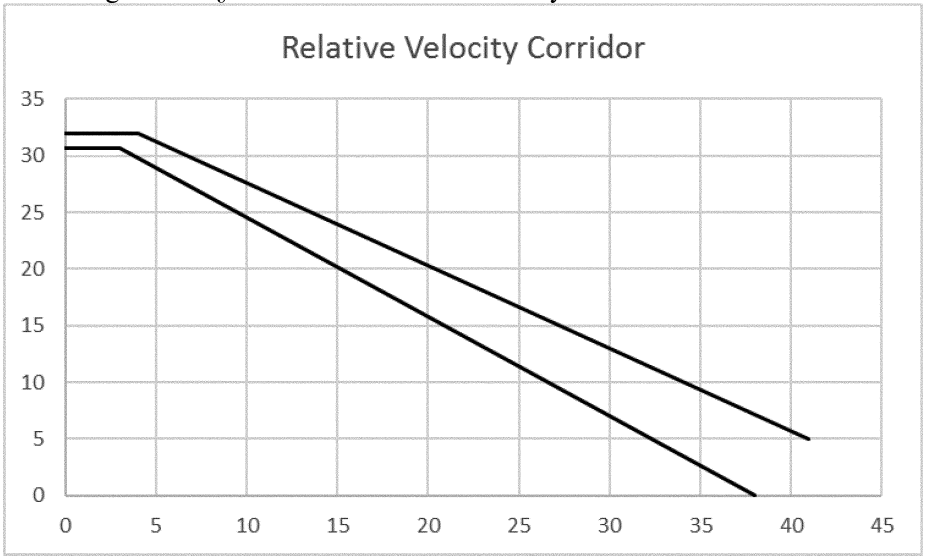


Figure 3 to § 571.213a. SISA Sliding Seat Acceleration Boundaries



Upper Boundary		Lower Boundary	
Time (milliseconds)	Acceleration (g)	Time (milliseconds)	Acceleration (g)
0	0.5	2	0
6	25.5	13	18.5
44	25.5	40	18.5
58	0	48	0

Figure 4 to § 571.213a. Relative Velocity Corridor Plot and Table



Lower Boundary		Upper Boundary	
Time (milliseconds)	Velocity (kph)	Time (milliseconds)	Velocity (kph)
0	30.66	0	31.94
3	30.66	4	31.94
38	0	41	5

[87 FR 39310, June 30, 2022, as amended at 89 FR 81846, Oct. 9, 2024]

§ 571.213b Standard No. 213b; Child restraint systems; Mandatory applicability beginning December 5, 2026.

S1. *Scope*. This standard specifies requirements for child restraint systems used in motor vehicles and aircraft.

S2. *Purpose*. The purpose of this standard is to reduce the number of children killed or injured in motor vehicle crashes and in aircraft.

S3. *Application*. This standard applies to passenger cars, multipurpose passenger vehicles, trucks and buses, and to child restraint systems for use in motor vehicles and aircraft, manufactured on or after December 5, 2026.

S4. *Definitions*—

Add-on child restraint system means any portable child restraint system.

Backless child restraint system means a child restraint system, other than a belt-positioning seat, that consists of a seating platform that does not extend up to provide a cushion for the child's back or head and has a structural element designed to restrain forward motion of the child's torso in a forward impact.

Belt-positioning seat means a child restraint system that positions a child on a vehicle seat to improve the fit of a vehicle Type 2 belt system on the child and that lacks any component, such as a belt system or a structural element, designed to restrain forward movement of the child's torso in a forward impact.

Booster seat means either a backless child restraint system or a belt-positioning seat.

Built-in child restraint system means a child restraint system that is designed to be an integral part of and permanently installed in a motor vehicle.

Car bed means a child restraint system designed to restrain or position a child in the supine or prone position on a continuous flat surface.

Child restraint anchorage system is defined in S3 of FMVSS No. 225 (§571.225).

Child restraint system means any device, except Type 1 or Type 2 seat belts, designed for use in a motor vehicle or aircraft to restrain, seat, or position children who weigh 36 kilograms (kg) (80 lb) or less.

Contactable surface means any child restraint system surface (other than that of a belt, belt buckle, or belt adjustment hardware) that may contact any part of the head or torso of the appropriate test dummy, specified in S7, when a child restraint system is tested in accordance with S6.1.

Factory-installed built-in child restraint system means a built-in child restraint system that has been or will be permanently installed in a motor vehicle before that vehicle is certified as a completed or altered vehicle in accordance with part 567 of this chapter.

Harness means a combination pelvic and upper torso child restraint system that consists primarily of flexible material, such as straps, webbing or similar material, and that does not include a rigid seating structure for the child.

Rear-facing child restraint system means a child restraint system, except a car bed, that positions a child to face in the direction opposite to the normal direction of travel of the motor vehicle.

Representative aircraft passenger seat means either a Federal Aviation Administration approved production aircraft passenger seat or a simulated aircraft passenger seat conforming to Figure 6.

School bus child restraint system means an add-on child restraint system (including a harness) manufactured and sold only for use on school bus seats, that has a label conforming with S5.3.1(b).

Seat orientation reference line or *SORL* means the horizontal line through Point Z as illustrated in Figure 1A–1 and 1A–2.

Specific vehicle shell means the actual vehicle model part into which the built-in child restraint system is or is intended to be fabricated, including the complete surroundings of the built-in system. If the built-in child restraint system is or is intended to be fabricated as part of any seat other than a front seat, these surroundings include the back of the seat in front, the interior rear side door panels and trim, the floor pan, adjacent pillars (*e.g.*, the B and C pillars), and the ceiling. If the built-in system is or is intended to be fabricated as part of the front seat, these surroundings include the dashboard, the steering mechanism and its associated trim hardware, any levers and knobs installed on the floor or on a console, the interior front side door panels and trim, the front seat, the floor pan, the A pillars and the ceiling.

Tether anchorage is defined in S3 of FMVSS No. 225 (§571.225).

Tether hook is defined in S3 of FMVSS No. 225 (§571.225).

Tether strap is defined in S3 of FMVSS No. 225 (§571.225).

Torso means the portion of the body of a seated anthropomorphic test dummy, excluding the thighs, that lies between the top of the child restraint system seating surface and the top of the shoulders of the test dummy.

S5. *Requirements.* (a) Each motor vehicle with a built-in child restraint system shall meet the requirements in this section when, as specified, tested in accordance with S6.1 and this paragraph.

(b)(1) Each child restraint system manufactured for use in motor vehicles shall meet the requirements in this section when, as specified, tested in accordance with S6.1 and this paragraph. Each add-on system shall meet the requirements at each of the restraint's seat back angle adjustment positions and restraint belt routing positions, when the restraint is oriented in the direction recommended by the manufacturer (*e.g.*, forward, rearward or laterally) pursuant to S5.6, and tested with the test dummy specified in S7.

(2) Each add-on child restraint system manufactured for use in motor vehicles, that is recommended for children in a weight range that includes weights less than 18 kilograms (40 pounds) regardless of height, or for children in a height range that includes heights less than 1100 millimeters (mm) regardless of weight, shall meet the requirements in this standard and the applicable side impact protection requirements in Standard No. 213a (§571.213a).

(c) Each child restraint system manufactured for use in aircraft shall meet the requirements in this section and the additional requirements in S8.

(d) Each child restraint system tested with a part 572 subpart S dummy need not meet S5.1.2 and S5.1.3.

(e) Each child restraint system tested with a part 572 subpart T dummy need not meet S5.1.2.1(a).

(f) Each child restraint system that is equipped with an internal harness or other internal components to restrain the child need not meet this standard when attached to the lower anchors of the child restraint anchorage system on the standard seat assembly if the sum of the weight of the child restraint system (in pounds) and the average weight of child represented by the test dummy used to test the child restraint system in accordance with S7 of this standard, shown in the table below, exceeds 65 pounds. Such a child restraint system must meet this standard when tested using its internal harness or components to restrain such a test dummy while installed using the means of installation specified in S5.3.2 of this standard.

TABLE 1 TO S5(f)—AVERAGE WEIGHT OF CHILD REPRESENTED BY VARIOUS TEST DUMMIES

Test dummy (specified in S7 of this standard)	Average weight of child represented by test dummy (pounds)
CRABI 12-month-old infant dummy (49 CFR Part 572, Subpart R)	22
Hybrid III 3-year-old dummy (49 CFR Part 572, Subpart P)	31
Hybrid III 6-year-old dummy (49 CFR Part 572, Subpart N)	45
Hybrid III 6-year-old weighted dummy (49 CFR Part 572 Subpart S)	62
Hybrid II 6-year-old dummy (49, CFR Part 572, Subpart I)	45

S5.1 *Dynamic performance.*

S5.1.1 *Child restraint system integrity.* When tested in accordance with S6.1, each child restraint system shall meet the requirements of paragraphs (a) through (c) of this section.

(a) Exhibit no complete separation of any load bearing structural element and no partial separation exposing either surfaces with a radius of less than 6 mm or surfaces with protrusions greater than 9 mm above the immediate adjacent surrounding contactable surface of any structural element of the system.

(b)(1) If adjustable to different positions, remain in the same adjustment position during the testing that it was in immediately before the testing, except as otherwise specified in paragraph (b)(2).

(2)(i) Subject to paragraph (b)(2)(ii) of this section, a rear-facing child restraint system may have a means for repositioning the seating surface of the system that allows the system's occupant to move from a reclined position to an upright position and back to a reclined position during testing.

(ii) No opening that is exposed and is larger than ¼ inch before the testing shall become smaller during the testing as a result of the movement of the seating surface relative to the restraint system as a whole.

(c) If a front facing child restraint system, not allow the angle between the system's back support surfaces for the child and the system's seating surface to be less than 45 degrees at the completion of the test.

S5.1.2 *Injury criteria.*

S5.1.2.1 When tested in accordance with S6.1 and with the test dummies specified in S7, each child restraint system shall:

(a) Limit the resultant acceleration at the location of the accelerometer mounted in the test dummy head such that, for any two points in time, t1 and t2, during the event which are separated by not more than a 36 millisecond time interval and where t1 is less than t2, the maximum calculated head injury criterion (HIC36) shall not exceed 1,000, determined using the resultant head acceleration at the center of gravity of the dummy head, a, expressed as a multiple of g (the acceleration of gravity), calculated using the expression below. The HIC calculation shall be calculated within the first 175 milliseconds of the sled acceleration that is within the acceleration corridor in Figure 2, when testing with the HIII–6YO dummy in a backless child restraint system.

Equation 1 to S5.1.2.1(a)

$$HIC = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a\,dt \right]^{2.5} (t_2 - t_1)$$

(b) The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S5.1.2.2 [Reserved]

S5.1.3 *Occupant excursion.* When tested in accordance with S6.1 and the requirements specified in this section, each child restraint system shall meet the applicable excursion limit requirements specified in S5.1.3.1–S5.1.3.3.

S5.1.3.1 *Child restraint systems other than rear-facing ones and car beds.* Each child restraint system, other than a rear-facing child restraint system or a car bed, shall retain the test dummy's torso within the system.

(a) For each add-on child restraint system:

(1) No portion of the test dummy's head shall pass through a vertical transverse plane that is 720 mm or 813 mm (as specified in the table in this S5.1.3.1) forward of point Z on the standard seat assembly, measured along the center SORL (as illustrated in figure 1B–1 and 1B–2 of this standard); and

(2) Neither knee pivot point shall pass through a vertical transverse plane that is 915 mm forward of point Z on the standard seat assembly, measured along the center SORL.

TABLE 2 TO S5.1.3.1(a)—ADD–ON CHILD RESTRAINTS THAT CAN BE USED FORWARD–FACING

When this type of child restraint system	Is tested in accordance with—	These excursion limits apply	**Explanatory note:** in the test specified in 2nd column, the excursion requirement must be met when the child restraint system is attached to the test seat assembly in the manner described below, subject to certain conditions
All harnesses	S6.1.2(a)(1)(i)(A)	Head 813 mm; Knee 915 mm.	Attached with lap belt; in addition, if a tether is provided, it is attached.
Restraints designed for use by children with physical disabilities.	S6.1.2(a)(1)(i)(A)	Head 813 mm; Knee 915 mm.	Attached with lap and shoulder belt; in addition, if a tether is provided, it is attached.
School bus child restraint systems	S6.1.2(a)(1)(i)(A)	Head 813 mm; Knee 915 mm.	Attached with seat back mount, or seat back and seat pan mounts.
Booster seats	S6.1.2(a)(1)(ii)	Head 813 mm; Knee 915 mm.	Attached with lap and shoulder belt; no tether is attached.
Child restraint systems other than harnesses, restraints designed for use by children with physical disabilities, school bus child restraint systems, and booster seats.	S6.1.2(a)(1)(i)(B)	Head 813 mm; Knee 915 mm.	Attached with a lap and shoulder belt; without a tether attached. Attached to lower anchorages of child restraint anchorage system; without a tether attached.
Child restraint systems other than harnesses, restraints designed for use by children with physical disabilities, school bus child restraint systems.	S6.1.2(a)(1)(i)(A), S6.1.2(a)(1)(i)(C).	Head 720 mm; Knee 915 mm.	Attached with a lap and shoulder belt, with a tether attached. Attached to lower anchorages of child restraint anchorage system, with a tether attached.
Child restraint systems equipped with a fixed or movable surface described in S5.2.2.2 that has belts that are not an integral part of that fixed or movable surface.	S6.1.2(a)(2)	Head 813 mm; Knee 915 mm.	Attached with lap and shoulder belt or lower anchorages of child restraint anchorage system; no tether is attached.

(b) In the case of a built-in child restraint system, neither knee pivot point shall, at any time during the dynamic test, pass through a vertical transverse plane that is 305 mm forward of the initial pre-test position of the respective knee pivot point, measured along a horizontal line that passes through the knee pivot point and is parallel to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline.

S5.1.3.2 *Rear-facing child restraint systems.* In the case of each rear-facing child restraint system, all portions of the test dummy's torso shall be retained within the system and neither of the target points on either side of the dummy's head and on the transverse axis passing through the center of mass of the dummy's head and perpendicular to the head's midsagittal plane, shall pass through the transverse orthogonal planes whose intersection contains the forward-most and top-most points on the child restraint system surfaces (illustrated in Figure 1C in this section).

S5.1.3.3 *Car beds.* In the case of car beds, all portions of the test dummy's head and torso shall be retained within the confines of the car bed.

S5.1.4 *Back support angle.* When a rear-facing child restraint system is tested in accordance with S6.1, the angle between the system's back support surface for the child and the vertical shall not exceed 70 degrees.

S5.2 *Force distribution.*

S5.2.1 *Minimum head support surface—child restraint systems other than car beds.*

S5.2.1.1 Except as provided in S5.2.1.2, each child restraint system other than a car bed shall provide restraint against rearward movement of the head of the child (rearward in relation to the child) by means of a continuous seat back which is an integral part of the system and which—

(a) Has a height, measured along the system seat back surface for the child in the vertical longitudinal plane passing through the longitudinal centerline of the child restraint systems from the lowest point on the system seating surface that is contacted by the buttocks of the seated dummy, as follows:

TABLE 3 TO S5.2.1.1(a)

Weight [1]	Height [2](mm)
Not more than 18 kg	500
More than 18 kg	560

[1] When a child restraint system is recommended under S5.5 for use by children of the above weights.

[2] The height of the portion of the system seat back providing head restraint shall not be less than the above.

(b) Has a width of not less than 8 inches, measured in the horizontal plane at the height specified in paragraph (a) of this section. Except that a child restraint system with side supports extending at least 4 inches forward from the padded surface of the portion of the restraint system provided for support of the child's head may have a width of not less than 6 inches, measured in the horizontal plane at the height specified in paragraph (a) of this section.

(c) Limits the rearward rotation of the test dummy head so that the angle between the head and torso of the dummy specified in S7 when tested in accordance with S6.1 is not more than 45 degrees greater than the angle between the head and torso after the dummy has been placed in the system in accordance with S6.1.2.3 and before the system is tested in accordance with S6.1.

S5.2.1.2 The applicability of the requirements of S5.2.1.1 to a front-facing child restraint system, and the conformance of any child restraint system other than a car bed to those requirements, is determined using the largest of the test dummies specified in S7 for use in testing that restraint, provided that the 6-year-old dummy described in subpart I or subpart N of part 572 of this title and the 10-year-old dummy described in subpart T of part 572 of this title, are not used to determine the applicability of or compliance with S5.2.1.1. A front facing child restraint system is not required to comply with S5.2.1.1 if the target point on either side of the dummy's head is below a horizontal plane tangent to the top of—

(a) The standard seat assembly, in the case of an add-on child restraint system, when the dummy is positioned in the system and the system is installed on the assembly in accordance with S6.1.2.

(b) The vehicle seat, in the case of a built-in child restraint system, when the system is activated and the dummy is positioned in the system in accordance with S6.1.2.

S5.2.2 *Torso impact protection.* Each child restraint system other than a car bed shall comply with the applicable requirements of S5.2.2.1 and S5.2.2.2.

S5.2.2.1 (a) The system surface provided for the support of the child's back shall be flat or concave and have a continuous surface area of not less than 85 square inches.

(b) Each system surface provided for support of the side of the child's torso shall be flat or concave and have a continuous surface of not less than 24 square inches for systems recommended for children weighing 20 pounds or more, or 48 square inches for systems recommended for children weighing less than 20 pounds.

(c) Each horizontal cross section of each system surface designed to restrain forward movement of the child's torso shall be flat or concave and each vertical longitudinal cross section shall be flat or convex with a radius of curvature of the underlying structure of not less than 2 inches.

S5.2.2.2 Each forward-facing child restraint system shall have no fixed or movable surface—

(a) Directly forward of the dummy and intersected by a horizontal line—

(1) Parallel to the SORL, in the case of the add-on child restraint system, or

(2) Parallel to a vertical plane through the longitudinal center line of the vehicle seat, in the case of a built-in child restraint system, and,

(b) Passing through any portion of the dummy, except for surfaces which restrain the dummy when the system is tested in accordance with S6.1.2(a)(2), so that the child restraint system shall conform to the requirements of S5.1.2 and S5.1.3.1.

S5.2.3 [Reserved]

S5.2.4 *Protrusion limitation.* Any portion of a rigid structural component within or underlying a contactable surface, or any portion of a child restraint system surface that is subject to the requirements of S5.2.3 shall, with any padding or other flexible overlay material removed, have a height above any immediately adjacent restraint system surface of not more than 9 mm and no exposed edge with a radius of less than 6 mm.

S5.3 *Installation.*

S5.3.1 Add-on child restraint systems shall meet either (a) or (b), as appropriate.

(a) Except for components designed to attach to a child restraint anchorage system, each add-on child restraint system must not have any means designed for attaching the system to a vehicle seat cushion or vehicle seat back and any component (except belts) that is designed to be inserted between the vehicle seat cushion and vehicle seat back.

(b) School bus child restraint systems (including harnesses manufactured for use on school bus seats) must have a label that conforms in content to Figure 12 and to the requirements of S5.3.1(b)(1) through S5.3.1(b)(3) of this standard. The label must be permanently affixed to the part of the school bus child restraint system, that attaches the system to a vehicle seat back.

(1) The label must be plainly visible when installed and easily readable.

(2) The message area must be white with black text. The message area must be no less than 20 square centimeters.

(3) The pictogram shall be gray and black with a red circle and slash on a white background. The pictogram shall be no less than 20 mm in diameter.

(c) The provision that add-on child restraint systems shall meet the requirements of this standard when installed solely by a Type 1 belt applies to child restraint systems manufactured before September 1, 2029. Except for harnesses, the requirement sunsets for child restraint systems manufactured on or after September 1, 2029. For harnesses, the requirement does not sunset and continues to apply to harnesses manufactured on or after September 1, 2029.

S5.3.2 Each add-on child restraint system shall be capable of meeting the requirements of this standard when installed solely by each of the means indicated in the following table for the particular type of child restraint system:

TABLE 4 TO S5.3.2 MEANS OF INSTALLATION FOR CHILD RESTRAINT SYSTEMS

Type of add-on child restraint system	Type 1 seat belt assembly plus a tether anchorage, if needed	Type 2 seat belt assembly plus a tether anchorage, if needed	Type 2 seat belt assembly	Lower anchorages of the child restraint anchorage system plus a tether, if needed	Lower anchorages of the child restraint anchorage system	Seat back mount, or, seat back mount, and, seat pan mount
School bus child restraint systems						X
Harnesses	X					
Car beds			X			
Rear-facing restraints			X		X	
Booster seats			X			
All other child restraint systems		X	X	X	X	

S5.3.3 *Car beds.* Each car bed shall be designed to be installed on a vehicle seat so that the car bed's longitudinal axis is perpendicular to a vertical longitudinal plane through the longitudinal axis of the vehicle.

S5.4 *Belts, belt buckles, and belt webbing.*

S5.4.1 *Performance requirements.*

S5.4.1.1 [Reserved]

S5.4.1.2 The webbing of belts provided with a child restraint system and used to attach the system to the vehicle or to restrain the child within the system shall—

(a) Have a minimum breaking strength for new webbing of not less than 15,000 N in the case of webbing used to secure a child restraint system to the vehicle, including the tether and lower anchorages of a child restraint anchorage system, and not less than 11,000 N in the case of the webbing used to secure a child to a child restraint system when tested in accordance with S5.1 of FMVSS No. 209. Each value shall be not less than the 15,000 N and 11,000 N applicable breaking strength requirements, but the median value shall be used for determining the retention of breaking strength in paragraphs (b)(1) and (c)(1) and (2) of this section. ''New webbing'' means webbing that has not been exposed to abrasion, light or micro-organisms as specified elsewhere in this section.

(b)(1) After being subjected to abrasion as specified in S5.1(d) or S5.3(c) of FMVSS 209 (§ 571.209), have a breaking strength of not less than 75 percent of the new webbing strength, when tested in accordance with S5.1(b) of FMVSS 209.

(2) A mass of 2.35 ±.05 kg shall be used in the test procedure in S5.1(d) of FMVSS 209 for webbing, including webbing to secure a child restraint system to the tether and lower anchorages of a child restraint anchorage system, except that a mass of 1.5 ±.05 kg shall be used for webbing in pelvic and upper torso restraints of a belt assembly used in a child restraint system. The mass is shown as (B) in Figure 2 of FMVSS 209.

(c)(1) After exposure to the light of a carbon arc and tested by the procedure specified in S5.1(e) of FMVSS 209 (§ 571.209), have a breaking strength of not less than 60 percent of the new webbing, and shall have a color retention not less than No. 2 on the AATCC Gray Scale for Color Change (incorporated by reference, see § 571.5).

(2) After being subjected to micro-organisms and tested by the procedures specified in S5.1(f) of FMVSS 209 (§ 571.209), shall have a breaking strength not less than 85 percent of the new webbing.

(d) If contactable by the test dummy torso when the system is tested in accordance with S6.1, have a width of not less than 1½ inches when measured in accordance with S5.4.1.3.

S5.4.1.3 *Width test procedure.* Condition the webbing for 24 hours in an atmosphere of any relative humidity between 48 and 67 percent, and any ambient temperature between 70 and 77 °F. Measure belt webbing width under a tension of 5 pounds applied lengthwise.

S5.4.2 *Belt buckles and belt adjustment hardware.* Each belt buckle and item of belt adjustment hardware used in a child restraint system shall conform to the requirements of S4.3(a) and S4.3(b) of FMVSS No. 209 (§571.209).

S5.4.3 *Belt Restraint.*

S5.4.3.1 *General.* Each belt that is part of a child restraint system and that is designed to restrain a child using the system shall be adjustable to snugly fit any child whose height and weight are within the ranges recommended in accordance with S5.5.2(f) and who is positioned in the system in accordance with the instructions required by S5.6.

S5.4.3.2 *Direct restraint.* Except for belt-positioning seats, each belt that is part of a child restraint system and that is designed to restrain a child using the system and to attach the system to the vehicle, and each Type 1 and lap portion of a Type 2 vehicle belt that is used to attach the system to the vehicle shall, when tested in accordance with S6.1, impose no loads on the child that result from the mass of the system, or—

(a) In the case of an add-on child restraint system, from the mass of the seat back of the standard seat assembly specified in S6.1, or

(b) In the case of a built-in child restraint system, from the mass of any part of the vehicle into which the child restraint system is built.

S5.4.3.3 *Seating systems.* Except for child restraint systems subject to S5.4.3.4, each child restraint system that is designed for use by a child in a seated position and that has belts designed to restrain the child, shall, with the test dummy specified in S7 positioned in the system in accordance with S10 provide:

(a) Upper torso restraint in the form of:

(i) Belts passing over each shoulder of the child, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c), and

(b) Lower torso restraint in the form of:

(i) A lap belt assembly making an angle between 45° and 90° with the child restraint system seating surface at the lap belt attachment points, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c), and

(c) In the case of each seating system recommended for children whose masses are more than 10 kg, crotch restraint in the form of:

(i) A crotch belt connectable to the lap belt or other device used to restrain the lower torso, or

(ii) A fixed or movable surface that complies with S5.2.2.1(c).

S5.4.3.4 *Harnesses.* Each child harness shall:

(a) Provide upper torso restraint, including belts passing over each shoulder of the child;

(b) Provide lower torso restraint by means of lap and crotch belt; and

(c) Prevent a child of any height for which the restraint is recommended for use pursuant to S5.5.2(f) from standing upright on the vehicle seat when the child is placed in the device in accordance with the instructions required by S5.6.

S5.4.3.5 *Buckle release.* Any buckle in a child restraint system belt assembly designed to restrain a child using the system shall:

(a) When tested in accordance with S6.2.1 prior to the dynamic test of S6.1, not release when a force of less than 40 newtons (N) is applied and shall release when a force of not more than 62 N is applied;

(b) After the dynamic test of S6.1, when tested in accordance with the appropriate sections of S6.2, release when a force of not more than 71 N is applied, provided, however, that the conformance of any child restraint system to this requirement is determined using the largest of the test dummies specified in S7 for use in testing that restraint when the restraint is facing forward, rearward, and/or laterally;

(c) Meet the requirements of S4.3(d)(2) of FMVSS No. 209 (§571.209), except that the minimum surface area for child restraint system buckles designed for push button application shall be 0.6 square inch;

(d) Meet the requirements of S4.3(g) of FMVSS No. 209 (§571.209) when tested in accordance with S5.2(g) of FMVSS No. 209; and

(e) Not release during the testing specified in S6.1.

S5.5 *Labeling.* Any labels or written instructions provided in addition to those required by this section shall not obscure or confuse the meaning of the required information or be otherwise misleading to the consumer. Any labels or written instructions other than in the English language shall be an accurate translation of English labels or written instructions.

S5.5.1 Each add-on child restraint system shall be permanently labeled with the information specified in S5.5.2(a) through (m).

S5.5.2 The information specified in paragraphs (a) through (m) of this section shall be stated in the English language and lettered in letters and numbers that are not smaller than 10 point type. Unless otherwise specified, the information shall be labeled on a white background with black text. Unless written in all capitals, the information shall be stated in sentence capitalization.

(a) The model name or number of the system.

(b) The manufacturer's name. A distributor's name may be used instead if the distributor assumes responsibility for all duties and liabilities imposed on the manufacturer with respect to the system by the National Traffic and Motor Vehicle Safety Act, as amended.

(c) The statement: ''Manufactured in ____,'' inserting the month and year of manufacture.

(d) The place of manufacture (city and State, or foreign country). However, if the manufacturer uses the name of the distributor, then it shall state the location (city and State, or foreign country) of the principal offices of the distributor.

(e) The statement: ''This child restraint system conforms to all applicable Federal motor vehicle safety standards.''

(f) Statements or a combination of statements and pictograms specifying the manufacturer's recommendations for the weight and height ranges (in English and metric units) of children who can safely occupy the system in each applicable mode (rear-facing, forward facing, booster), except manufacturers shall not recommend that child restraint systems with internal harnesses be used forward-facing with children of weights less than 12 kg (26.5 lb), and shall not recommend that booster seats be used by children of weights less than 18 kg (40 lb).

(g) The statements specified in paragraphs (1) and (2):

(1) A heading as specified in S5.5.2(k)(3)(i), with the statement ''WARNING! DEATH or SERIOUS INJURY can occur,'' capitalized as written and followed by bulleted statements in the following order:

(i) As appropriate, the statements required by the following sections will be bulleted and placed after the statement required by 5.5.2(g)(1) in the following order: 5.5.2(k)(1), 5.5.2(h), 5.5.2(j), and 5.5.2(i).

(ii) Secure this child restraint with the vehicle's child restraint anchorage system, if available, or with a vehicle belt. [For car beds, harnesses, and belt positioning seats, the first part of the statement regarding attachment by the child restraint anchorage system is optional.] [For belt-positioning seats, the second part of the statement regarding attachment by the vehicle belt does not apply.]

(iii) Follow all instructions on this child restraint and in the written instructions located (*insert storage location on the restraint for the manufacturer's installation instruction booklet or sheet*).

(iv) Register your child restraint with the manufacturer.

(2) At the manufacturer's option, the phrase ''DEATH or SERIOUS INJURY can occur'' in the heading can be on either a white or yellow background.

(3) More than one label may be used for the required bulleted statements. Multiple labels shall be placed one above the other unless that arrangement is precluded by insufficient space or shape of the child restraint system. In that case, multiple labels shall be placed side by side. When using multiple labels, the mandated warnings must be in the correct order when read from top to bottom. If the labels are side-by-side, then the mandated warnings must appear top to bottom of the leftmost label, then top to bottom of the next label to its right, and so on. There shall be no intervening labels and the required heading shall only appear on the first label in the sequence.

(h) In the case of each child restraint system that has belts designed to restrain children using them and which do not adjust automatically to fit the child: Snugly adjust the belts provided with this child restraint around your child.

(i)(1) For a booster seat that is recommended for use with either a vehicle's Type 1 or Type 2 seat belt assembly, one of the following statements, as appropriate:

(i) Use only the vehicle's lap and shoulder belt system when restraining the child in this booster seat; or,

(ii) Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child in this seat.

(2)(i) Except as provided in paragraph (i)(2)(ii) of this section, for a booster seat which is recommended for use with both a vehicle's Type 1 and Type 2 seat belt assemblies, the following statement: Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child with the (*insert description of the system element provided to restrain forward movement of the child's torso when used with a lap belt* (*e.g., shield*)), and only the vehicle's lap and shoulder belt system when using the booster without the (*insert above description*).

(ii) A booster seat which is recommended for use with both a vehicle's Type 1 and Type 2 seat belt assemblies is not subject to S5.5.2(i)(2)(i) if, when the booster is used with the shield or similar component, the booster will cause the shoulder belt to be located in a position other than in front of the child when the booster is installed. However, such a booster shall be labeled with a warning to use the booster with the vehicle's lap and shoulder belt system when using the booster without a shield.

(j) In the case of each child restraint system equipped with a tether strap system the statement: Secure the tether strap provided with this child restraint. For child restraints manufactured before January 8, 2028, the statement may state: Secure the top anchorage strap provided with this child restraint.

(k)(1) In the case of each rear-facing child restraint system that is designed for infants only, the statement: Use only in a rear-facing position when using it in the vehicle.

(2) [Reserved]

(3) Except as provided in (k)(4) of this section, each child restraint system that can be used in a rear-facing position shall have a label that conforms in content to Figure 10 and to the requirements of S5.5.2(k)(3)(i) through S5.5.2(k)(3)(iii) of this standard permanently affixed to the outer surface of the cushion or padding in or adjacent to the area where a child's head would rest, so that the label is plainly visible and easily readable.

(i) The heading area shall be yellow with the word ''warning'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 square cm.

(iii) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 30 mm in diameter.

(4) If a child restraint system is equipped with a device that deactivates the passenger-side air bag in a vehicle when and only when the child restraint is installed in the vehicle and provides a signal, for at least 60 seconds after deactivation, that the air bag is deactivated, the label specified in Figure 10 may include the phrase ''unless air bag is off'' after ''on front seat with air bag.''

(l) An installation diagram showing the child restraint system installed in:

(1) A seating position equipped with a continuous-loop lap/shoulder belt;

(2) For child restraint systems manufactured before September 1, 2029, a seating position equipped with only a lap belt, as specified in the manufacturer's instructions; and

(3) A seating position equipped with a child restraint anchorage system. For child restraint systems the following paragraphs (l)(3)(i) and (ii) of this section apply, as appropriate.

(i) If the child restraint system is designed to meet the requirements of this standard when installed by the child restraint anchorage system according

to S5.3.2, and if the sum of the weight of the child restraint system and the maximum child weight recommended for the child restraint system when used with the restraint's internal harness or components is greater than 65 lb when used forward-facing or rear-facing, include the following statement on this installation diagram: ''Do not install by this method for a child weighing more than *.'' At the manufacturer's option, ''*'' is the child weight limit in English units in accordance with S5.5.2(l)(3)(i)(A), (B), or (C). The corresponding child weight limit in metric units may also be included in the statement at the manufacturer's option.

(A) For forward-facing and rear-facing child restraint systems, * is less than or equal to 65 minus child restraint system weight (pounds).

(B) For forward-facing child restraint systems, * is the child weight limit specified in the following table corresponding to the value CW, calculated as 65 minus child restraint system weight (pounds).

TABLE 5 TO S5.5.2(l)(3)(i)(B)—MAXIMUM CHILD WEIGHT LIMIT FOR LOWER ANCHOR USE FOR FORWARD-FACING CHILD RESTRAINT SYSTEM—ROUNDING

CW = 65 − child restraint system weight (pounds)	Child weight limit "*" (pounds)
20 < CW ≤ 25	25
25 < CW ≤ 30	30
30 < CW ≤ 35	35
35 < CW ≤ 40	40
40 < CW ≤ 45	45
45 < CW ≤ 50	50
50 < CW ≤ 55	55
55 < CW ≤ 60	60

(C) For rear-facing child restraint systems, * is the child weight limit specified in the following table corresponding to the value CW, calculated as 60 minus child restraint system weight (pounds).

TABLE 6 TO S5.5.2(l)(3)(i)(C)—MAXIMUM CHILD WEIGHT LIMIT FOR LOWER ANCHOR USE FOR REAR-FACING CHILD RESTRAINT SYSTEM—ROUNDING

CW = 60 − child restraint system weight (pounds)	Child weight limit "*" (pounds)
15 < CW ≤ 20	20
20 < CW ≤ 25	25

TABLE 6 TO S5.5.2(l)(3)(i)(C)—MAXIMUM CHILD WEIGHT LIMIT FOR LOWER ANCHOR USE FOR REAR-FACING CHILD RESTRAINT SYSTEM—ROUNDING—Continued

CW = 60 − child restraint system weight (pounds)	Child weight limit "*" (pounds)
25 < CW ≤ 30	30
30 < CW ≤ 35	35
35 < CW ≤ 40	40
40 < CW ≤ 45	45
45 < CW ≤ 50	50
50 < CW ≤ 55	55

(ii) For child restraint systems designed to meet the requirements of this standard when installed forward-facing and rear-facing using the child restraint anchorage system according to S5.3.2, the following applies:

(A) If separate installation diagrams are provided for the child restraint system installed forward-facing and rear-facing, S5.5.2(l)(3)(i) applies to each of the installation diagrams.

(B) If only one installation diagram is provided and if a statement specifying a child weight limit is required in only rear-facing or forward-facing mode pursuant to S5.5.2(l)(3)(i), then the diagram shall depict installation in that mode along with the corresponding child weight limit in accordance with S5.5.2(l)(3)(i).

(C) If a statement specifying a child weight limit is required for the child restraint system installed forward-facing and rear-facing pursuant to S5.5.2(l)(3)(i) and only one installation diagram is provided, then the child weight limit shall be in accordance with S5.5.2(l)(3)(i)(A) or the lesser of the child weight limits described in S5.5.2(l)(3)(i)(B) and (C).

(m) Statements informing the owner of the importance of registering the child restraint system for recall purposes and instructing the owner how to register the child restraint system at least by both mail and telephone, providing a U.S. telephone number. The following statement must also be provided: ''For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

(n) Child restraint systems, other than belt-positioning seats, harnesses and backless child restraint systems, may be certified as complying with the

provisions of S8. Child restraint systems that are so certified shall be labeled with the statement ''This Restraint is Certified for Use in Motor Vehicles and Aircraft.'' Belt-positioning seats, harnesses and backless child restraint systems shall be labeled with the statement ''This Restraint is Not Certified for Use in Aircraft.'' The statement required by this paragraph shall be in red lettering and shall be placed after the certification statement required by S5.5.2(e).

S5.5.3 The information specified in S5.5.2(f) through (l) shall be located on the add-on child restraint system so that it is visible when the system is installed as specified in S5.6.1, except that for child restraint systems with a detachable base, the installation diagrams specified in S5.5.2(l) are required to be visible only when the base alone is installed.

S5.5.4 (a) Each built-in child restraint system other than a factory-installed built-in restraint shall be permanently labeled with the information specified in S5.5.5 (a) through (l). The information specified in S5.5.5(a) through (j) and in S5.5.5(l) shall be visible when the system is activated for use.

(b) Each factory-installed built-in child restraint system shall be permanently labeled with the information specified in S5.5.5(f) through (j) and S5.5.5(l), so that the information is visible when the restraint is activated for use. The information shall also be included in the vehicle owner's manual.

S5.5.5 The information specified in paragraphs (a) through (l) of this section that is required by S5.5.4 for the built-in child restraint systems shall be in English and lettered in letters and numbers using a not smaller than 10-point type. Unless specified otherwise, the information shall be labeled on a white background with black text. Unless written in all capitals, the information shall be stated in sentence capitalization.

(a) The model name or number of the system.

(b) The manufacturer's name. A distributor's or dealer's name may be used instead if the distributor or dealer assumes responsibility for all duties and liabilities imposed on the manufacturer with respect to the system by the National Traffic and Motor Vehicle Safety Act, as amended.

(c) The statement: ''Manufactured in _____,'' inserting the month and year of manufacture.

(d) The place of manufacture (city and State, or foreign country). However, if the manufacturer uses the name of the distributor or dealer, then it shall state the location (city and State, or foreign country) of the principal offices of the distributor or dealer.

(e) The statement: ''This child restraint system conforms to all applicable Federal motor vehicle safety standards.''

(f) Statements or a combination of statements and pictograms specifying the manufacturer's recommendations for the weight and height ranges (in English and metric units) of children who can safely occupy the system in each applicable mode (rear-facing, forward facing, booster), except manufacturers shall not recommend forward-facing child restraint systems with internal harnesses for children of weights less than 12 kg (26.5 lb), and shall not recommend booster seats for children of weights less than 18 kg (40 lb).

(g) The heading and statement specified in paragraph (1), and if appropriate, the statements in paragraph (2) and (3). If used, the statements in paragraphs (2) and (3) shall be bulleted and precede the bulleted statement required by paragraph (1) after the heading.

(1) A heading as specified in S5.5.2(k)(3)(i), with the statement ''WARNING! DEATH or SERIOUS INJURY can occur,'' capitalized as written and followed by the bulleted statement: Follow all instructions on the child restraint and in the vehicle's owner's manual. At the manufacturer's option, the phrase ''DEATH or SERIOUS INJURY can occur'' in the heading can be on either a white or yellow background.

(2) In the case of each built-in child restraint system which is not intended for use in motor vehicles in certain adjustment positions or under certain circumstances, an appropriate statement of the manufacturers restrictions

regarding those positions or circumstances.

(3) As appropriate, the statements required by the following sections will be bulleted and placed after the statement required by 5.5.5(g)(1) in the following order: 5.5.5(g)(2), 5.5.5(f), S5.5.5(h) and S5.5.5(i).

(h) In the case of each built-in child restraint system that has belts designed to restrain children using them and which do not adjust automatically to fit the child: Snugly adjust the belts provided with this child restraint around your child.

(i) In the case of each built-in child restraint which can be used in a rear-facing position, the following statement: Place an infant in a rear-facing position in this child restraint.

(j) A diagram or diagrams showing the fully activated child restraint system in infant and/or child configurations.

(k) One of the following statements, inserting an address and a U.S. telephone number. If a manufacturer opts to provide a website on the registration card as permitted in Figure 9a of this section, the manufacturer must include the statement in paragraph (k)(2) of this section:

(1) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, email address if available (preceding four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (*insert a U.S. telephone number*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *http://www.NHTSA.gov*.''

(2) ''Child restraints could be recalled for safety reasons. You must register this restraint to be reached in a recall. Send your name, address, email address if available (preceding four words are optional), and the restraint's model number and manufacturing date to (*insert address*) or call (*insert telephone number*) or register online at (*insert website for electronic registration form*). For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *http://www.NHTSA.gov*.''

(l) In the case of a built-in belt-positioning seat that uses either the vehicle's Type 1 or Type 2 belt systems or both, a statement describing the manufacturer's recommendations for the maximum height and weight of children who can safely occupy the system and how the booster should be used (*e.g.*, with or without shield) with the different vehicle belt systems.

S5.6 *Printed instructions for proper use.* Any labels or written instructions provided in addition to those required by this section shall not obscure or confuse the meaning of the required information or be otherwise misleading to the consumer. Any labels or written instructions other than in the English language shall be an accurate translation of English labels or written instructions. Unless written in all capitals, the information required by S5.6.1 through S5.6.3 shall be stated in sentence capitalization.

S5.6.1 *Add-on child restraint systems.* Each add-on child restraint system shall be accompanied by printed installation instructions in English that provide a step-by-step procedure, including diagrams, for installing the system in motor vehicles, securing the system in the vehicles, positioning a child in the system, and adjusting the system to fit the child. For each child restraint system that has components for attaching to a tether anchorage or a child restraint anchorage system, the installation instructions shall include a step-by-step procedure, including diagrams, for properly attaching to that anchorage or system.

S5.6.1.1 In a vehicle with rear designated seating positions, the instructions shall alert vehicle owners that, according to accident statistics, children are safer when properly restrained in the rear seating positions than in the front seating positions.

S5.6.1.2 The instructions shall specify in general terms the types of vehicles, the types of seating positions, and the types of vehicle seat belts with which the add-on child restraint system can or cannot be used.

S5.6.1.3 The instructions shall explain the primary consequences of not following the warnings required to be labeled on the child restraint system in accordance with S5.5.2(g) through (k).

S5.6.1.4 The instructions for each car bed shall explain that the car bed should be positioned in such a way that the child's head is near the center of the vehicle.

S5.6.1.5 The instructions shall state that add-on child restraint systems should be securely belted to the vehicle, even when they are not occupied, since in a crash an unsecured child restraint system may injure other occupants.

S5.6.1.6 Each add-on child restraint system shall have a location on the restraint for storing the manufacturer's instructions.

S5.6.1.7 Child restraint systems shall include statements informing the owner of the importance of registering the child restraint system for recall purposes and instructing the owner how to register the child restraint system at least by mail and by telephone, providing a U.S. telephone number. The following statement must also be provided: ''For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

S5.6.1.8 In the case of each child restraint system that can be used in a position so that it is facing the rear of the vehicle, the instructions shall provide a warning against using restraints rear-facing at seating positions equipped with air bags, and shall explain the reasons for, and consequences of not following the warning. The instructions shall also include a statement that owners of vehicles with front passenger-side air bags should refer to their vehicle owner's manual for child restraint system installation instructions.

S5.6.1.9 In the case of each rear-facing child restraint system that has a means for repositioning the seating surface of the system that allows the system's occupant to move from a reclined position to an upright position during dynamic testing, the instructions shall include a warning against impeding the ability of the restraint to change adjustment position.

S5.6.1.10 (a) For instructions for a booster seat that is recommended for use with either a vehicle's Type 1 or Type 2 seat belt assembly, one of the following statements, as appropriate, and the reasons for the statement:

(1) Warning! Use only the vehicle's lap and shoulder belt system when restraining the child in this booster seat; or,

(2) Warning! Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child in this seat.

(b)(1) Except as provided in S5.6.1.10(b)(2), the instructions for a booster seat that is recommended for use with both a vehicle's Type 1 and Type 2 seat belt assemblies shall include the following statement and the reasons therefor: Warning! Use only the vehicle's lap belt system, or the lap belt part of a lap/shoulder belt system with the shoulder belt placed behind the child, when restraining the child with the (*insert description of the system element provided to restrain forward movement of the child's torso when used with a lap belt* (*e.g., shield*)), and only the vehicle's lap and shoulder belt system when using this booster without the (*insert above description*).

(2) A booster seat which is recommended for use with both a vehicle's Type 1 and Type 2 seat belt assemblies is not subject to S5.6.1.10(b)(1) if, when the booster is used with the shield or similar component, the booster will cause the shoulder belt to be located in a position other than in front of the child when the booster is installed. However, the instructions for such a booster shall include a warning to use the booster with the vehicle's lap and shoulder belt system when using the booster without a shield.

(c) The instructions for belt-positioning seats shall include the statement, ''This restraint is not certified for aircraft use,'' and the reasons for this statement.

S5.6.1.11 For school bus child restraint systems, the instructions must include the following statement:

''WARNING! This restraint must only be used on school bus seats. Entire seat directly behind must be unoccupied or have restrained occupants.''

(The instruction's reference to a ''restrained occupant'' refers to an occupant restrained by any user-appropriate vehicle restraint or child restraint system (*e.g.*, lap belt, lap and shoulder belt, booster seat or other child restraint system.)

S5.6.1.12 If the child restraint system is designed to meet the requirements of this standard when installed by the child restraint anchorage system according to S5.3.2, the installation diagram showing the child restraint system installed using a child restraint anchorage system must meet the specifications in S5.5.2(l)(3).

S5.6.1.13 For child restraints manufactured on or after January 8, 2028, in the case of child restraint systems marked as specified in S5.9(a) and (b) of this standard, explain that the markings identify the lower anchor connectors and the tether anchor connector, respectively, and that the consumer should look for corresponding marks on the vehicle child restraint anchorage system to attach the appropriate connectors of the child restraint system.

S5.6.1.14 For child restraints manufactured on or after January 8, 2028, use the following terms when referring to the different components of the child restraint anchorage system or for components of the child restraint system that are used to connect the child restraint system to the vehicle: ''lower anchor'' means the lower anchorage of the child restraint anchorage system in the vehicle, ''tether anchor'' means the top tether anchorage of the child restraint anchorage system in the vehicle, ''lower anchor attachment'' means the child restraint system or the detachable base's (in the case of a rear-facing child restraint with a detachable base) lower anchorage connector and the lower anchorage strap (for flexible lower anchorage attachments), ''rigid lower anchor attachment'' means the child restraint system or the detachable base's (in the case of a rear-facing child restraint with a detachable base) lower anchorage connector that is rigidly attached to the CRS and does not have a lower anchorage strap, and ''tether'' means the child restraints system's tether hook and tether strap.

S5.6.2 *Built-in child restraint systems.* (a) Each built-in child restraint system shall be accompanied by printed instructions in English that provide a step-by-step procedure, including diagrams, for activating the restraint system, positioning a child in the system, adjusting the restraint and, if provided, the restraint harness to fit the child. The instructions for each built-in car bed shall explain that the child should be positioned in the bed in such a way that the child's head is near the center of the vehicle.

(b) Each motor vehicle equipped with a factory-installed built-in child restraint system shall have the information specified in paragraph (a) of this section included in its vehicle owner's manual.

S5.6.2.1 The instructions shall explain the primary consequences of not following the manufacturer's warnings for proper use of the child restraint system in accordance with S5.5.5(f) through (i).

S5.6.2.2 The instructions for each built-in child restraint system other than a factory-installed restraint shall include statements informing the owner of the importance of registering the child restraint system for recall purposes and instructing the owner how to register the child restraint system at least by mail and by telephone, providing a U.S. telephone number. The following statement must also be provided: ''For recall information, call the U.S. Government's Vehicle Safety Hotline at 1–888–327–4236 (TTY: 1–800–424–9153), or go to *www.NHTSA.gov*.''

S5.6.2.3 Each built-in child restraint system other than a factory-installed built-in restraint, shall have a location on the restraint for storing the instructions.

S5.6.2.4 Each built-in child restraint system, other than a system that has been installed in a vehicle or a factory-installed built-in system that is designed for a specific vehicle model and seating position, shall be accompanied by instructions in English that provide a step-by-step procedure for installing the system in a motor vehicle. The instructions shall specify the types of vehicles and the seating positions into which the restraint can or cannot be installed. The instructions for each car

bed shall explain that the bed should be installed so that the child's head will be near the center of the vehicle.

S5.6.2.5 In the case of a built-in belt-positioning seat that uses either the vehicle's Type 1 or Type 2 belt systems or both, the instructions shall include a statement describing the manufacturer's recommendations for the maximum height and weight of children who can safely occupy the system and how the booster must be used with the vehicle belt systems appropriate for the booster seat. The instructions shall explain the consequences of not following the directions. The instructions shall specify that, if the booster seat is recommended for use with only the lap-belt part of a Type 2 assembly, the shoulder belt portion of the assembly must be placed behind the child.

S5.6.3 *Add-on and built-in child restraint systems.* In the case of each child restraint system that has belts designed to restrain children using them and which do not adjust automatically to fit the child, the printed instructions shall include the following statement: A snug strap should not allow any slack. It lies in a relatively straight line without sagging. It does not press on the child's flesh or push the child's body into an unnatural position.

S5.7 *Flammability.* Each material used in a child restraint system shall conform to the requirements of S4 of FMVSS No. 302 (571.302). In the case of a built-in child restraint system, the requirements of S4 of FMVSS No. 302 shall be met in both the ''in-use'' and ''stowed'' positions.

S5.8 Information requirements—attached registration form and electronic registration form.

S5.8.1 *Attached registration form.* (a) Each child restraint system, except a factory-installed built-in restraint system, shall have a registration form attached to any surface of the restraint that contacts the dummy when the dummy is positioned in the system in accordance with S6.1.2 of Standard 213. The form shall not have advertising or any information other than that related to registering the child restraint system.

(b) Each attached registration form shall provide a mail-in postcard that conforms in size, and in basic content and format to the forms depicted in Figures 9a' and 9b' of this section.

(1) The mail-in postcard shall:

(i) Have a thickness of at least 0.007 inches and not more than 0.0095 inches;

(ii) Be pre-printed with the information identifying the child restraint system for recall purposes, such as the model name or number and date of manufacture (month, year) of the child restraint system to which the form is attached;

(iii) Contain space for the owner to record his or her name, mailing address, email address (optional), telephone number (optional) and other pertinent information;

(iv) Be addressed to the manufacturer, and be postage paid.

(v) Be detachable from the information card without the use of scissors or other tools.

(c) The registration form attached to the child restraint system shall also provide an information card with the following:

(1) Informing the owner of the importance of registering the child restraint system; and,

(2) Instructing the owner how to register the CRS.

(3) Manufacturers must provide statements informing the purchaser that the registration card is pre-addressed and that postage has been paid.

(4) Manufacturers may provide instructions to register the child restraint system electronically. If an electronic registration form is used or referenced, it must meet the requirements of S5.8.2 of this section.

(5) Manufacturers may optionally provide statements to the owner explaining that the registration card is not a warranty card, and that the information collected from the owner will not be used for marketing purposes.

S5.8.2 *Electronic registration form.* (a) Each electronic registration form must meet the requirements of this S5.8.2. Each form shall:

(1) Contain statements at the top of the form:

(i) Informing the owner of the importance of registering the CRS; and,

(ii) Instructing the owner how to register the CRS.

(2) Provide as required registration fields, space for the purchaser to record the model name or number and date of manufacture (month, year) of the child restraint system, and space for the purchaser to record his or her name and mailing address. At the manufacturer's option, a space is provided for the purchaser to optionally record his or her email address. At the manufacturer's option, a space is provided for the purchaser to optionally record his or her telephone number.

(b) No advertising or other information shall appear on the electronic registration form. However, manufacturers may optionally provide statements to the owner explaining that the registration is not for a warranty, and that the information collected from the owner will not be used for marketing purposes.

(c) The electronic registration form may provide information identifying the manufacturer or a link to the manufacturer's home page, a field to confirm submission, and a prompt to indicate any incomplete or invalid fields prior to submission.

(d) If a manufacturer printed the electronic address (in form of a website (printed URL)) on the attached registration form provided pursuant to S5.8.1, the electronic registration form shall be accessed directly by the electronic address. Accessing the electronic address (in form of a website (printed URL)) that contains the electronic registration form shall not cause additional screens or electronic banners to appear. In addition to the electronic address in the form of a website, manufacturers may include a code (such as QR code or similar) to access the electronic address.

S5.9 *Attachment to child restraint anchorage system.* (a) Each add-on child restraint system other than a car bed, harness, or belt-positioning seat shall have components permanently attached to the system that enable the restraint to be securely fastened to the lower anchorages of the child restraint anchorage system specified in Standard No. 225 (§ 571.225) and depicted in NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2021, (March 2023) (incorporated by reference, *see* § 571.5). The components must be attached to the add-on child restraint by use of a tool, such as a screwdriver. In the case of rear-facing child restraints with detachable bases, only the base is required to have the components. For child restraints manufactured on or after January 8, 2028, all components provided to attach the add-on child restraint or the detachable base (in the case of a rear-facing child restraint with a detachable base) to the lower anchorages of the child restraint anchorage system shall be permanently marked with the pictogram in figure 15 to this section.

(b) In the case of each child restraint system that has components for attaching the system to a tether anchorage, those components shall include a tether hook that conforms to the configuration and geometry specified in figure 11 to this section. For child restraints manufactured on or after January 8, 2028, the tether hook or the tether strap shall be permanently marked with either pictogram shown in figure 16 to this section. If the mark is on the tether strap or on a tag attached to the tether strap, the mark must be located within 25 mm of the tether hardware assembly (which consists of a tether hook and a webbing tightening mechanism designed to tighten or loosen the tether strap).

(c) In the case of each child restraint system that has components, including belt webbing, for attaching the system to an anchorage of a child restraint anchorage system (lower anchorage or tether anchorage), the belt webbing shall be adjustable so that the child restraint can be tightly attached to the vehicle. For child restraints manufactured on or after January 8, 2025, the length of the tether hardware assembly, which consists of a tether hook and a mechanism designed to tighten and loosen the tether strap, shall not exceed 165 mm.

(d) Each child restraint system with components that enable the restraint to be securely fastened to the lower anchorages of a child restraint anchorage system, other than a system with hooks for attaching to the lower anchorages, shall provide either an indication when each attachment to the lower anchorages becomes fully

latched or attached, or a visual indication that all attachments to the lower anchorages are fully latched or attached. Visual indications shall be detectable under normal daylight lighting conditions.

S6 *Test conditions and procedures.*

S6.1 *Dynamic systems test for child restraint systems.*

The test conditions described in S6.1.1 apply to the dynamic systems test. The test procedure for the dynamic systems test is specified in S6.1.2. The test dummy specified in S7 is placed in the test specimen (child restraint system), clothed as described in S9 and positioned according to S10.

S6.1.1 *Test conditions*—(a) *Test devices.* (1) Add-on child restraint systems. The test device for add-on child restraint systems is a standard seat assembly consisting of a simulated vehicle rear seat which is depicted in NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2021 (March 2023) (incorporated by reference; see §571.5). The assembly is mounted on a dynamic test platform so that the center SORL of the seat is parallel to the direction of the test platform travel and so that movement between the base of the assembly and the platform is prevented. As illustrated in Figures 1A and 1B of this standard, attached to the seat belt anchorage points provided on the standard seat assembly is a Type 1 or a Type 2 seat belt assembly. The seat belt assembly meets the requirements of Standard No. 209 (§571.209) and has webbing with a width of not more than 2 inches, and are attached to the anchorage points without the use of retractors or reels of any kind. As illustrated in Figures 1A' and 1B' of this standard, attached to the standard seat assembly is a child restraint anchorage system conforming to the specifications of Standard No. 225 (§571.225). The indentation force deflection (IFD) characteristics of the seat pan cushion and seat back cushion are described in drawing numbers 3021–233 and 3021–248 in the NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2021, (March 2023) (incorporated by reference; see §571.5); the IFD is measured on the full size cushion samples using the test methodology and apparatus described in ASTM Standard D3574–11 (incorporated by reference; see §571.5) at 50% indentation.

(2) The test device for built-in child restraint systems is either the specific vehicle shell or the specific vehicle.

(i) *Specific vehicle shell.* (A) The specific vehicle shell, if selected for testing, is mounted on a dynamic test platform so that the longitudinal center line of the shell is parallel to the direction of the test platform travel and so that movement between the base of the shell and the platform is prevented. Adjustable seats are in the adjustment position midway between the forwardmost and rearmost positions, and if separately adjustable in a vertical direction, are at the lowest position. If an adjustment position does not exist midway between the forwardmost and rearmost position, the closest adjustment position to the rear of the midpoint is used. Adjustable seat backs are in the manufacturer's nominal design riding position. If such a position is not specified, the seat back is positioned so that the longitudinal center line of the child test dummy's neck is vertical, and if an instrumented test dummy is used, the accelerometer surfaces in the dummy's head and thorax, as positioned in the vehicle, are horizontal. If the vehicle seat is equipped with adjustable head restraints, each is adjusted to its highest adjustment position.

(B) The platform is instrumented with an accelerometer and data processing system having a frequency response of 60 Hz channel frequency class as specified in SAE Recommended Practice J211/1, (incorporated by reference, see §571.5). The accelerometer sensitive axis is parallel to the direction of test platform travel.

(ii) *Specific vehicle.* For built-in child restraint systems, an alternate test device is the specific vehicle into which the built-in system is fabricated. The following test conditions apply to this alternate test device.

(A) The vehicle is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the appropriate child test dummy and, at the vehicle manufacturer's option, an anthropomorphic test dummy which

conforms to the requirements of subpart B or subpart E of part 572 of this title for a 50th percentile adult male dummy placed in the front outboard seating position. If the built-in child restraint system is installed at one of the seating positions otherwise requiring the placement of a part 572 test dummy, then in the frontal barrier crash specified in paragraph (c) of this section, the appropriate child test dummy shall be substituted for the part 572 adult dummy, but only at that seating position. The fuel tank is filled to any level from 90 to 95 percent of capacity.

(B) Adjustable seats are in the adjustment position midway between the forward-most and rearmost positions, and if separately adjustable in a vehicle direction, are at the lowest position. If an adjustment position does not exist midway between the forward-most and rearmost positions, the closest adjustment position to the rear of the midpoint is used.

(C) Adjustable seat backs are in the manufacturer's nominal design riding position. If a nominal position is not specified, the seat back is positioned so that the longitudinal center line of the child test dummy's neck is vertical, and if an anthropomorphic test dummy is used, the accelerometer surfaces in the test dummy's head and thorax, as positioned in the vehicle, are horizontal. If the vehicle is equipped with adjustable head restraints, each is adjusted to its highest adjustment position.

(D) Movable vehicle windows and vents are, at the manufacturer's option, placed in the fully closed position.

(E) Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

(F) Doors are fully closed and latched but not locked.

(G) All instrumentation and data reduction are in conformance with SAE Recommended Practice J211/1, (incorporated by reference, see § 571.5).

(b) The tests are frontal barrier impact simulations of the test platform or frontal barrier crashes of the specific vehicles as specified in S5.1 of § 571.208 and for:

(1) Test Configuration I, are at a velocity change of 48 km/h with the acceleration of the test platform entirely within the curve shown in Figure 2, or for the specific vehicle test with the deceleration produced in a 48 km/h frontal barrier crash.

(2) Test Configuration II, are set at a velocity change of 32 km/h with the acceleration of the test platform entirely within the curve shown in Figure 3, or for the specific vehicle test, with the deceleration produced in a 32 km/h frontal barrier crash.

(c) As illustrated in Figures 1A and 1B of this standard, attached to the seat belt anchorage points provided on the standard seat assembly are Type 1 or Type 2 seat belt assemblies. These seat belt assemblies meet the requirements of Standard No. 209 (§ 571.209) and have webbing with a width of not more than 2 inches, and are attached to the anchorage points without the use of retractors or reels of any kind. As illustrated in Figures 1A' and 1B' of this standard, attached to the standard seat assembly is a child restraint anchorage system conforming to the specifications of Standard No. 225 (§ 571.225).

(d)(1) When using the test dummy specified in 49 CFR part 572, subparts I and K, performance tests under S6.1 are conducted at any ambient temperature from 19 °C to 26 °C and at any relative humidity from 10 percent to 70 percent.

(2) When using the test dummies specified in 49 CFR part 572, subpart N, P, R or T, performance tests under S6.1 are conducted at any ambient temperature from 20.6 °C to 22.2 °C and at any relative humidity from 10 percent to 70 percent.

(e) In the case of add-on child restraint systems, the restraint shall meet the requirements of S5 at each of its seat back angle adjustment positions and restraint belt routing positions, when the restraint is oriented in the direction recommended by the manufacturer (*e.g.*, forward, rearward or laterally) pursuant to S5.6, and tested with the test dummy specified in S7.

S6.1.2 *Dynamic test procedure.* (a) Activate the built-in child restraint system or attach the add-on child restraint system to the seat assembly in any of the following manners, at the agency's option.

(1) *Test configuration I.* (i) *Child restraint systems other than booster seats.* At the agency's option, attach the child restraint in any of the following manners specified in S6.1.2(a)(1)(i)(A) through (D), unless otherwise specified in this standard. The child restraint system must meet the requirements of the standard when attached in any of these manners, subject to S6.1.2.

(A) Install the child restraint system on the standard seat assembly, in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1, except that, at the agency's option, the standard lap belt is used or the lap and shoulder belt is used. If provided, a tether strap may be used, but only if the manufacturer's instructions instruct consumers to use it. Attach the school bus child restraint system in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1, *e.g.*, the seat back mount or seat back and seat pan mount are used.

(B) Except for a child harness, a school bus child restraint system, and a restraint designed for use by children with physical disabilities, install the child restraint system on the standard seat assembly as in S6.1.2(a)(1)(i)(A), except that no tether strap (or any other supplemental device) is used.

(C) Install the child restraint system using the child restraint anchorage system on the standard seat assembly in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1. The tether strap, if one is provided, is attached to the tether anchorage.

(D) Install the child restraint system using only the lower anchorages of the child restraint anchorage system as in S6.1.2(a)(1)(i)(C). No tether strap (or any other supplemental device) is used.

(ii) *Booster seats.* A booster seat is placed on the standard seat assembly in accordance with the manufacturer's instructions provided with the system pursuant to S5.6.1. The booster seat is dynamically tested using only the standard vehicle lap and shoulder belt and no tether (or any other supplemental device). At NHTSA's option, the ATD Head Protection Device depicted in NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA–213–2021, (March 2023), (incorporated by reference, see §571.5) can be used when testing backless child restraint systems. Place the booster seat on the standard seat assembly such that the center plane of the booster seat is parallel and aligned to the center plane of the standard seat assembly and the base of the booster seat is flat on the standard seat assembly cushion. Move the booster seat rearward on the standard seat assembly until some part of the booster seat touches the standard seat assembly back. Keep the booster seat and the seating position center plane aligned as much as possible. Apply 133 N (30 pounds) of force to the front of the booster seat rearward into the standard seat assembly and release.

(iii) In the case of each built-in child restraint system, activate the restraint in the specific vehicle shell or the specific vehicle, in accordance with the manufacturer's instructions provided in accordance with S5.6.2.

(2) *Test configuration II.* (i) In the case of each add-on child restraint system which is equipped with a fixed or movable surface described in S5.2.2.2, install the add-on child restraint system onto the standard seat assembly using only the standard seat lap belt or the lap and shoulder belt to secure the system to the standard seat, or at NHTSA's option, only the lower anchorages of the child restraint anchorage system. Do not attach the top tether.

(ii) In the case of each built-in child restraint system which is equipped with a fixed or movable surface described in S5.2.2.2 that has belts that are not an integral part of that fixed or movable surface, activate the system in the specific vehicle shell or the specific vehicle in accordance with the manufacturer's instructions provided in accordance with S5.6.2.

(b) Select any dummy specified in S7 for testing systems for use by children of any height or any weight for which the system is recommended in accordance with S5.5. The dummy is assembled, clothed and prepared as specified in S7 and S9 and part 572 of this chapter, as appropriate.

(c) Place the dummy in the child restraint system. Position it, and attach

the child restraint system belts, if appropriate, as specified in S10.

(d)(1) The belts of add-on systems other than belt-positioning seats are adjusted as follows.

(i) Shoulder and pelvic belts that directly restrain the dummy are adjusted as follows: Tighten the belt system used to restrain the child within the child restraint system to any tension of not less than 9 Newtons and not more than 18 Newtons on the webbing at the top of each dummy shoulder and the pelvic region.

(ii) All Type 1 or Type 2 belt systems used to attach an add-on child restraint system to the standard seat assembly are tightened to any tension of not less than 53.5 N and not more than 67 N. Tighten any provided additional anchorage belt (top tether) to any tension of not less than 45 Newtons and not more than 53.5 Newtons. All belt systems used to attach a school bus child restraint system are also tightened to any tension of not less than 53.5 N and not more than 67 N.

(iii) When using the child restraint anchorage system to attach the child restraint system to the standard seat assembly, tighten the belt systems of the lower anchorage attachments used to attach the restraint to the standard seat assembly to any tension of not less than 53.5 Newtons and not more than 67 Newtons and tighten the belt of the top tether attachment used to attach the restraint to the standard seat assembly to any tension of not less than 45 Newtons and not more than 53.5 Newtons.

(2) The belts of add-on belt-positioning seats are adjusted as follows.

(i) The lap portion of Type 2 belt systems used to restrain the dummy is tightened to a tension of not less than 9 N and not more than 18 N.

(ii) The shoulder portion of Type 2 belt systems used to restrain the dummy is tightened to a tension of not less than 9 N and not more than 18 N.

(3) The belts of built-in child restraint systems are adjusted as follows.

(i) The lap portion of Type 2 belt systems used to restrain the dummy is tightened to a tension of not less than 9 N and not more than 18 N.

(ii) The shoulder portion of Type 2 belt systems used to restrain the dummy is tightened to a tension of not less than 9 N and not more than 18 N.

(iii) For built-in child restraint systems, if provided, shoulder and pelvic belts that directly restrain the dummy are adjusted as follows. Tighten the belt system used to restrain the child within the child restraint system to any tension of not less than 9 Newtons and not more than 18 Newtons on the webbing at the top of each dummy shoulder and the pelvic region.

(e) Accelerate the test platform to simulate frontal impact in accordance with Test Configuration I or II, as appropriate.

(f) Determine conformance with the requirements in S5.1.

S6.2 *Buckle release test procedure.* The belt assembly buckles used in any child restraint system shall be tested in accordance with S6.2.1 through S6.2.4 inclusive.

S6.2.1 Before conducting the testing specified in S6.1, place the loaded buckle on a hard, flat, horizontal surface. Each belt end of the buckle shall be pre-loaded in the following manner. The anchor end of the buckle shall be loaded with a 9 N force in the direction away from the buckle. In the case of buckles designed to secure a single latch plate, the belt latch plate end of the buckle shall be pre-loaded with a 9 N force in the direction away from the buckle. In the case of buckles designed to secure two or more latch plates, the belt latch plate ends of the buckle shall be loaded equally so that the total load is 9 N, in the direction away from the buckle. For pushbutton-release buckles, the release force shall be applied by a conical surface (cone angle not exceeding 90 degrees). For pushbutton-release mechanisms with a fixed edge (referred to in Figure 7 as ''hinged button''), the release force shall be applied at the centerline of the button, 3 mm away from the movable edge directly opposite the fixed edge, and in the direction that produces maximum releasing effect. For pushbutton-release mechanisms with no fixed edge (referred to in Figure 7 as ''floating button''), the release force shall be applied at the center of the release mechanism in the direction that produces the maximum releasing effect. For all other buckle release mechanisms, the force

shall be applied on the centerline of the buckle lever or finger tab in the direction that produces the maximum releasing effect. Measure the force required to release the buckle. Figure 7 illustrates the loading for the different buckles and the point where the release force should be applied, and Figure 8 illustrates the conical surface used to apply the release force to pushbutton-release buckles.

S6.2.2 After completion of the testing specified in S6.1 and before the buckle is unlatched, tie a self-adjusting sling to each wrist and ankle of the test dummy in the manner illustrated in Figure 4, without disturbing the belted dummy and the child restraint system.

S6.2.3 Pull the sling tied to the dummy restrained in the child restraint system and apply the following force: 50 N for a system tested with a newborn dummy (49 CFR part 572, subpart K); 90 N for a system tested with a 12-month-old dummy (49 CFR part 572, subpart R); 200 N for a system tested with a 3-year-old dummy (49 CFR part 572, subpart P); 270 N for a system tested with a 6-year-old dummy (49 CFR part 572, subpart N or I); 350 N for a system tested with a weighted 6-year-old dummy (49 CFR part 572, subpart S); or 437 N for a system tested with a 10-year-old dummy (49 CFR part 572, subpart T). The force is applied in the manner illustrated in Figure 4 and as follows:

(a) *Add-on child restraint systems.* For an add-on child restraint system other than a car bed, apply the specified force by pulling the sling horizontally and parallel to the SORL of the standard seat assembly. For a car bed, apply the force by pulling the sling vertically.

(b) *Built-in child restraint systems.* For a built-in child restraint systems other than a car bed, apply the force by pulling the sling parallel to the longitudinal centerline of the specific vehicle shell or the specific vehicle. In the case of a car bed, apply the force by pulling the sling vertically.

S6.2.4 While applying the force specified in S6.2.3, and using the device shown in Figure 8 for pushbutton-release buckles, apply the release force in the manner and location specified in S6.2.1, for that type of buckle. Measure the force required to release the buckle.

S6.3 [Reserved]

S7 *Test dummies.* (Subparts referenced in this section are of part 572 of this chapter.)

S7.1 *Dummy selection.* Select any dummy specified in S7.1.1, S7.1.2 or S7.1.3, as appropriate, for testing systems for use by children of the height (regardless of weight) or weight (regardless of height) for which the system is recommended in accordance with S5.5. A child restraint system that meets the criteria in two or more of the following paragraphs in S7 may be tested with any of the test dummies specified in those paragraphs.

S7.1.1 [Reserved]

S7.1.2 Child restraints systems are subject to the following provisions and S7.1.3.

(a) A child restraint system that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified weight range that includes any children having a weight of not greater than 5 kg (11 lb) regardless of height, or by children in a specified height range that includes any children whose height is not greater than 650 mm regardless of weight, is tested with a 49 CFR part 572 subpart K dummy (newborn infant dummy).

(b) A child restraint system that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified weight range that includes any children having a weight greater than 5 kg (11 lb) but not greater than 10 kg (22 lb) regardless of height, or by children in a specified height range that includes any children whose height is greater than 650 mm but not greater than 750 mm regardless of weight, is tested with a 49 CFR part 572 subpart K dummy (newborn infant dummy), and a part 572 subpart R dummy (CRABI 12-month-old test dummy).

(c) A child restraint system that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified weight range that includes any children having a weight greater than 10 kg (22 lb) but

not greater than 13.6 kg (30 lb) regardless of height, or by children in a specified height range that includes any children whose height is greater than 750 mm but not greater than 870 mm regardless of weight, is tested with a part 572 subpart R dummy (CRABI 12-month-old test dummy), provided, however, that the CRABI 12-month-old dummy is not used to test a forward-facing child restraint system.

(d) A child restraint system that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified weight range that includes any children having a weight greater than 13.6 kg (30 lb) but not greater than 18 kg (40 lb) regardless of height, or by children in a specified height range that includes any children whose height is greater than 870 mm but not greater than 1100 mm regardless of weight, is tested with a 49 CFR part 572, subpart P dummy (Hybrid III 3-year-old dummy).

(e) A child restraint system that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified weight range that includes any children having a weight greater than 18 kg (40 lb) but not greater than 22.7 kg (50 lb) regardless of height, or by children in a specified height range that includes any children whose height is greater than 1100 mm but not greater than 1250 mm regardless of weight, is tested with a 49 CFR part 572, subpart N dummy (Hybrid III 6- year-old dummy).

(f) A child restraint system that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified weight range that includes any children having a weight greater than 22.7 kg (50 lb) but not greater than 30 kg (65 lb) regardless of height, or by children in a specified height range that includes any children whose height is greater than 1100 mm but not greater than 1250 mm regardless of weight, is tested with a 49 CFR part 572, subpart N dummy (Hybrid III 6-year-old dummy) and with a part 572, subpart S dummy (Hybrid III 6-year-old weighted dummy).

(g) A child restraint system that is recommended by its manufacturer in accordance with S5.5 for use either by children in a specified weight range that includes any children having a weight greater than 30 kg (65 lb) regardless of height, or by children in a specified height range that includes any children whose height is greater than 1250 mm regardless of weight, is tested with a 49 CFR part 572, subpart T dummy (Hybrid III 10-year-old dummy).

S8 *Requirements, test conditions, and procedures for child restraint systems manufactured for use in aircraft.* Each child restraint system manufactured for use in both motor vehicles and aircraft must comply with all of the applicable requirements specified in Section S5 and with the additional requirements specified in S8.1 and S8.2.

S8.1 *Installation instructions.* Each child restraint system manufactured for use in aircraft shall be accompanied by printed instructions in English that provide a step-by-step procedure, including diagrams, for installing the system in aircraft passenger seats, securing a child in the system when it is installed in aircraft, and adjusting the system to fit the child.

S8.2 *Inversion test.* When tested in accordance with S8.2.1 through S8.2.5, each child restraint system manufactured for use in aircraft shall meet the requirements of S8.2.1 through S8.2.6. The manufacturer may, at its option, use any seat which is a representative aircraft passenger seat within the meaning of S4. Each system shall meet the requirements at each of the restraint's seat back angle adjustment positions and restraint belt routing positions, when the restraint is oriented in the direction recommended by the manufacturer (*e.g.*, facing forward, rearward or laterally) pursuant to S8.1, and tested with the test dummy specified in S7. If the manufacturer recommendations do not include instructions for orienting the restraint in aircraft when the restraint seat back angle is adjusted to any position, position the restraint on the aircraft seat by following the instructions (provided in accordance with S5.6) for orienting the restraint in motor vehicles.

S8.2.1 A standard seat assembly consisting of a representative aircraft passenger seat shall be positioned and adjusted so that its horizontal and vertical orientation and its seat back

angle are the same as shown in Figure 6.

S8.2.2 The child restraint system shall be attached to the representative aircraft passenger seat using, at the manufacturer's option, any Federal Aviation Administration approved aircraft safety belt, according to the restraint manufacturer's instructions for attaching the restraint to an aircraft seat. No supplementary anchorage belts or tether straps may be attached; however, Federal Aviation Administration approved safety belt extensions may be used.

S8.2.3 In accordance with S10, place in the child restraint system any dummy specified in S7 for testing systems for use by children of the heights and weights for which the system is recommended in accordance with S5.5 and S8.1.

S8.2.4 If provided, shoulder and pelvic belts that directly restrain the dummy shall be adjusted in accordance with S6.1.2.

S8.2.5 The combination of representative aircraft passenger seat, child restraint system, and test dummy shall be rotated forward around a horizontal axis which is contained in the median transverse vertical plane of the seating surface portion of the aircraft seat and is located 25 mm below the bottom of the seat frame, at a speed of 35 to 45 degrees per second, to an angle of 180 degrees. The rotation shall be stopped when it reaches that angle and the seat shall be held in this position for three seconds. The child restraint system shall not fall out of the aircraft safety belt nor shall the test dummy fall out of the child restraint system at any time during the rotation or the three second period. The specified rate of rotation shall be attained in not less than one half second and not more than one second, and the rotating combination shall be brought to a stop in not less than one half second and not more than one second.

S8.2.6 Repeat the procedures set forth in S8.2.1 through S8.2.4. The combination of the representative aircraft passenger seat, child restraint system, and test dummy shall be rotated sideways around a horizontal axis which is contained in the median longitudinal vertical plane of the seating surface portion of the aircraft seat and is located 25 mm below the bottom of the seat frame, at a speed of 35 to 45 degrees per second, to an angle of 180 degrees. The rotation shall be stopped when it reaches that angle and the seat shall be held in this position for three seconds. The child restraint system shall not fall out of the aircraft safety belt nor shall the test dummy fall out of the child restraint system at any time during the rotation or the three second period. The specified rate of rotation shall be attained in not less than one half second and not more than one second, and the rotating combination shall be brought to a stop in not less than one half second and not more than one second.

S9 *Dummy clothing and preparation.*

S9.1 *Type of clothing.*

(a) *Newborn dummy (49 CFR part 572, subpart K).* When used in testing under this standard, the dummy is unclothed.

(b) [Reserved]

(c) *12-month-old dummy (49 CFR part 572, subpart R).* When used in testing under this standard, the dummy specified in 49 CFR part 572, subpart R, is clothed in a cotton-polyester based tight fitting sweatshirt with long sleeves and ankle long pants whose combined weight is not more than 0.25 kg.

(d) [Reserved]

(e) *Hybrid III 3-year-old dummy (49 CFR part 572, subpart P).* When used in testing under this standard, the dummy specified in 49 CFR part 572, subpart P, is clothed as specified in that subpart, except that the shoes are children's size 8 canvas oxford style sneakers weighing not more than 0.26 kg each.

(f) *Hybrid III 6-year-old dummy (49 CFR part 572, subpart N) and Hybrid III 6-year-old weighted dummy (49 CFR part 572, subpart S), and Hybrid III 10-year-old dummy (49 CFR part 572, subpart T).* When used in testing under this standard, the dummies specified in 49 CFR part 572, subparts N and S, are clothed as specified in subpart N and with child or youth size 13 M sneakers weighing not more than 0.45 kg each. When used in testing under this standard, the dummy specified in 49 CFR part 572, subpart T, is clothed as specified in

subpart T and with youth size 3 sneakers weighing not more than 0.6 kg each.

S9.2 *Preparing clothing.* Clothing other than the shoes is machine-washed in 71 °C to 82 °C and machine-dried at 49 °C to 60 °C for 30 minutes.

S9.3 *Preparing dummies.* (Subparts referenced in this section are of part 572 of this chapter.)

S9.3.1 When using the test dummy conforming to subpart K, prepare the dummy as specified in this paragraph. Before being used in testing under this standard, the dummy must be conditioned at any ambient temperature from 19 °C to 25.5 °C and at any relative humidity from 10 percent to 70 percent, for at least 4 hours.

S9.3.2 When using the test dummies conforming to subparts N, P, R, S or T, prepare the dummies as specified in this paragraph. Before being used in testing under this standard, dummies must be conditioned at any ambient temperature from 20.6° to 22.2 °C and at any relative humidity from 10 percent to 70 percent, for at least 4 hours.

S10 *Positioning the dummy and attaching the system belts.*

S10.1 *Car beds.* Place the test dummy in the car bed in the supine position with its midsagittal plane perpendicular to the center SORL of the standard seat assembly, in the case of an add-on car bed, or perpendicular to the longitudinal axis of the specific vehicle shell or the specific vehicle, in the case of a built-in car bed. Position the dummy within the car bed in accordance with the instructions for child positioning that the bed manufacturer provided with the bed in accordance with S5.6.

S10.2 *Restraints other than car beds.*

S10.2.1 *Newborn dummy and 12-month-old dummy.* Position the test dummy according to the instructions for child positioning that the manufacturer provided with the system under S5.6.1 or S5.6.2, while conforming to the following:

(a) [Reserved]

(b) When testing rear-facing child restraint systems, place the newborn, or 12-month-old dummy in the child restraint system so that the back of the dummy torso contacts the back support surface of the system. For a child restraint system which is equipped with a fixed or movable surface described in S5.2.2.2 which is being tested under the conditions of test configuration II, do not attach any of the child restraint system belts unless they are an integral part of the fixed or movable surface. For all other child restraint systems and for a child restraint system with a fixed or movable surface which is being tested under the conditions of test configuration I, attach all appropriate child restraint system belts and tighten them as specified in S6.1.2. Attach all appropriate vehicle belts and tighten them as specified in S6.1.2. Position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2. If the dummy's head does not remain in the proper position, tape it against the front of the seat back surface of the system by means of a single thickness of 6 mm-wide paper masking tape placed across the center of the dummy's face.

(c) When testing rear-facing child restraint systems, extend the dummy's arms vertically upwards and then rotate each arm downward toward the dummy's lower body until the arm contacts a surface of the child restraint system or the standard seat assembly in the case of an add-on child restraint system, or the specific vehicle shell or the specific vehicle, in the case of a built-in child restraint system. Ensure that no arm is restrained from movement in other than the downward direction, by any part of the system or the belts used to anchor the system to the standard seat assembly, the specific shell, or the specific vehicle.

S10.2.2 *Other dummies generally.* When using: (1) the Hybrid III 3-year-old (part 572, subpart P), and Hybrid III weighted 6-year-old (part 572, subpart S) in child restraint systems including belt-positioning seats; (2) the Hybrid III 6-year-old (part 572, subpart N) and the Hybrid III 10-year-old (part 572, subpart T) in child restraint systems other than belt-positioning seats, position the dummy in accordance with S5.6.1 or S5.6.2, while conforming to the following:

(a) Holding the test dummy torso upright until it contacts the system's design seating surface, place the test dummy in the seated position within

the system with the midsagittal plane of the test dummy head—

(1) Coincident with the center SORL of the standard seating assembly, in the case of the add-on child restraint system, or

(2) Vertical and parallel to the longitudinal center line of the specific vehicle, in the case of a built-in child restraint system.

(b) Extend the arms of the test dummy as far as possible in the upward vertical direction. Extend the legs of the dummy as far as possible in the forward horizontal direction, with the dummy feet perpendicular to the center line of the lower legs.

(c) Using a flat square surface with an area of 2580 square millimeters, apply a force of 178 N, perpendicular to:

(1) The plane of the back of the standard seat assembly, in the case of an add-on system, or

(2) The back of the vehicle seat in the specific vehicle shell or the specific vehicle, in the case of a built-in system, first against the dummy crotch and then at the dummy thorax in the midsagittal plane of the dummy. For a child restraint system with a fixed or movable surface described in S5.2.2.2, which is being tested under the conditions of test configuration II, do not attach any of the child restraint system belts unless they are an integral part of the fixed or movable surface. For all other child restraint systems and for a child restraint system with a fixed or movable surface which is being tested under the conditions of test configuration I, attach all appropriate child restraint system belts and tighten them as specified in S6.1.2. Attach all appropriate vehicle belts and tighten them as specified in S6.1.2. Position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2.

(d) After the steps specified in paragraph (c) of this section, rotate each dummy limb downwards in the plane parallel to the dummy's midsagittal plane until the limb contacts a surface of the child restraint system or the standard seat assembly, in the case of an add-on system, or the specific vehicle shell or specific vehicle, in the case of a built-in system, as appropriate. Position the limbs, if necessary, so that limb placement does not inhibit torso or head movement in tests conducted under S6.

(e) Additional provisions when using the Hybrid III 3-year-old (part 572, subpart P) dummy in a rear-facing child restraint system.

(1) When using the Hybrid III 3-year-old dummy in a rear-facing child restraint system with an internal harness or other components to restrain the child, remove the knee stop screw (as shown in drawing 210–6516 of Drawing No. 210–5000–1 (L),–2(R), Leg Assembly in subpart P of part 572 of this chapter (incorporated by reference, see §571.5) from the right and left knee so as to let the knees hyperextend.

(2) Place the subpart P dummy in the child restraint system being tested so that the back of the dummy torso contacts the back support surface of the system. For a child restraint system equipped with a fixed or movable surface described in S5.2.2.2 that is being tested under the conditions of test configuration II, do not attach any of the child restraint system belts unless they are an integral part of the fixed or movable surface. For all other child restraint systems and for a child restraint system with a fixed or movable surface that is being tested under the conditions of test configuration I, attach all appropriate child restraint system belts and tighten them as specified in S6.1.2. Attach all appropriate vehicle belts and tighten them as specified in S6.1.2. Position each movable surface in accordance with the instructions that the manufacturer provided under S5.6.1 or S5.6.2.

S10.2.3 *Hybrid III 6-year-old in belt-positioning seats, Hybrid III weighted 6-year-old in belt-positioning seats, and Hybrid III 10-year-old in belt-positioning seats.* When using the Hybrid III 6-year-old (part 572, subpart N), the Hybrid III weighted 6-year-old (part 572, subpart S), or the Hybrid III 10-year-old (part 572, subpart T) in belt-positioning seats, position the dummy in accordance with S5.6.1 or S5.6.2, while conforming to the following:

(a) *Prepare the dummy.* (1) When using the Hybrid III 10-year-old dummy, prepare the dummy according to the following:

(i) Set the dummy's neck angle at the SP–16 setting (''SP'' means standard procedure), see Figure 14a.

(ii) Set the dummy's lumbar angle at the SP–12 setting, see Figure 14b. This is done by aligning the notch on the lumbar adjustment bracket with the SP–12 notch on the lumbar attachment.

(iii) Adjust the limb joints to 1–2 g while the torso is in the seated position.

(iv) Apply double-sided tape to the surface of a lap shield, which is a piece of translucent silicone rubber 3 mm ±0.5 mm thick (50A durometer) cut to the dimensions specified in Figure 13 in this section. Place the lap shield on the pelvis of the dummy. Align the top of the lap shield with the superior anterior edge of the pelvis skin. Attach the lap shield to the dummy.

(v) Apply double-sided tape to one side of a pelvis positioning pad, which is a 125 x 95 x 20 mm (±2 mm tolerance in each of the three dimensions) piece of closed cell (Type 2 according to ASTM D1056–07) (incorporated by reference; see § 571.5) foam or rubber cut from material having the following specifications: compression resistance between 9 to 17 psi in a compression-deflection test specified in ASTM D1056–07 (incorporated by reference; see § 571.5), and a density of 7 to 12.5 lb/ft^3. Center the long axis of the pad on the posterior of the pelvis with the top edge of the foam aligned with the superior edge of the pelvis skin. Attach the pelvis positioning pad to the dummy.

(vi) Dress and prepare the dummy according to S9.

(2) When using the Hybrid III 6-year-old dummy and the Hybrid III weighted 6-year-old dummy, prepare the dummy according to the following:

(i) If necessary, adjust the limb joints to 1–2 g while the torso is in the seated position.

(ii) Apply double-sided tape to the surface of a lap shield, which is a piece of translucent silicone rubber 3 mm thick ±0.5 mm thick (50A durometer) cut to the dimensions specified in Figure 13. Place the lap shield on the pelvis of the dummy. Align the top of the lap shield with the superior anterior edge of the pelvis skin. Attach the lap shield to the dummy.

(iii) Dress and prepare the dummy according to S9.

(b) *Position the belt-positioning seat.* Position the belt-positioning seat according to S6.1.2(a)(1)(ii).

(c) *Position the dummy.* Position the dummy in the belt-positioning seat.

(1) Place the dummy on the seat cushion of the belt-positioning seat such that the plane of the posterior pelvis is parallel to the plane of the seat back of the belt-positioning seat, standard seat assembly or vehicle seat back, but not touching. Pick up and move the dummy rearward, maintaining the parallel planes, until the pelvis positioning pad, if used, or the pelvis or back of the dummy and the back of the belt-positioning seat or the back of the standard seat assembly, are in minimal contact.

(2) Straighten and align the arm segments horizontally, then rotate the arms upward at the shoulder as far as possible without contacting the belt-positioning seat. Straighten and align the legs horizontally and extend the lower legs as far as possible in the forward horizontal direction, with the feet perpendicular to the centerline of the lower legs.

(3) Using a flat square surface with an area of 2580 square millimeters, apply a force of 178 N (40 lb) first against the dummy crotch and then against the dummy thorax on the midsagittal plane of the dummy, perpendicular to:

(i) The plane of the back of the belt-positioning seat, in the case of a belt-positioning seat with a back, or,

(ii) The plane of the back of the standard seat assembly or vehicle seat, in the case of a backless belt-positioning seat or built-in booster.

(4) Rotate the arms of the dummy down so that they are perpendicular to the torso.

(5) Bend the knees until the back of the lower legs are in minimal contact with the belt-positioning seat, standard seat assembly or vehicle seat. Position the legs such that the outer edges of the knees are 180 ±10 mm apart for the Hybrid III 6-year-old dummy and 220 ±10 mm apart for the Hybrid III 10-year-old dummy. Position the feet such that the soles are perpendicular to the centerline of the lower legs. In the case

of a belt-positioning seat with a back, adjust the dummy so that the shoulders are parallel to a line connecting the shoulder belt guides. This can be accomplished by leaning the torso such that the dummy's head and neck are centered on the backrest components of the belt-positioning seat. In case of a backless child restraint system, adjust the dummy's torso so that the head is as close to laterally level as possible.

(d) *Apply the belt.* Attach the vehicle belts and tighten them as specified in S6.1.2.

(e) *Dummy final positioning.* (1) Check the leg, feet, thorax and head positions and make any necessary adjustments to achieve the positions described in S10.2.3(c)(5). Position the legs, if necessary, so that the leg placement does not inhibit thorax movement in tests conducted under S6.

(2) Rotate each dummy arm downwards in the plane parallel to the dummy's midsagittal plane until the arm contacts a surface of the child restraint system or the standard seat assembly, in the case of an add-on system, or the specific vehicle shell or specific vehicle, in the case of a built-in system, as appropriate. Position the arms, if necessary, so that the arm placement does not inhibit torso or head movement in tests conducted under S6.

Figure 1A–1 to §571.213b—Seat Orientation Reference Line and Seat Belt Anchorage Point Locations on the Standard Seat Assembly

(See drawing package referenced in this section for tolerances)

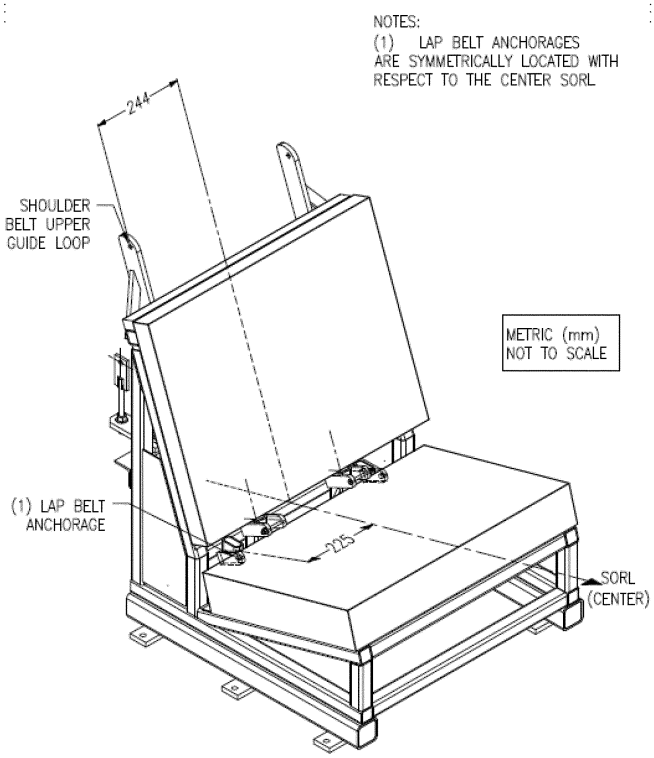


Figure 1A–2 to § 571.213b—Seat Orientation Reference Line and Location of the Lower Anchorages of the Child Restraint Anchorate System on the Standard Seat Assembly

(See drawing package referenced in this standard for tolerances)

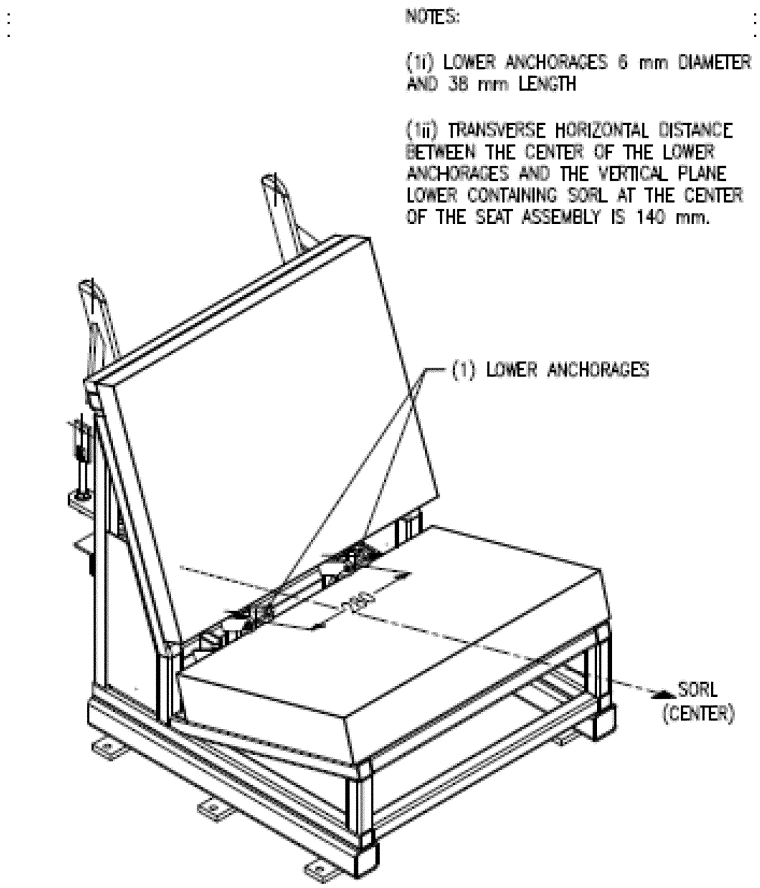
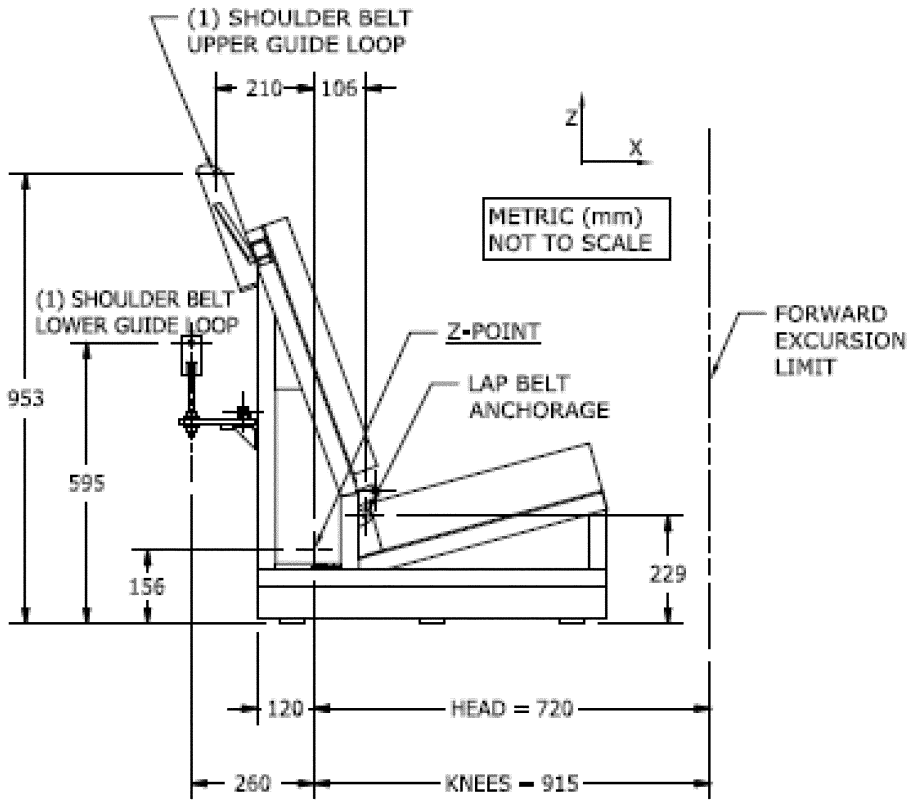


Figure 1B–1 to §571.213b—Location of Shoulder Belt Upper and Lower Guide Loops and Forward Excursion Limits on the Standard Seat Assembly

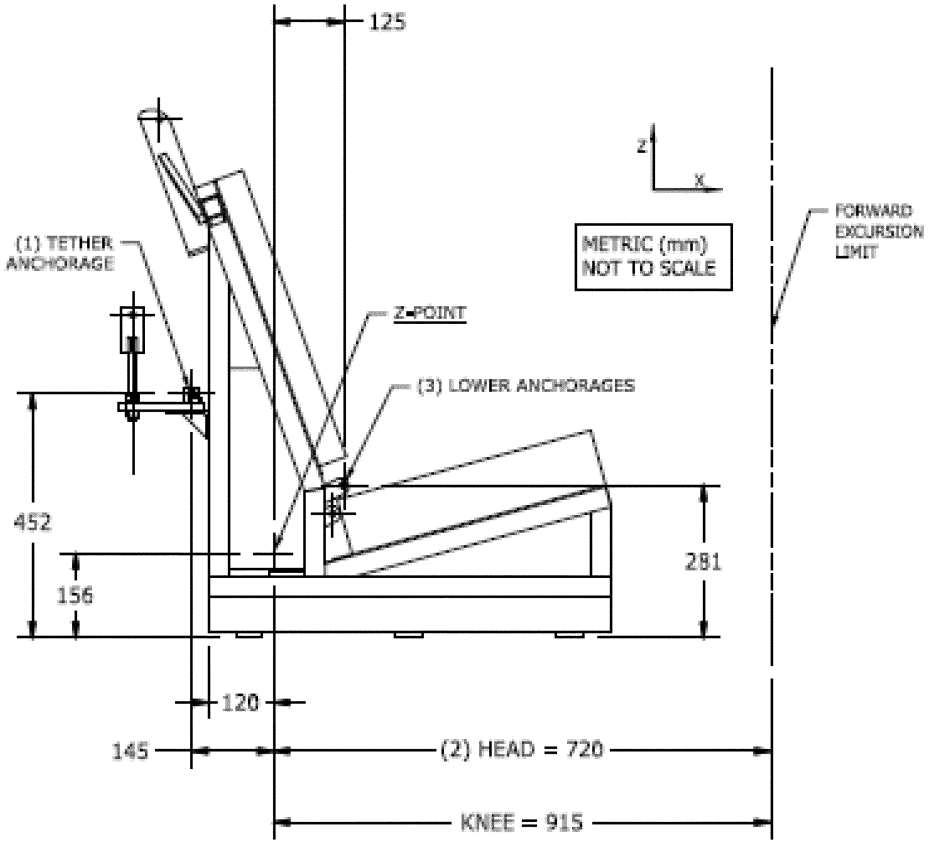
(See drawing package referenced in this standard for tolerances)



NOTES:
(1) SHOULDER BELT UPPER AND LOWER GUIDE LOOPS ARE LOCATED 244 mm RIGHT AND LEFT OF THE CENTER SORL AS SHOWN IN FIGURE 1A

Figure 1B–2 to § 571.213b—Location of the Child Restraint Anchorages and Forward Excursion Limits on the Standard Seat Assembly

(See drawing package referenced in this standard for tolerances)



NOTES:
(1) TETHER ANCHORAGE LOCATED ON CENTER SORL
(2) HEAD EXCURSION LIMIT IS (|) 720 mm WITH TETHER ATTACHED AND (▮) 813 mm WITH TETHER UNATTACHED
(3) LOWER ANCHORAGES LOCATED 125 mm FORWARD OF Z POINT AND 281 mm UPWARD FROM FLOOR

Figure 1C to §571.213b—Rear-Facing Child Restraint Forward and Upper Head Excursion Limits

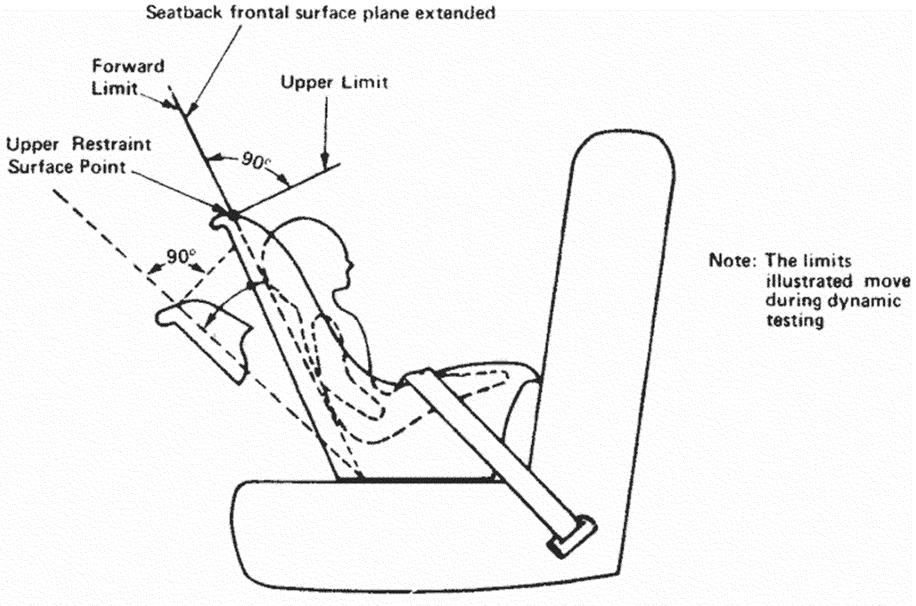
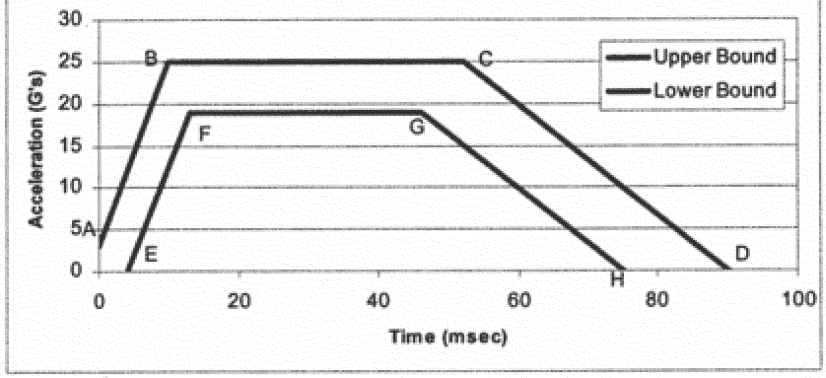


Figure 2 to §571.213b



Upper Bound			Lower Bound		
Point	Time	Acceleration	Point	Time	Acceleration
A	0	3	E	4	0
B	10	25	F	13	19
C	52	25	G	46	19
D	90	0	H	75	0

Figure 3 to §571.213b

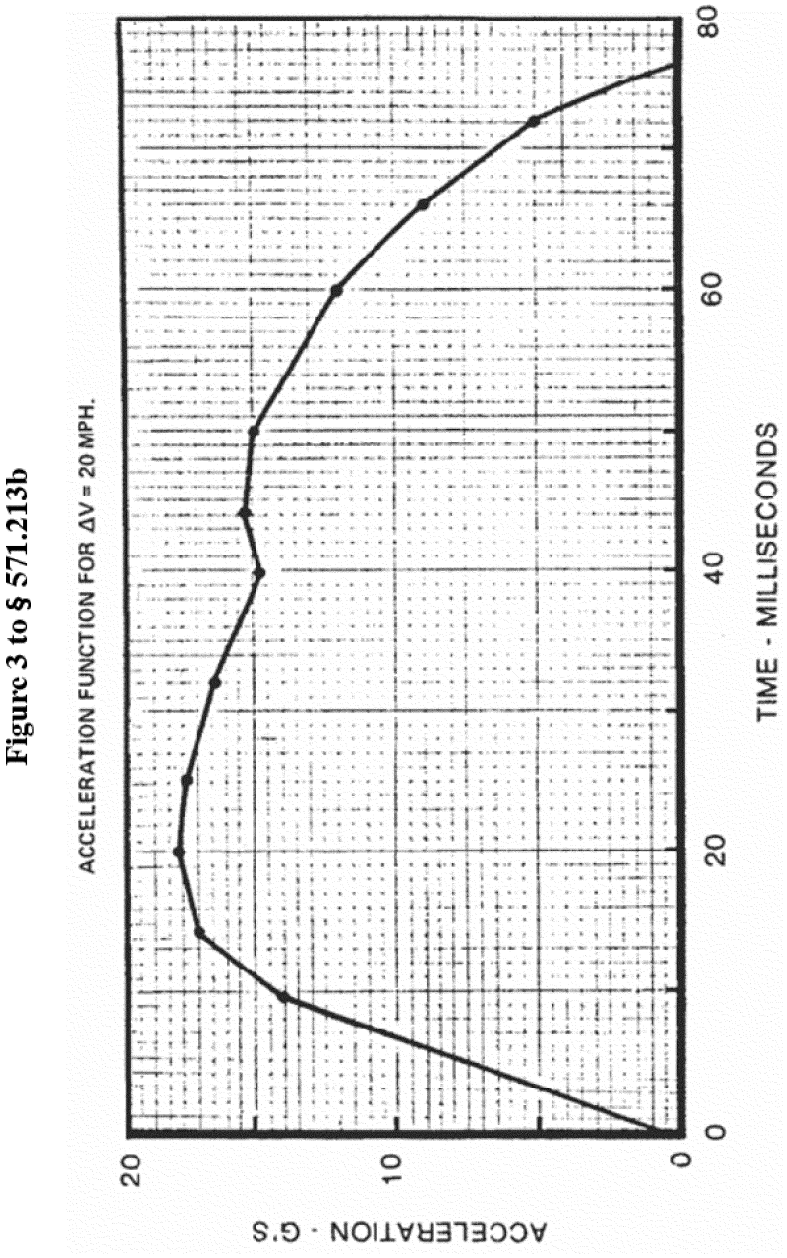


Figure 3 to § 571.213b

Figure 4 to §571.213b—Buckle Release Test

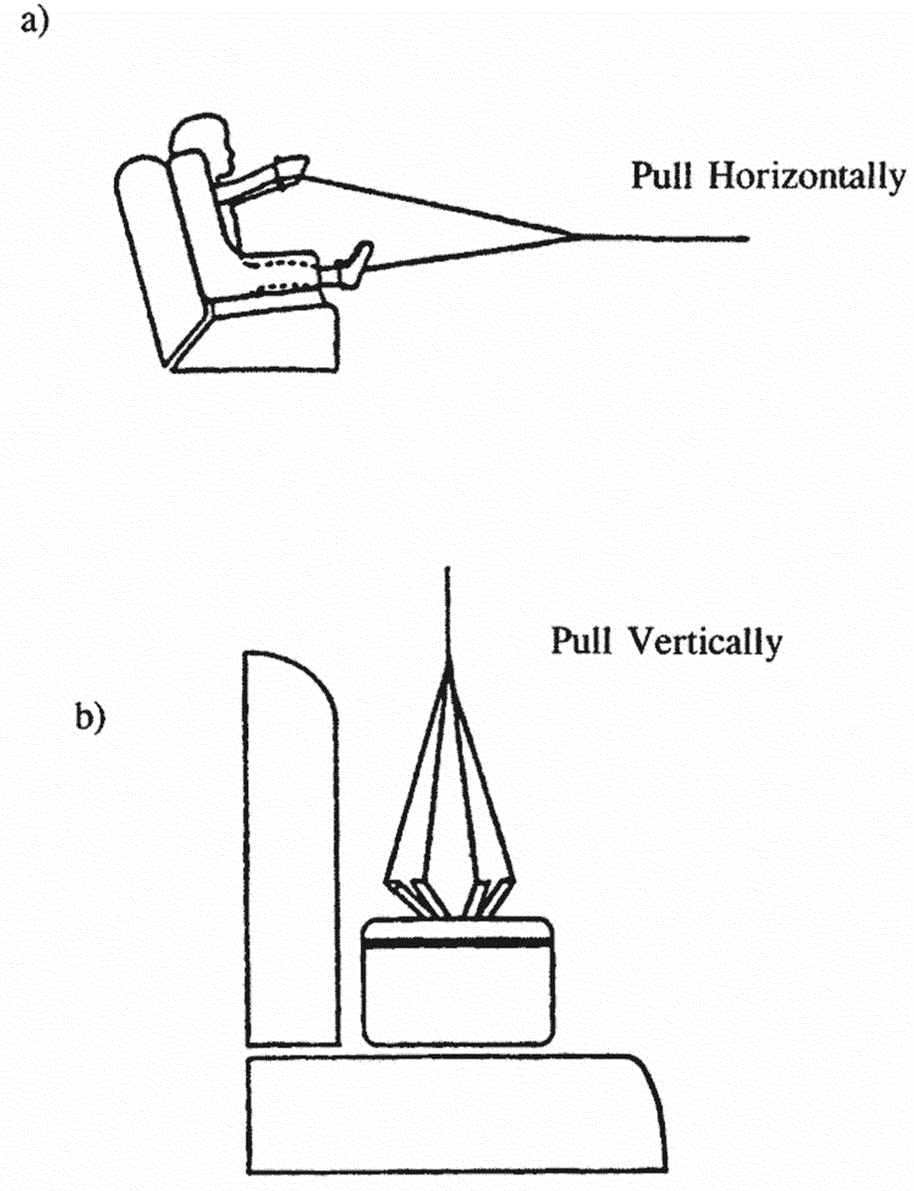
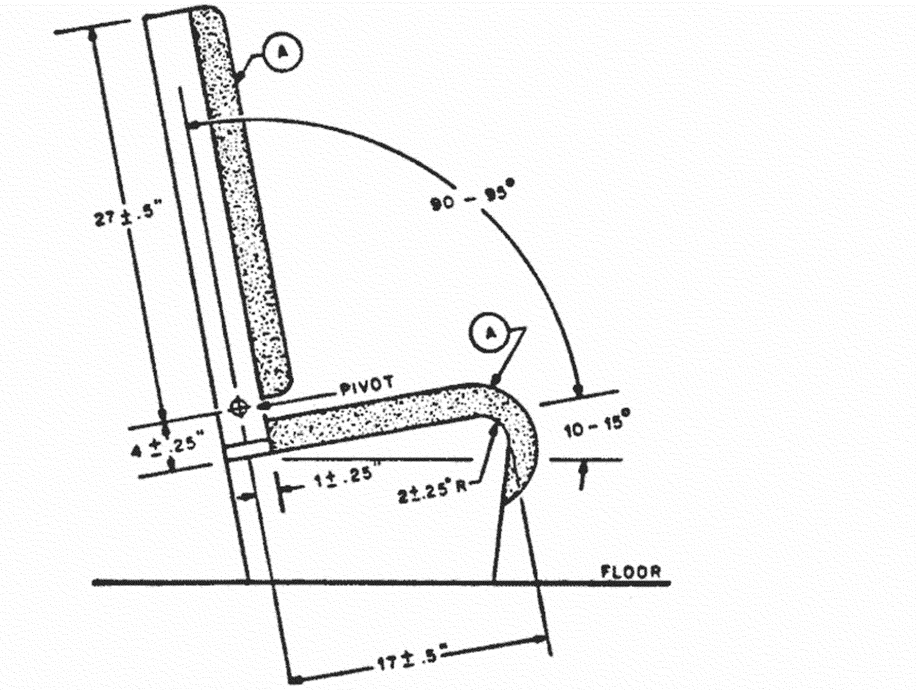


FIGURE 5 [RESERVED]

Figure 6 to §571.213b—Simulated Aircraft Passenger Seat

Figure 6 to § 571.213b -Simulated Aircraft Passenger Seat



"A" represents a 2- to 3-inch thick polyurethane foam pad, 1.5-2.0 pounds per cubic foot density, over 0.020-inch-thick aluminum pan, and covered by 12- to 14-ounce marine canvas. The sheet aluminum pan is 20 inches wide and supported on each side by a rigid structure. The seat back is a rectangular frame covered with the aluminum sheet and weighing between 14 and 15 pounds, with a center of mass 13 to 16 inches above the seat pivot axis. The mass moment of inertia of the seat back about the seat pivot axis is between 195 and 220 ounce-inch-second^2. The seat back is free to fold forward about the pivot, but a stop prevents rearward motion. The passenger safety belt anchor points are spaced 21 to 22 inches apart and are located in line with the seat pivot axis.

Figure 7 to §571.213b—Pre-Impact Buckle Release Force Test Set-up

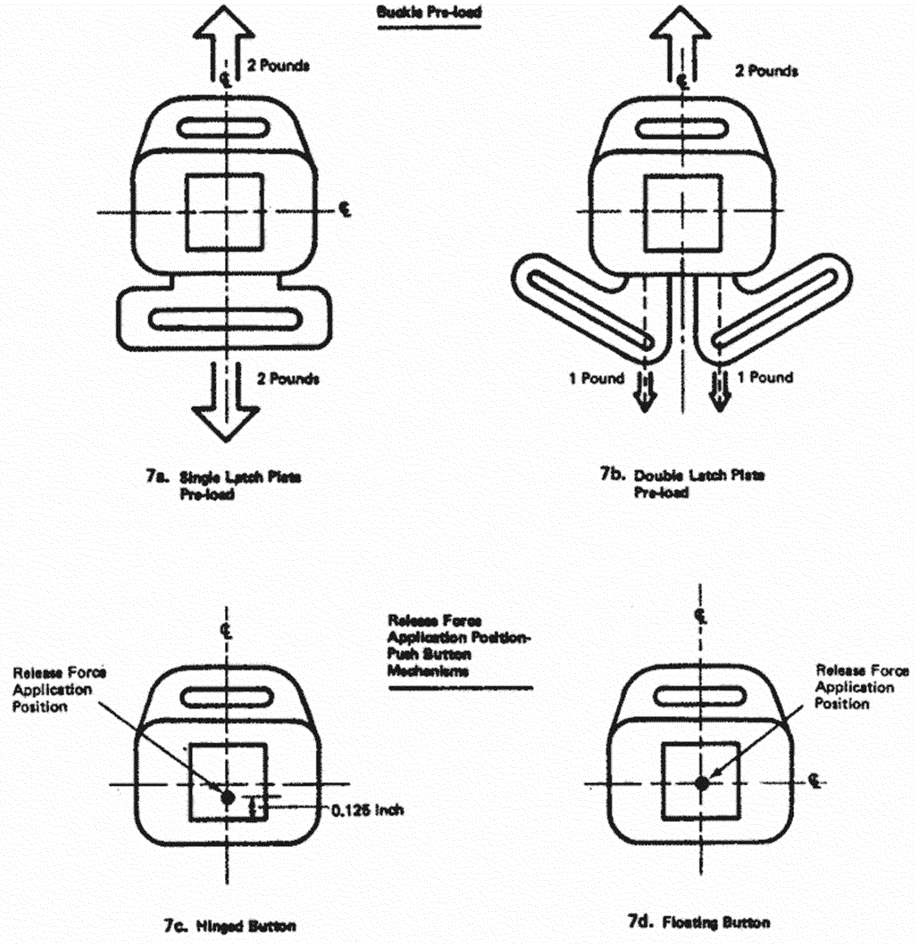


Figure 8 to §571.213b—Release Force Application Device-Push Button Release Buckles

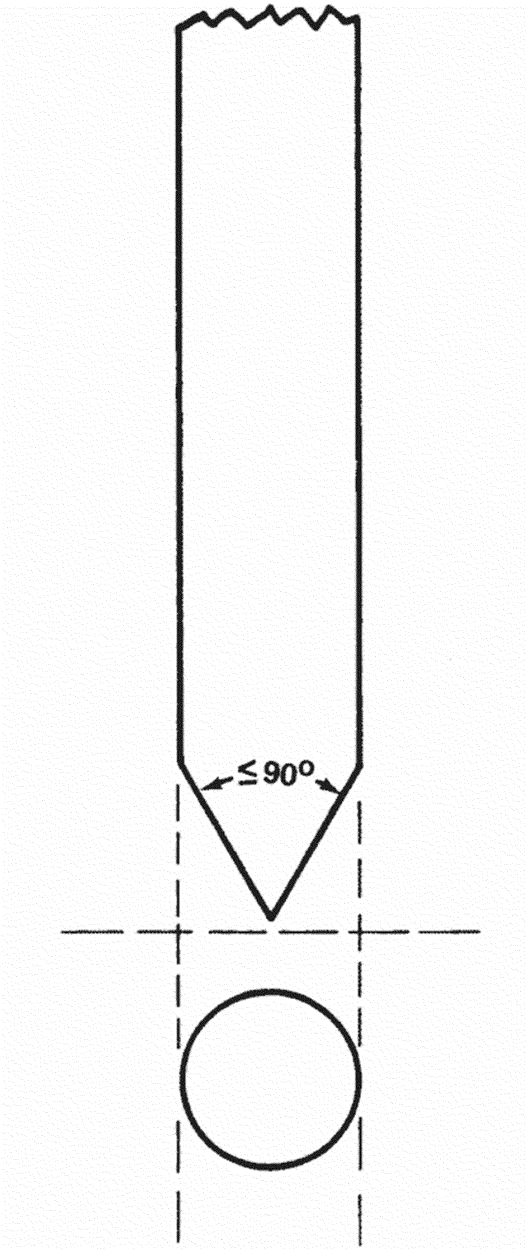


Figure 9a to § 571.213b—Registration Form for Child Restraint Systems—Product Identification Number and Purchaser Information Side

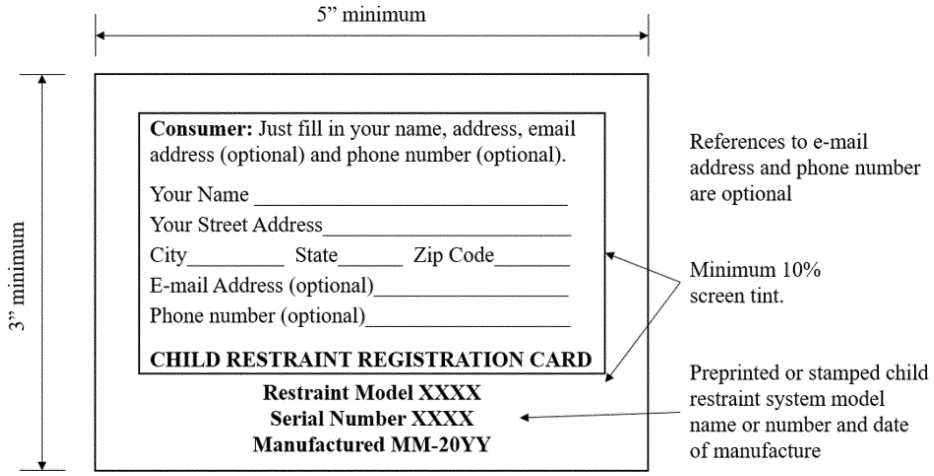


Figure 9b to § 571.213b—Registration Form for Child Restraint Systems—Address Side

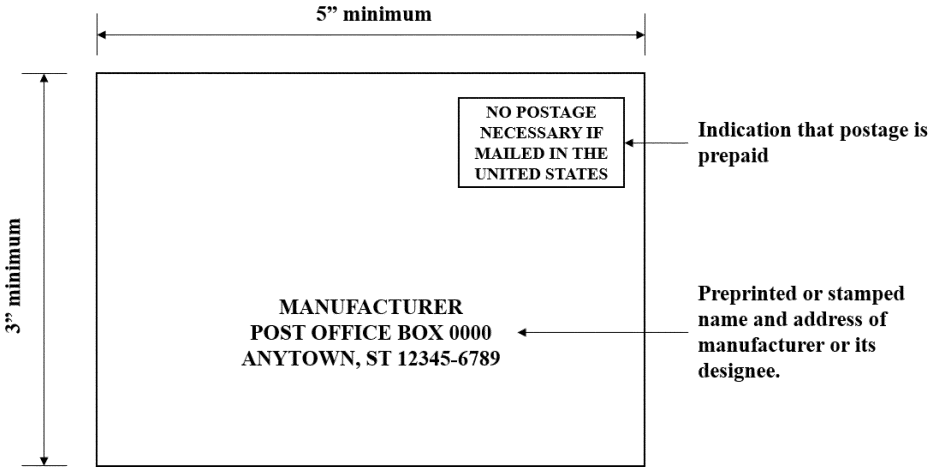
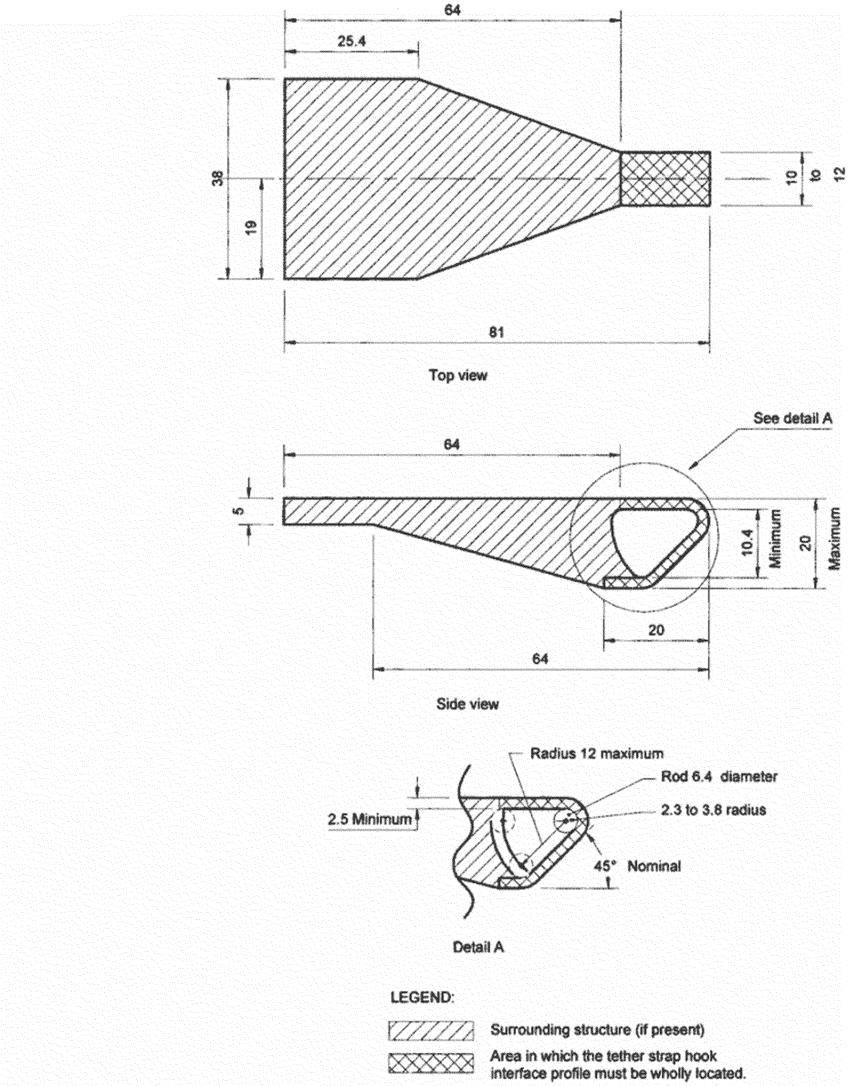


Figure 10 to §571.213b—Label on Child Seat Where Child's Head Rests



Figure 11 to §571.213b—Interface Profile of Tether Hook



Notes

1. Dimensions in mm, except where otherwise indicated
2. Drawing not to scale

Figure 12 to §571.213b—Label on Harness Component That Attaches to School Bus Seat Back

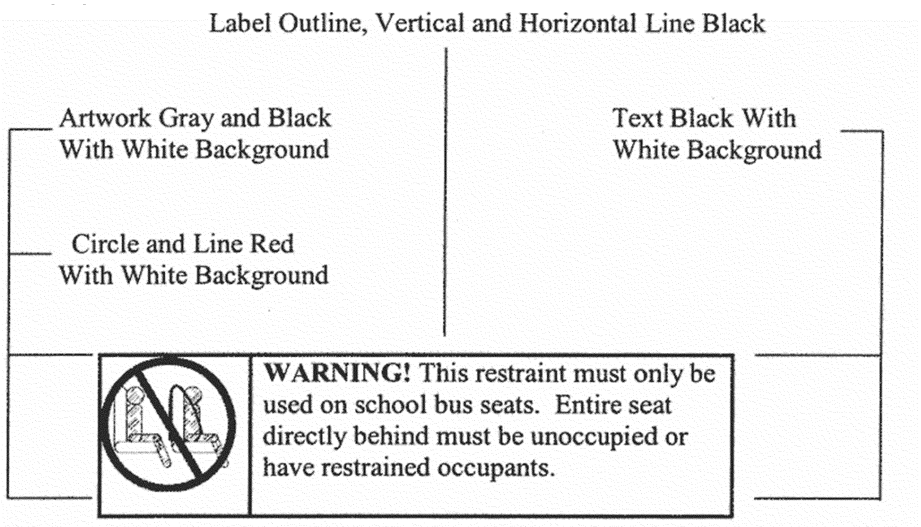


Figure 13 to §571.213b—Lap Shield

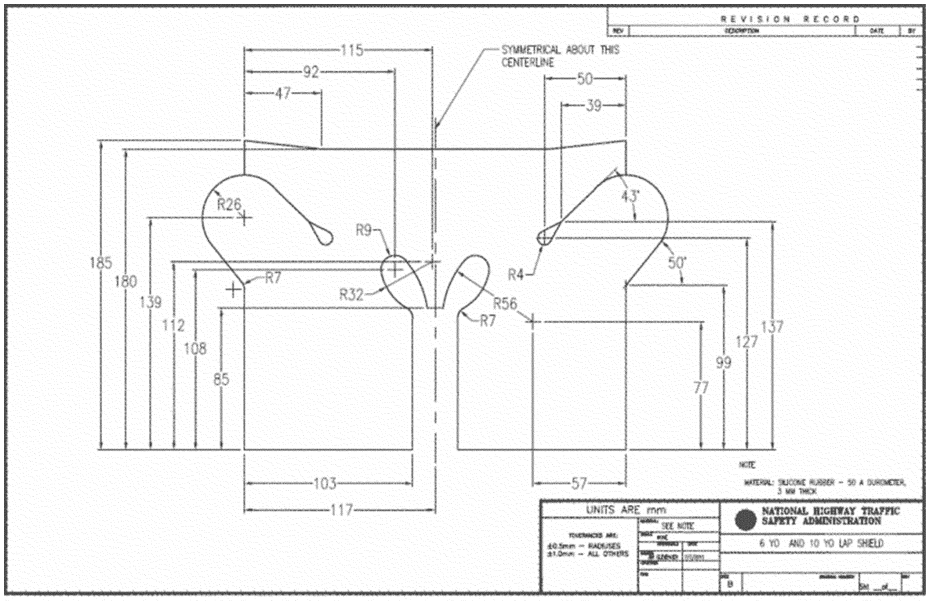


Figure 14a to § 571.213b—HIII–10C Dummy Neck Angle Setting is SP–16 Degrees

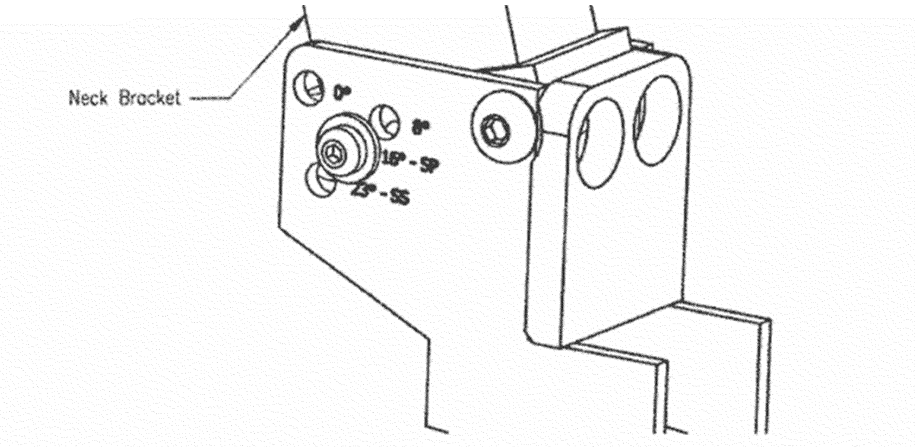


Figure 14b to § 571.213b—HIII–10C Dummy Lumbar Angle Setting is SP–12 Degrees

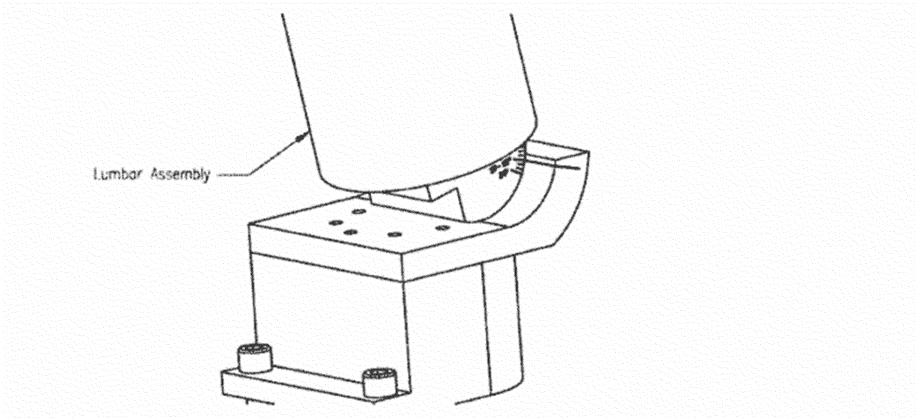
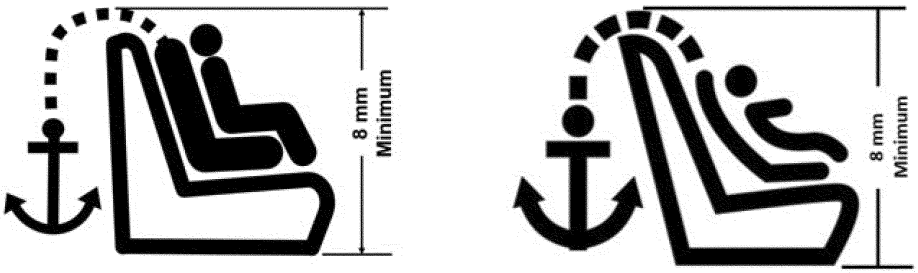


Figure 15 to §571.213b—Lower Anchorage Connector Symbol



Note 1 to Figure 15 to §571.213b: Drawing not to scale.
Note 2 to Figure 15 to §571.213b: Symbol may be shown in mirror image.
Note 3 to Figure 15 to §571.213b: Color of the symbol is at the option of the manufacturer.

Figure 16 to §571.213b—Tether Anchorage Connector Symbols



Note 1 to Figure 16 to §571.213b: Drawing not to scale.
Note 2 to Figure 16 to §571.213b: Symbol may be shown in mirror image.
Note 3 to Figure 16 to §571.213b: Color of the symbol is at the option of the manufacturer.
Note 4 to Figure 16 to §571.213b: Either symbol may be marked at the option of the manufacturer.

[88 FR 84591, Dec. 5, 2023, as amended at 89 FR 81846, Oct. 9, 2024; 90 FR 1341, Jan. 7, 2025; 90 FR 11031, Mar. 3, 2025]

§571.214 Standard No. 214; Side impact protection.

S1 *Scope and purpose.*

(a) *Scope.* This standard specifies performance requirements for protection of occupants in side impacts.

(b) *Purpose.* The purpose of this standard is to reduce the risk of serious and fatal injury to occupants of passenger cars, multipurpose passenger vehicles, trucks and buses in side impacts by specifying strength requirements for side doors, limiting the forces, deflections and accelerations measured on anthropomorphic dummies in test crashes, and by other means.

S2 *Applicability.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks designed to carry at least one person and buses with a gross vehicle weight rating (GVWR) of 4,536 kilograms (kg) (10,000 pounds (lb)) or less, except for walk-in vans, or otherwise specified.

S3 *Definitions.*

Contoured means, with respect to a door, that the lower portion of its front or rear edge is curved upward, typically to conform to a wheel well.

Double side doors means a pair of hinged doors with the lock and latch mechanisms located where the door lips overlap.

Limited line manufacturer means a manufacturer that sells three or fewer carlines, as that term is defined in 49 CFR 583.4, in the United States during a production year.

Lowered floor means the replacement floor on a motor vehicle whose original floor has been removed, in part or in total, and replaced by a floor that is lower than the original floor.

Modified roof means the replacement roof on a motor vehicle whose original roof has been removed, in part or in total.

Raised roof is used as defined in paragraph S4 of 49 CFR 571.216.

Walk-in van means a special cargo/mail delivery vehicle that has only one designated seating position. That designated seating position must be forward facing and for use only by the driver. The vehicle usually has a thin and light sliding (or folding) side door for easy operation and a high roof clearance that a person of medium stature can enter the passenger compartment area in an up-right position.

S4 *Requirements.* Subject to the exceptions of S5—

(a) *Passenger cars.* Passenger cars must meet the requirements set forth in S6 (door crush resistance), S7 (moving deformable barrier test), and S9 (vehicle-to-pole test), subject to the phased-in application of S7 and S9.

(b) *Multipurpose passenger vehicles, trucks and buses with a GVWR of 2,722 kg or less (6,000 lb or less).* Multipurpose passenger vehicles, trucks and buses with a GVWR of 2,722 kg or less (6,000 lb or less) must meet the requirements set forth in S6 (door crush resistance), S7 (moving deformable barrier test), and S9 (vehicle-to-pole test), subject to the phased-in application of S7 and S9.

(c) *Multipurpose passenger vehicles, trucks and buses with a GVWR greater than 2,722 kg (6,000 lb).* Multipurpose passenger vehicles, trucks and buses with a GVWR greater than 2,722 kg (6,000 lb) must meet the requirements set forth in S6 (door crush resistance) and S9 (vehicle-to-pole test), subject to the phased-in application of S9.

S5 *General exclusions.*

(a) *Exclusions from S6 (door crush resistance).* A vehicle need not meet the requirements of S6 (door crush resistance) for—

(1) Any side door located so that no point on a ten-inch horizontal longitudinal line passing through and bisected by the H-point of a manikin placed in any seat, with the seat adjusted to any position and the seat back adjusted as specified in S8.3, falls within the transverse, horizontal projection of the door's opening,

(2) Any side door located so that no point on a ten-inch horizontal longitudinal line passing through and bisected by the H–point of a manikin placed in any seat recommended by the manufacturer for installation in a location for which seat anchorage hardware is provided, with the seat adjusted to any position and the seat back adjusted as specified in S8.3, falls within the transverse, horizontal projection of the door's opening,

(3) Any side door located so that a portion of a seat, with the seat adjusted to any position and the seat back adjusted as specified in S8.3, falls within the transverse, horizontal projection of the door's opening, but a longitudinal vertical plane tangent to the outboard side of the seat cushion is more than 254 mm (10 inches) from the innermost point on the inside surface

of the door at a height between the H–point and shoulder reference point (as shown in Figure 1 of Federal Motor Vehicle Safety Standard No. 210 (49 CFR 571.210)) and longitudinally between the front edge of the cushion with the seat adjusted to its forwardmost position and the rear edge of the cushion with the seat adjusted to its rearmost position.

(4) Any side door that is designed to be easily attached to or removed (e.g., using simple hand tools such as pliers and/or a screwdriver) from a motor vehicle manufactured for operation without doors.

(b) *Exclusions from S7 (moving deformable barrier test).* The following vehicles are excluded from S7 (moving deformable barrier test):

(1) Motor homes, ambulances and other emergency rescue/medical vehicles (including vehicles with fire-fighting equipment), vehicles equipped with wheelchair lifts, and vehicles which have no doors or exclusively have doors that are designed to be easily attached or removed so the vehicle can be operated without doors.

(2) Passenger cars with a wheelbase greater than 130 inches need not meet the requirements of S7 as applied to the rear seat.

(3) Passenger cars, multipurpose passenger vehicles, trucks and buses need not meet the requirements of S7 (moving deformable barrier test) as applied to the rear seat for side-facing rear seats and for rear seating areas that are so small that a Part 572 Subpart V dummy representing a 5th percentile adult female cannot be accommodated according to the positioning procedure specified in S12.3.4 of this standard. Vehicles that are manufactured before September 1, 2010, and vehicles that manufactured on or after September 1, 2010, that are not part of the percentage of a manufacturer's production meeting the moving deformable barrier test requirements with advanced test dummies (S7.2 of this section) or are otherwise excluded from the phase-in requirements of S7.2, need not meet the requirements of the moving deformable barrier test as applied to the rear seat for rear seating areas that are so small that a Subpart F dummy (SID) cannot be accommodated according to the positioning procedure specified in S12.1 of this standard.

(4) Multipurpose passenger vehicles, trucks and buses with a GVWR of more than 2,722 kg (6,000 lb) need not meet the requirements of S7 (moving deformable barrier test).

(c) *Exclusions from S9 (vehicle-to-pole test).* The following vehicles are excluded from S9 (vehicle-to-pole test) (wholly or in limited part, as set forth below):

(1) Motor homes;

(2) Ambulances and other emergency rescue/medical vehicles (including vehicles with fire-fighting equipment) except police cars;

(3) Vehicles with a lowered floor or raised or modified roof and vehicles that have had the original roof rails removed and not replaced;

(4) Vehicles in which the seat for the driver or any front outboard passenger has been removed and wheelchair restraints installed in place of the seat are excluded from meeting the vehicle-to-pole test at that position; and

(5) Vehicles that have no doors, or exclusively have doors that are designed to be easily attached or removed so that the vehicle can be operated without doors.

S6 *Door Crush Resistance Requirements.* Except as provided in section S5, each vehicle shall be able to meet the requirements of either, at the manufacturer's option, S6.1 or S6.2, when any of its side doors that can be used for occupant egress is tested according to procedures described in S6.3 of this standard (49 CFR 571.214).

S6.1 With any seats that may affect load upon or deflection of the side of the vehicle removed from the vehicle, each vehicle must be able to meet the requirements of S6.1.1 through S6.1.3.

S6.1.1 Initial crush resistance. The initial crush resistance shall not be less than 10,000 N (2,250 lb).

S6.1.2 Intermediate crush resistance. The intermediate crush resistance shall not be less than 15,569 N (3,500 lb).

S6.1.3 *Peak crush resistance.* The peak crush resistance shall not be less than two times the curb weight of the vehicle or 31,138 N (7,000 lb), whichever is less.

S6.2 With seats installed in the vehicle, and located in any horizontal or vertical position to which they can be adjusted and at any seat back angle to which they can be adjusted, each vehicle must be able to meet the requirements of S6.2.1 through S6.2.3.

S6.2.1 Initial crush resistance. The initial crush resistance shall not be less than 10,000 N (2,250 lb).

S6.2.2 Intermediate crush resistance. The intermediate crush resistance shall not be less than 19,460 N (4,375 lb).

S6.2.3 Peak crush resistance. The peak crush resistance shall not be less than three and one half times the curb weight of the vehicle or 53,378 N (12,000 lb), whichever is less.

S6.3 *Test procedures for door crush resistance.* The following procedures apply to determining compliance with S6.1 and S6.2 of S6, *Door crush resistance requirements.*

(a) Place side windows in their uppermost position and all doors in locked position. Place the sill of the side of the vehicle opposite to the side being tested against a rigid unyielding vertical surface. Fix the vehicle rigidly in position by means of tiedown attachments located at or forward of the front wheel centerline and at or rearward of the rear wheel centerline.

(b) Prepare a loading device consisting of a rigid steel cylinder or semicylinder 305 mm (12 inches) in diameter with an edge radius of 13 mm (½ inch). The length of the loading device shall be such that—

(1) For doors with windows, the top surface of the loading device is at least 13 mm (½ inch) above the bottom edge of the door window opening but not of a length that will cause contact with any structure above the bottom edge of the door window opening during the test.

(2) For doors without windows, the top surface of the loading device is at the same height above the ground as when the loading device is positioned in accordance with paragraph (b)(1) of this section for purposes of testing a front door with windows on the same vehicle.

(c) Locate the loading device as shown in Figure 1 (side view) of this section so that—

(1) Its longitudinal axis is vertical.

(2) Except as provided in paragraphs (c)(2)(i) and (ii) of this section, its longitudinal axis is laterally opposite the midpoint of a horizontal line drawn across the outer surface of the door 127 mm (5 inches) above the lowest point of the door, exclusive of any decorative or protective molding that is not permanently affixed to the door panel.

(i) For contoured doors on trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lb) or less, if the length of the horizontal line specified in this paragraph (c)(2) is not equal to or greater than 559 mm (22 inches), the line is moved vertically up the side of the door to the point at which the line is 559 mm (22 inches) long. The longitudinal axis of the loading device is then located laterally opposite the midpoint of that line.

(ii) For double side doors on trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lb) or less, its longitudinal axis is laterally opposite the midpoint of a horizontal line drawn across the outer surface of the double door span, 127 mm (5 inches) above the lowest point on the doors, exclusive of any decorative or protective molding that is not permanently affixed to the door panel.

(3) Except as provided in paragraphs (c)(3)(i) and (ii) of this section, its bottom surface is in the same horizontal plane as the horizontal line drawn across the outer surface of the door 127 mm (5 inches) above the lowest point of the door, exclusive of any decorative or protective molding that is not permanently affixed to the door panel.

(i) For contoured doors on trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lb) or less, its bottom surface is in the lowest horizontal plane such that every point on the lateral projection of the bottom surface of the device on the door is at least 127 mm (5 inches), horizontally and vertically, from any edge of the door panel, exclusive of any decorative or protective molding that is not permanently affixed to the door panel.

(ii) For double side doors, its bottom surface is in the same horizontal plane as a horizontal line drawn across the

outer surface of the double door span, 127 mm (5 inches) above the lowest point of the doors, exclusive of any decorative or protective molding that is not permanently affixed to the door panel.

(d) Using the loading device, apply a load to the outer surface of the door in an inboard direction normal to a vertical plane along the vehicle's longitudinal centerline. Apply the load continuously such that the loading device travel rate does not exceed 12.7 mm (0.5 inch) per second until the loading device travels 457 mm (18 inches). Guide the loading device to prevent it from being rotated or displaced from its direction of travel. The test is completed within 120 seconds.

(e) Record applied load versus displacement of the loading device, either continuously or in increments of not more than 25.4 mm (1 inch) or 91 kg (200 pounds) for the entire crush distance of 457 mm (18 inches).

(f) Determine the initial crush resistance, intermediate crush resistance, and peak crush resistance as follows:

(1) From the results recorded in paragraph (e) of this section, plot a curve of load versus displacement and obtain the integral of the applied load with respect to the crush distances specified in paragraphs (f)(2) and (3) of this section. These quantities, expressed in mm-kN (inch-pounds) and divided by the specified crush distances, represent the average forces in kN (pounds) required to deflect the door those distances.

(2) The initial crush resistance is the average force required to deform the door over the initial 152 mm (6 inches) of crush.

(3) The intermediate crush resistance is the average force required to deform the door over the initial 305 mm (12 inches) of crush.

(4) The peak crush resistance is the largest force recorded over the entire 457 mm (18-inch) crush distance.

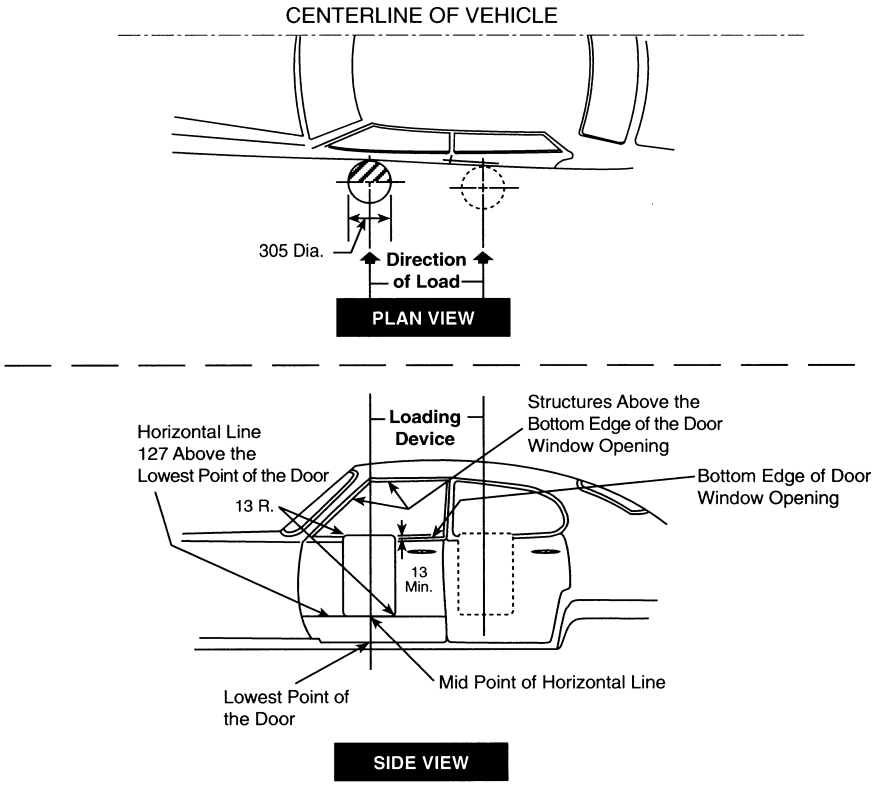


Figure 1—LOADING DEVICE LOCATION AND APPLICATION TO THE DOOR
All dimensions in millimeters (mm)

S7 *Moving Deformable Barrier (MDB) Requirements.* Except as provided in section S5, when tested under the conditions of S8 each vehicle shall meet S7.3 and the following requirements in a 53 ±1.0 km/h (33.5 mph) impact in which the vehicle is struck on either side by a moving deformable barrier.

S7.1 *MDB test with SID.* For vehicles manufactured before September 1, 2010, the following requirements must be met. The following requirements also apply to vehicles manufactured on or after September 1, 2010 that are not part of the percentage of a manufacturer's production meeting the MDB test with advanced test dummies (S7.2 of this section) or are otherwise excluded from the phase-in requirements of S7.2. (Vehicles manufactured before September 1, 2010 may meet S7.2, at the manufacturer's option.)

S7.1.1 The test dummy specified in 49 CFR Part 572 Subpart F (SID) is placed in the front and rear outboard seating positions on the struck side of the vehicle, as specified in S11 and S12 of this standard (49 CFR 571.214).

S7.1.2 When using the Part 572 Subpart F dummy (SID), the following performance requirements must be met.

(a) *Thorax.* The Thoracic Trauma Index (TTI(d)) shall not exceed:

(1) 85 g for a passenger car with four side doors, and for any multipurpose passenger vehicle, truck, or bus; and,

(2) 90 g for a passenger car with two side doors, when calculated in accordance with the following formula:

$TI(d) = \frac{1}{2}(G_R + G_{LS})$

Where the term "G_R" is the greater of the peak accelerations of either the upper or lower rib, expressed in g's and the term "G_{LS}" is the lower spine (T12) peak acceleration, expressed in g's. The peak acceleration values are obtained in accordance with the procedure specified in S11.5.

(b) *Pelvis.* The peak lateral acceleration of the pelvis, as measured in accordance with S11.5, shall not exceed 130 g's.

S7.2 *MDB test with advanced test dummies.*

S7.2.1 *Vehicles manufactured on or after September 1, 2010 to August 31, 2014.*

(a) Except as provided in S7.2.4 of this section, for vehicles manufactured on or after September 1, 2010 to August 31, 2014, a percentage of each manufacturer's production, as specified in S13.1.1, S13.1.2, S13.1.3, and S13.1.4, shall meet the requirements of S7.2.5 and S7.2.6 when tested with the test dummy specified in those sections. Vehicles manufactured before September 1, 2014 may be certified as meeting the requirements of S7.2.5 and S7.2.6.

(b) For vehicles manufactured on or after September 1, 2010 that are not part of the percentage of a manufacturer's production meeting S7.2.1 of this section, the requirements of S7.1 of this section must be met.

(c) Place the Subpart U ES–2re 50th percentile male dummy in the front seat and the Subpart V SID–IIs 5th percentile female test dummy in the rear seat. The test dummies are placed and positioned in the front and rear outboard seating positions on the struck side of the vehicle, as specified in S11 and S12 of this standard (49 CFR 571.214).

S7.2.2 *Vehicles manufactured on or after September 1, 2014.*

(a) Subject to S7.2.4 of this section, each vehicle manufactured on or after September 1, 2014 must meet the requirements of S7.2.5 and S7.2.6, when tested with the test dummy specified in those sections.

(b) Place the Subpart U ES–2re 50th percentile male dummy in the front seat and the Subpart V SID–IIs 5th percentile female test dummy in the rear seat. The test dummies are placed and positioned in the front and rear outboard seating positions on the struck side of the vehicle, as specified in S11 and S12 of this standard (49 CFR 571.214).

S7.2.3 [Reserved]

S7.2.4 *Exceptions from the MDB phase-in; special allowances.*

(a)(1) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to S7.2.1 of this section (but vehicles that will be manufactured on or after September 1, 2014 are subject to S7.2.2);

(2) Vehicles that are manufactured by a limited line manufacturer are not subject to S7.2.1 of this section (but vehicles that will be manufactured on or after September 1, 2014 are subject to S7.2.2).

(3) Convertibles manufactured before September 1, 2015, are not subject to S7.2.1 or S7.2.2 of this section. These vehicles may be voluntarily certified to meet the MDB test requirements prior to September 1, 2015. Vehicles manufactured on or after September 1, 2015 are subject to S7 and S7.2.2.

(b) Vehicles that are altered (within the meaning of 49 CFR 567.7) before September 1, 2016 after having been previously certified in accordance with part 567 of this chapter, and vehicles manufactured in two or more stages before September 1, 2016, are not subject to S7.2.1. Vehicles that are altered on or after September 1, 2016, and vehicles that are manufactured in two or more stages on or after September 1, 2016, must meet the requirements of S7.2.5 and S7.2.6, when tested with the test dummy specified in those sections. Place the Subpart U ES–2re 50th percentile male dummy in the front seat and the Subpart V SID-IIs 5th percentile female test dummy in the rear seat. The test dummies are placed and positioned in the front and rear outboard seating positions on the struck side of the vehicle, as specified in S11 and S12 of this standard (49 CFR 571.214).

S7.2.5 *Dynamic performance requirements using the Part 572 Subpart U dummy (ES–2re 50th percentile male) dummy.* Use the 49 CFR Part 572 Subpart U ES–2re dummy specified in S11 with measurements in accordance with

S11.5. The following criteria shall be met:

(a) The HIC shall not exceed 1000 when calculated in accordance with the following formula:

$$HIC = [\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} adt]^{2.5}(t_2 - t_1)$$

Where the term *a* is the resultant head acceleration at the center of gravity of the dummy head expressed as a multiple of *g* (the acceleration of gravity), and t1 and t2 are any two points in time during the impact which are separated by not more than a 36 millisecond time interval and where t1 is less than t2.

(b) Thorax. The deflection of any of the upper, middle, and lower ribs, shall not exceed 44 mm (1.73 inches).

(c) Force measurements.

(1) The sum of the front, middle and rear abdominal forces, shall not exceed 2,500 N (562 lb).

(2) The pubic symphysis force shall not exceed 6,000 N (1,350 pounds).

S7.2.6 *Dynamic performance requirements using the Part 572 Subpart V SID–IIs (5th percentile female) dummy*. Use the 49 CFR Part 572 Subpart V SID–IIs 5th percentile female dummy specified in S11 with measurements in accordance with S11.5. The following criteria shall be met:

(a) The HIC shall not exceed 1000 when calculated in accordance with the following formula:

$$HIC = [\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} adt]^{2.5}(t_2 - t_1)$$

Where the term *a* is the resultant head acceleration expressed as a multiple of *g* (the acceleration of gravity), and t1 and t2 are any two points in time during the impact which are separated by not more than a 36 millisecond time interval.

(b) The resultant lower spine acceleration shall not exceed 82 g.

(c) The sum of the acetabular and iliac pelvic forces shall not exceed 5,525 N.

S7.3 *Door opening.*

(a) Any side door that is struck by the moving deformable barrier shall not separate totally from the vehicle.

(b) Any door (including a rear hatchback or tailgate) that is not struck by the moving deformable barrier shall meet the following requirements:

(1) The door shall not disengage from the latched position;

(2) The latch shall not separate from the striker, and the hinge components shall not separate from each other or from their attachment to the vehicle.

(3) Neither the latch nor the hinge systems of the door shall pull out of their anchorages.

S8 *Test conditions for determining compliance with moving deformable barrier requirements.* General test conditions for determining compliance with the moving deformable barrier test are specified below. Additional specifications may also be found in S12 of this standard (49 CFR 571.214).

S8.1 *Test weight.* Each vehicle is loaded to its unloaded vehicle weight, plus 136 kg (300 pounds) or its rated cargo and luggage capacity (whichever is less), secured in the luggage or load-carrying area, plus the weight of the necessary anthropomorphic test dummies. Any added test equipment is located away from impact areas in secure places in the vehicle. The vehicle's fuel system is filled in accordance with the following procedure. With the test vehicle on a level surface, pump the fuel from the vehicle's fuel tank and then operate the engine until it stops. Then, add Stoddard solvent to the test vehicle's fuel tank in an amount that is equal to not less than 92 percent and not more than 94 percent of the fuel tank's usable capacity stated by the vehicle's manufacturer. In addition, add the amount of Stoddard solvent needed to fill the entire fuel system from the fuel tank through the engine's induction system.

S8.2 *Vehicle test attitude.* Determine the distance between a level surface and a standard reference point on the test vehicle's body, directly above each wheel opening, when the vehicle is in its fully loaded condition at the test site, with all tires inflated to the manufacturer's specifications listed on the vehicle's tire placard, and with the vehicle filled to 100 percent of all fluid capacities. The ''fully loaded condition'' is the test vehicle loaded in accordance with S8.1 of this standard (49 CFR 571.214). The load placed in the

cargo area is centered over the longitudinal centerline of the vehicle. The pretest vehicle attitude is equal to the fully loaded attitude ± 10 mm.

S8.3 *Adjustable seats.*

S8.3.1 *50th Percentile Male ES–2re Dummy (49 CFR Part 572 Subpart U) In Front Seats*

S8.3.1.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S8.3.1.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or non-deployed adjustment position. Position any adjustable head restraint in the highest and most forward position. Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer. If the position is not specified, set the seat back at the first detent rearward of 25° from the vertical.

S8.3.1.3 *Seat position adjustment.* If the driver and any front outboard passenger seats do not adjust independently of each other, the struck side seat shall control the final position of the non-struck side seat. If the driver and any front outboard passenger seats adjust independently of each other, adjust both the struck and non-struck side seats in the manner specified in S8.3.1.

S8.3.1.3.1 Using only the controls that primarily move the seat and seat cushion independent of the seat back in the fore and aft directions, move the seat cushion reference point (SCRP) to the rearmost position. Using any part of any control, other than those just used, determine the full range of angles of the seat cushion reference line and set the seat cushion reference line to the middle of the range. Using any part of any control other than those that primarily move the seat or seat cushion fore and aft, while maintaining the seat cushion reference line angle, place the SCRP to its lowest position.

S8.3.1.3.2 Using only the control that primarily moves the seat fore and aft, move the seat cushion reference point to the mid travel position. If an adjustment position does not exist midway between the forwardmost and rearmost positions, the closest adjustment position to the rear of the midpoint is used.

S8.3.1.3.3 If the seat or seat cushion height is adjustable, other than by the controls that primarily move the seat or seat cushion fore and aft, set the height of the seat cushion reference point to the minimum height, with the seat cushion reference line angle set as closely as possible to the angle determined in S8.3.1.3.1. Mark location of the seat for future reference.

S8.3.2 *50th Percentile Male SID Dummy (49 CFR Part 572 Subpart F) in Front and Rear Seats*

S8.3.2.1 *Adjustable seats.* Adjustable seats are placed in the adjustment position midway between the forward most and rearmost positions, and if separately adjustable in a vertical direction, are at the lowest position. If an adjustment position does not exist midway between the forward most and rearmost positions, the closest adjustment position to the rear of the midpoint is used.

S8.3.2.2 *Adjustable seat back placement.* Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer. If the position is not specified, set the seat back at the first detent rearward of 25° from the vertical. Place each adjustable head restraint in its highest adjustment position. Position adjustable lumbar supports so that they are set in their released, i.e., full back position.

S8.3.3 *5th Percentile Female Dummy in Second Row Seat.*

S8.3.3.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S8.3.3.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or non-deployed adjustment position. Position any adjustable head restraint in the lowest and most forward in-use position. If it is possible to achieve a position lower than the effective detent range, the head restraint should be set to its lowest possible position. A non-use position as specified by S4.4 of FMVSS No.

202a, is excluded from being considered as the lowest possible position.

S8.3.3.3 *Seat position adjustment.* Using only the controls that primarily move the seat and seat cushion independent of the seat back in the fore and aft directions, move the seat cushion reference point (SCRP) to the rearmost position. Using any part of any control, other than those just used, determine the full range of angles of the seat cushion reference line and set the seat cushion reference line to the middle of the range. Using any part of any control other than those that primarily move the seat or seat cushion fore and aft, while maintaining the seat cushion reference line angle, place the SCRP to its lowest position. Mark location of the seat for future reference. If the non-struck side seat adjusts independently of the struck side seat, adjust the seat in the manner specified in this section.

S8.4 *Adjustable steering controls.* Adjustable steering controls are adjusted so that the steering control hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If there is no setting detent in the mid-position, lower the steering control to the detent just below the mid-position. If the steering column is telescoping, place the steering column in the mid-position. If there is no mid-position, move the steering control rearward one position from the mid-position.

S8.5 *Windows and sunroofs.* Movable vehicle windows and vents are placed in the fully closed position on the struck side of the vehicle. Any sunroof shall be placed in the fully closed position.

S8.6 *Convertible tops.* Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S8.7 *Doors.* Doors, including any rear hatchback or tailgate, are fully closed and latched but not locked.

S8.8 *Transmission and brake engagement.* For a vehicle equipped with a manual transmission, the transmission is placed in second gear. For a vehicle equipped with an automatic transmission, the transmission is placed in neutral. For all vehicles, the parking brake is engaged.

S8.9 *Moving deformable barrier.* The moving deformable barrier conforms to the dimensions shown in Figure 2 and specified in 49 CFR Part 587.

S8.10 *Impact configuration.* The test vehicle (vehicle A in Figure 3) is stationary. The line of forward motion of the moving deformable barrier (vehicle B in Figure 3) forms an angle of 63 degrees with the centerline of the test vehicle. The longitudinal centerline of the moving deformable barrier is perpendicular to the longitudinal centerline of the test vehicle when the barrier strikes the test vehicle. In a test in which the test vehicle is to be struck on its left (right) side: All wheels of the moving deformable barrier are positioned at an angle of 27 ±1 degrees to the right (left) of the centerline of the moving deformable barrier; and the left (right) forward edge of the moving deformable barrier is aligned so that a longitudinal plane tangent to that side passes through the impact reference line within a tolerance of ±51 mm (2 inches) when the barrier strikes the test vehicle.

S8.11 *Impact reference line.* Place a vertical reference line at the location described below on the side of the vehicle that will be struck by the moving deformable barrier.

S8.11.1 *Passenger cars.*

(a) For vehicles with a wheelbase of 2,896 mm (114 inches) or less, 940 mm (37 inches) forward of the center of the vehicle's wheelbase.

(b) For vehicles with a wheelbase greater than 2,896 mm (114 inches), 508 mm (20 inches) rearward of the centerline of the vehicle's front axle.

S8.11.2 *Multipurpose passenger vehicles, trucks and buses.*

(a) For vehicles with a wheelbase of 2,489 mm (98 inches) or less, 305 mm (12 inches) rearward of the centerline of the vehicle's front axle, except as otherwise specified in paragraph (d) of this section.

(b) For vehicles with a wheelbase of greater than 2,489 mm (98 inches) but not greater than 2,896 mm (114 inches), 940 mm (37 inches) forward of the center of the vehicle's wheelbase, except as otherwise specified in paragraph (d) of this section.

(c) For vehicles with a wheelbase greater than 2,896 mm (114 inches), 508

mm (20 inches) rearward of the centerline of the vehicle's front axle, except as otherwise specified in paragraph (d) of this section.

(d) At the manufacturer's option, for different wheelbase versions of the same model vehicle, the impact reference line may be located by the following:

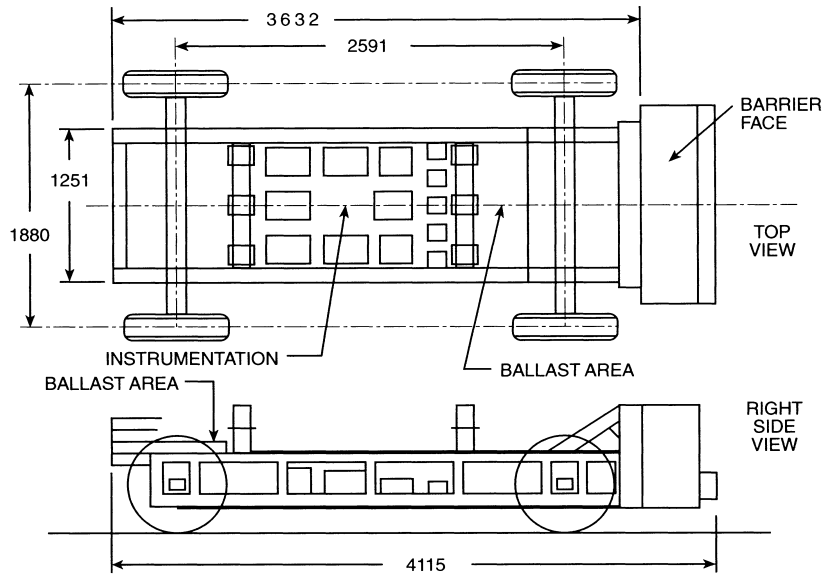
(1) Select the shortest wheelbase vehicle of the different wheelbase versions of the same model and locate on it the impact reference line at the location described in (a), (b) or (c) of this section, as appropriate;

(2) Measure the distance between the seating reference point (SgRP) and the impact reference line;

(3) Maintain the same distance between the SgRP and the impact reference line for the version being tested as that between the SgRP and the impact reference line for the shortest wheelbase version of the model.

(e) For the compliance test, the impact reference line will be located using the procedure used by the manufacturer as the basis for its certification of compliance with the requirements of this standard. If the manufacturer did not use any of the procedures in this section, or does not specify a procedure when asked by the agency, the agency may locate the impact reference line using either procedure.

S8.12 *Anthropomorphic test dummies.* The anthropomorphic test dummies used to evaluate a vehicle's performance in the moving deformable barrier test conform to the requirements of S11 and are positioned as described in S12 of this standard (49 CFR 571.214).



NHTSA VEHICLE SIMULATOR
All dimensions in millimeters (mm)

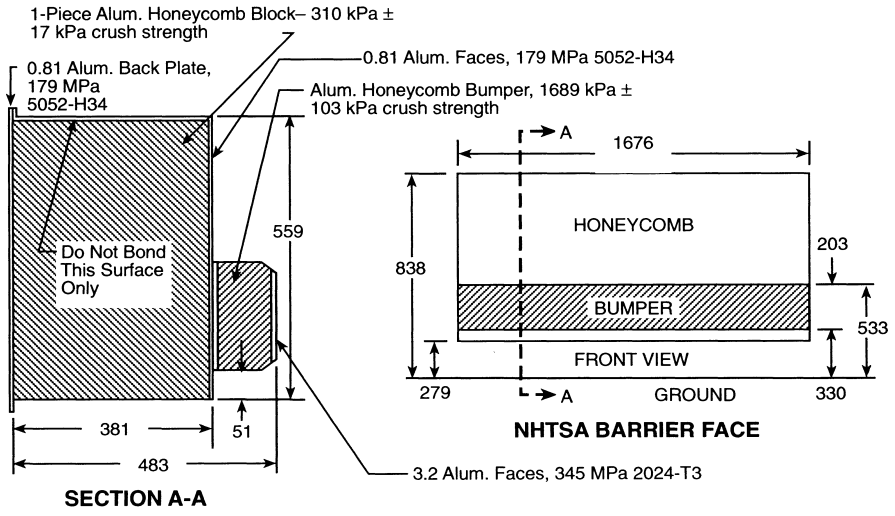


Figure 2—NHTSA SIDE IMPACTOR – MOVING DEFORMABLE BARRIER
All dimensions in millimeters (mm)

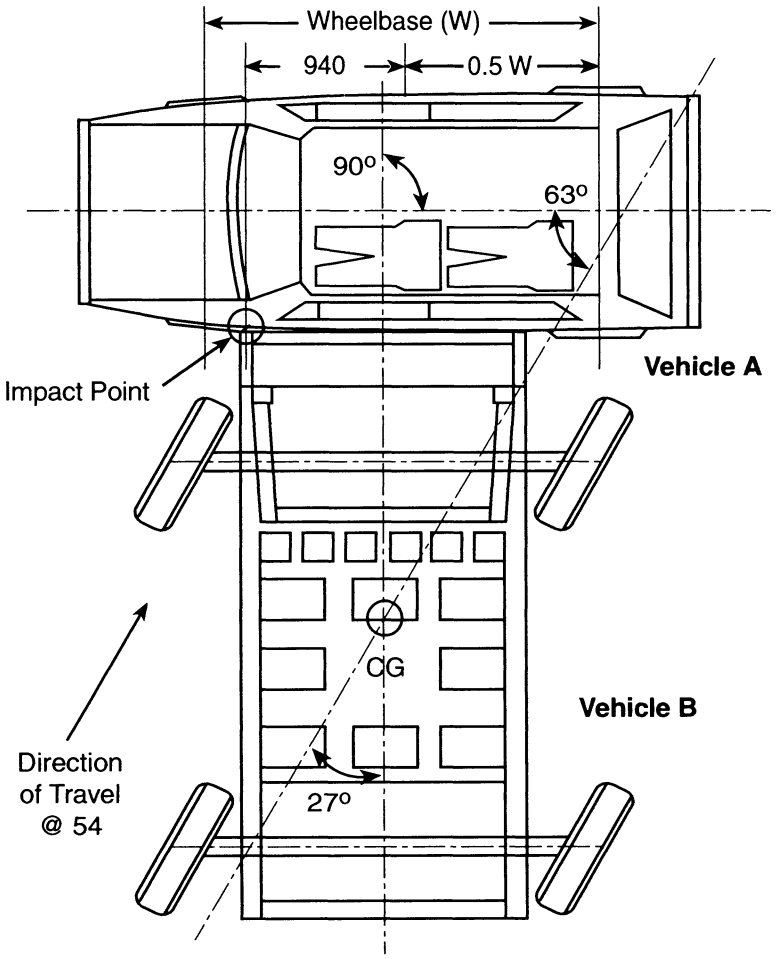


Figure 3—TEST CONFIGURATION
All dimensions in millimeters (mm)
velocity in km/h

S9. *Vehicle-To-Pole Requirements.*

S9.1 Except as provided in S5, when tested under the conditions of S10:

S9.1.1 Except as provided in S9.1.3 of this section, for vehicles manufactured on or after September 1, 2010 to August 31, 2014, a percentage of each manufacturer's production, as specified in S13.1.1, S13.1.2, S13.1.3, and S13.1.4 shall meet the requirements of S9.2.1, S9.2.2, and S9.2.3 when tested under the conditions of S10 into a fixed, rigid pole of 254 mm (10 inches) in diameter, at any velocity between 26 km/h to 32 km/h (16 to 20 mph) inclusive. Vehicles manufactured before September 1, 2014 that are

not subject to the phase-in may be certified as meeting the requirements specified in this section.

S9.1.2 Except as provided in S9.1.3 of this section, each vehicle manufactured on or after September 1, 2014, must meet the requirements of S9.2.1, S9.2.2 and S9.2.3, when tested under the conditions specified in S10 into a fixed, rigid pole of 254 mm (10 inches) in diameter, at any speed up to and including 32 km/h (20 mph). All vehicles manufactured on or after September 1, 2014 must meet S9.1.2 without the use of advance credits.

S9.1.3 *Exceptions from the phase-in; special allowances.*

(a)(1) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to S9.1.1 of this section (but vehicles manufactured on or after September 1, 2014 by these manufacturers are subject to S9.1.2);

(2) Vehicles that are manufactured by a limited line manufacturer are not subject to S9.1.1 of this section (but vehicles manufactured on or after September 1, 2014 by these manufacturers are subject to S9.1.2).

(b) Vehicles that are altered (within the meaning of 49 CFR 567.7) before September 1, 2016 after having been previously certified in accordance with part 567 of this chapter, and vehicles manufactured in two or more stages before September 1, 2016, are not subject to S9.1.1. Vehicles that are altered on or after September 1, 2016, and vehicles that are manufactured in two or more stages on or after September 1, 2016, must meet the requirements of S9.1.2, when tested under the conditions specified in S10 into a fixed, rigid pole of 254 mm (10 inches) in diameter, at any speed up to and including 32 km/h (20 mph).

(c) Vehicles with a gross vehicle weight rating greater than 3,855 kg (8,500 lb) manufactured before September 1, 2015 are not subject to S9.1.1 or S9.1.2 of this section. These vehicles may be voluntarily certified to meet the pole test requirements prior to September 1, 2015. Vehicles with a gross vehicle weight rating greater than 3,855 kg (8,500 lb) manufactured on or after September 1, 2015 must meet the requirements of S9.2.1, S9.2.2 and S9.2.3, when tested under the conditions specified in S10 into a fixed, rigid pole of 254 mm (10 inches) in diameter, at any speed up to and including 32 km/h (20 mph).

(d)(1) Convertibles manufactured before September 1, 2015 are not subject to S9.1.1 or S9.1.2 of this section. These vehicles may be voluntarily certified to meet the pole test requirements prior to September 1, 2015.

(2) Convertibles manufactured on or after September 1, 2015 must meet the requirements of S9.2.1, S9.2.2 and S9.2.3, when tested under the conditions specified in S10 into a fixed, rigid pole of 254 mm (10 inches) in diameter, at any speed up to and including 32 km/h (20 mph).

S9.2 *Requirements.* Each vehicle shall meet these vehicle-to-pole test requirements when tested under the conditions of S10 of this standard. At NHTSA's option, either the 50th percentile adult male test dummy (ES–2re dummy, 49 CFR Part 572 Subpart U) or the 5th percentile adult female test dummy (SID–IIs, 49 CFR Part 572 Subpart V) shall be used in the test. At NHTSA's option, either front outboard seating position shall be tested. The vehicle shall meet the specific requirements at all front outboard seating positions.

S9.2.1 *Dynamic performance requirements using the Part 572 Subpart U (ES–2re 50th percentile male) dummy.* When using the ES–2re Part 572 Subpart U dummy, use the specifications of S11 of this standard (49 CFR 571.214). When using the dummy, the following performance requirements must be met using measurements in accordance with S11.5.

(a) The HIC shall not exceed 1000 when calculated in accordance with the following formula:

$$\mathrm{HIC} = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a\,dt\right]^{2.5} (t_2 - t_1)$$

Where the term a is the resultant head acceleration at the center of gravity of the dummy head expressed as a multiple of g (the acceleration of gravity), and t1 and t2 are any two points in time during the impact which are separated by not more

than a 36 millisecond time interval and where t1 is less than t2.

(b) Thorax. The deflection of any of the upper, middle, and lower ribs, shall not exceed 44 mm (1.73 inches).

(c) Force measurements.

(1) The sum of the front, middle and rear abdominal forces, shall not exceed 2,500 N (562 pounds).

(2) The pubic symphysis force shall not exceed 6,000 N (1,350 pounds).

S9.2.2 *Dynamic performance requirements using the Part 572 Subpart V SID–IIs (5th percentile female) dummy*. When using the SID–IIs Part 572 Subpart V dummy, use the specifications of S11 of this standard (49 CFR 571.214). When using the dummy, the following performance requirements must be met.

(a) The HIC shall not exceed 1000 when calculated in accordance with the following formula:

$$\mathrm{HIC} = [\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a\,dt]^{2.5} (t_2 - t_1)$$

Where the term *a* is the resultant head acceleration at the center of gravity of the dummy head expressed as a multiple of g (the acceleration of gravity), and t1 and t2 are any two points in time during the impact which are separated by not more than a 36 millisecond time interval and where t1 is less than t2.

(b) Resultant lower spine acceleration must not exceed 82 g.

(c) The sum of the acetabular and iliac pelvic forces must not exceed 5,525 N.

S9.2.3 *Door opening.*

(a) Any side door that is struck by the pole shall not separate totally from the vehicle.

(b) Any door (including a rear hatchback or tailgate) that is not struck by the pole shall meet the following requirements:

(1) The door shall not disengage from the latched position; and

(2) The latch shall not separate from the striker, and the hinge components shall not separate from each other or from their attachment to the vehicle.

(3) Neither the latch nor the hinge systems of the door shall pull out of their anchorages.

S10. *General test conditions for determining compliance with vehicle-to-pole requirements.* General test conditions for determining compliance with the vehicle-to-pole test are specified below and in S12 of this standard (49 CFR 571.214).

S10.1 *Test weight.* Each vehicle is loaded as specified in S8.1 of this standard (49 CFR 571.214).

S10.2 *Vehicle test attitude.* When the vehicle is in its ''as delivered,'' ''fully loaded'' and ''as tested'' condition, locate the vehicle on a flat, horizontal surface to determine the vehicle attitude. Use the same level surface or reference plane and the same standard points on the test vehicle when determining the ''as delivered,'' ''fully loaded'' and ''as tested'' conditions. Measure the angles relative to a horizontal plane, front-to-rear and from left-to-right for the ''as delivered,'' ''fully loaded,'' and ''as tested'' conditions. The front-to-rear angle (pitch) is measured along a fixed reference on the left and right front occupant's door sills. Mark where the angles are taken on the door sills. The left to right angle (roll) is measured along a fixed reference point at the front and rear of the vehicle at the vehicle longitudinal center plane. Mark where the angles are measured. The ''as delivered'' condition is the vehicle as received at the test site, with 100 percent of all fluid capacities and all tires inflated to the manufacturer's specifications listed on the vehicle's tire placard. When the vehicle is in its ''fully loaded'' condition, measure the angle between the left front occupant's door sill and the horizontal, at the same place the ''as delivered'' angle was measured. The ''fully loaded condition'' is the test vehicle loaded in accordance with S8.1 of this standard (49 CFR 571.214). The load placed in the cargo area is centered over the longitudinal centerline of the vehicle. The vehicle ''as tested'' pitch and roll angles are between the ''as delivered'' and ''fully loaded'' condition, inclusive.

S10.3 *Adjustable seats.*

S10.3.1 *Driver and front outboard passenger seat set-up for 50th percentile male dummy.* The driver and front outboard passenger seats are set up as specified in S8.3.1 of this standard, 49 CFR 571.214.

S10.3.2. *Driver and front outboard passenger seat set-up for 49 CFR part 572 Subpart V 5th percentile female dummy.*

S10.3.2.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S10.3.2.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or non-deployed adjustment position. Position any adjustable head restraint in the lowest and most forward in-use position. If it is possible to achieve a position lower than the effective detent range, the head restraint should be set to its lowest possible position. A non-use position as specified by S4.4 of FMVSS No. 202a, is excluded from being considered as the lowest possible position.

S10.3.2.3 *Seat position adjustment.* If the driver and any front outboard passenger seats do not adjust independently of each other, the struck side seat shall control the final position of the non-struck side seat. If the driver and any front outboard passenger seats adjust independently of each other, adjust both the struck and non-struck side seats in the manner specified in S10.3.2.

S10.3.2.3.1 Using only the controls that primarily move the seat and seat cushion independent of the seat back in the fore and aft directions, move the seat cushion reference point (SCRP) to the rearmost position. Using any part of any control, other than those just used, determine the full range of angles of the seat cushion reference line and set the seat cushion reference line to the middle of the range. Using any part of any control other than those that primarily move the seat or seat cushion fore and aft, while maintaining the seat cushion reference line angle, place the SCRP to its lowest position.

S10.3.2.3.2 Using only the control that primarily moves the seat fore and aft, move the seat reference point to the most forward position.

S10.3.2.3.3 If the seat or seat cushion height is adjustable, other than by the controls that primarily move the seat or seat cushion fore and aft, set the seat reference point to the midpoint height, with the seat cushion reference line angle set as close as possible to the angle determined in S10.3.2.3.1. Mark location of the seat for future reference.

S10.4 *Positioning dummies for the vehicle-to-pole test.*

(a) *50th percentile male test dummy (49 CFR Part 572 Subpart U ES–2re dummy).* The 50th percentile male test dummy is positioned in the front outboard seating position on the struck side of the vehicle in accordance with the provisions of S12.2 of this standard, 49 CFR 571.214.

(b) *5th percentile female test dummy (49 CFR Part 572 Subpart V SID–IIs dummy).* The 5th percentile female test dummy is positioned in the front outboard seating positions on the struck side of the vehicle in accordance with the provisions of S12.3 of this standard, 49 CFR 571.214.

S10.5 *Adjustable steering controls.* Adjustable steering controls are adjusted so that the steering control hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If there is no setting detent in the mid-position, lower the steering control to the detent just below the mid-position. If the steering column is telescoping, place the steering column in the mid-position. If there is no mid-position, move the steering control rearward one position from the mid-position.

S10.6 *Windows and sunroofs.* Movable vehicle windows and vents are placed in the fully closed position on the struck side of the vehicle. Any sunroof is placed in the fully closed position.

S10.7 *Convertible tops.* Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S10.8 *Doors.* Doors, including any rear hatchback or tailgate, are fully closed and latched but not locked.

S10.9 *Transmission and brake engagement.* For a vehicle equipped with a manual transmission, the transmission is placed in second gear. For a vehicle equipped with an automatic transmission, the transmission is placed in neutral. For all vehicles, the parking brake is engaged.

S10.10 *Rigid pole.* The rigid pole is a vertical metal structure beginning no more than 102 millimeters (4 inches) above the lowest point of the tires on the striking side of the test vehicle

when the vehicle is loaded as specified in S8.1 and extending above the highest point of the roof of the test vehicle. The pole is 254 mm (10 inches) ±6 mm (0.25 in) in diameter and set off from any mounting surface, such as a barrier or other structure, so that the test vehicle will not contact such a mount or support at any time within 100 milliseconds of the initiation of vehicle to pole contact.

S10.11 *Impact reference line.* The impact reference line is located on the striking side of the vehicle at the intersection of the vehicle exterior and a vertical plane passing through the center of gravity of the head of the dummy seated in accordance with S12 in the front outboard designated seating position. The vertical plane forms an angle of 285 (or 75) degrees with the vehicle's longitudinal centerline for the right (or left) side impact test. The angle is measured counterclockwise from the vehicle's positive X-axis as defined in S10.13.

S10.12 *Impact configuration.*

S10.12.1 The rigid pole is stationary.

S10.12.2 The test vehicle is propelled sideways so that its line of forward motion forms an angle of 285 (or 75) degrees (±3 degrees) for the right (or left) side impact with the vehicle's longitudinal centerline. The angle is measured counterclockwise from the vehicle's positive X-axis as defined in S10.13. The impact reference line is aligned with the center line of the rigid pole surface, as viewed in the direction of vehicle motion, so that, when the vehicle-to-pole contact occurs, the center line contacts the vehicle area bounded by two vertical planes parallel to and 38 mm (1.5 inches) forward and aft of the impact reference line.

S10.13 *Vehicle reference coordinate system.* The vehicle reference coordinate system is an orthogonal coordinate system consisting of three axes, a longitudinal axis (X), a transverse axis (Y), and a vertical axis (Z). X and Y are in the same horizontal plane and Z passes through the intersection of X and Y. The origin of the system is at the center of gravity of the vehicle. The X-axis is parallel to the longitudinal centerline of the vehicle and is positive to the vehicle front end and negative to the rear end. The Y-axis is positive to the left side of the vehicle and negative to the right side. The Z-axis is positive above the X-Y plane and negative below it.

S11 *Anthropomorphic test dummies.* The anthropomorphic test dummies used to evaluate a vehicle's performance in the moving deformable barrier and vehicle-to-pole tests are specified in 49 CFR part 572. In a test in which the test vehicle is to be struck on its left side, each dummy is to be configured and instrumented to be struck on its left side, in accordance with part 572. In a test in which the test vehicle is to be struck on its right side, each dummy is to be configured and instrumented to be struck on its right side, in accordance with part 572.

S11.1 *Clothing.*

(a) *50th percentile male.* Each test dummy representing a 50th percentile male is clothed in formfitting cotton stretch garments with short sleeves and midcalf length pants. Each foot of the test dummy is equipped with a size 11EEE shoe, which meets the configuration size, sole, and heel thickness specifications of MIL–S–13192 (incorporated by reference, see §571.5) and weighs 0.68 ±0.09 kilograms (1.25 ±0.2 lb).

(b) *5th percentile female.* The 49 CFR Part 572 Subpart V test dummy representing a 5th percentile female is clothed in formfitting cotton stretch garments with short sleeves and about the knee length pants. Each foot has on a size 7.5W shoe that meets the configuration and size specifications of MIL–S–21711E (incorporated by reference, see §571.5) or its equivalent.

S11.2 *Limb joints.*

(a) For the 50th percentile male dummy, set the limb joints at between 1 and 2 g. Adjust the leg joints with the torso in the supine position. Adjust the knee and ankle joints so that they just support the lower leg and the foot when extended horizontally (1 to 2 g adjustment).

(b) For the 49 CFR Part 572 Subpart V 5th percentile female dummy, set the limb joints at slightly above 1 g, barely restraining the weight of the limb when extended horizontally. The force needed to move a limb segment does not exceed 2 g throughout the range of limb motion. Adjust the leg joints with the torso in the supine position.

S11.3 The stabilized temperature of the test dummy at the time of the test is at any temperature between 20.6 degrees C and 22.2 degrees C.

S11.4 *Acceleration data.* Accelerometers are installed on the head, rib, spine and pelvis components of various dummies as required to meet the injury criteria of the standard. Accelerations measured from different dummy components may use different filters and processing methods.

S11.5 *Processing Data.*

(a) *Subpart F (SID) test dummy.*

(1) Process the acceleration data from the accelerometers mounted on the ribs, spine and pelvis of the Subpart F dummy with the FIR100 software specified in 49 CFR 572.44(d). Process the data in the following manner:

(i) Filter the data with a 300 Hz, SAE Class 180 filter;

(ii) Subsample the data to a 1600 Hz sampling rate;

(iii) Remove the bias from the subsampled data; and

(iv) Filter the data with the FIR100 software specified in 49 CFR 572.44(d), which has the following characteristics—

(A) Passband frequency 100 Hz.

(B) Stopband frequency 189 Hz.

(C) Stopband gain −50 db.

(D) Passband ripple 0.0225 db.

(2) [Reserved]

(b) *Subpart U (ES–2re 50th percentile male) test dummy.*

(1) The rib deflection data are filtered at channel frequency class 180 Hz. Abdominal and pubic force data are filtered at channel frequency class of 600 Hz.

(2) The acceleration data from the accelerometers installed inside the skull cavity of the ES–2re test dummy are filtered at channel frequency class of 1000 Hz.

(c) *Subpart V (SID–IIs 5th percentile female) test dummy.*

(1) The acceleration data from the accelerometers installed inside the skull cavity of the SID–IIs test dummy are filtered at channel frequency class of 1000 Hz.

(2) The acceleration data from the accelerometers installed on the lower spine of the SID–IIs test dummy are filtered at channel frequency class of 180 Hz.

(3) The iliac and acetabular forces from load cells installed in the pelvis of the SID–IIs are filtered at channel frequency class of 600 Hz.

S12 *Positioning procedures for the anthropomorphic test dummies.*

S12.1 *50th percentile male test dummy—49 CFR part 572 subpart F (SID).* Position a correctly configured test dummy, conforming to the applicable requirements of part 572 Subpart F of this chapter, in the front outboard seating position on the side of the test vehicle to be struck by the moving deformable barrier and, if the vehicle has a second seat, position another conforming test dummy in the second seat outboard position on the same side of the vehicle, as specified in S12.1.3. Each test dummy is restrained using all available belt systems in all seating positions where such belt restraints are provided. Place any adjustable anchorages at the manufacturer's nominal design position for a 50th percentile adult male occupant. In addition, any folding armrest is retracted. Additional positioning procedures are specified below.

S12.1.1 *Positioning a Part 572 Subpart F (SID) dummy in the driver's seating position.*

(a) *Torso.* Hold the dummy's head in place and push laterally on the non-impacted side of the upper torso in a single stroke with a force of 66.7–89.0 N (15–20 lb) towards the impacted side.

(1) For a bench seat. The upper torso of the test dummy rests against the seat back. The midsagittal plane of the test dummy is vertical and parallel to the vehicle's longitudinal centerline, and passes through the center of the steering control.

(2) For a bucket seat. The upper torso of the test dummy rests against the seat back. The midsagittal plane of the test dummy is vertical and parallel to the vehicle's longitudinal centerline, and coincides with the longitudinal centerline of the bucket seat.

(b) *Pelvis.*

(1) H-point. The H-points of each test dummy coincide within 12.7 mm (½ inch) in the vertical dimension and 12.7 mm (½ inch) in the horizontal dimension of a point that is located 6.4 mm (¼ inch) below the position of the H-

point determined by using the equipment for the 50th percentile and procedures specified in SAE Standard J826–1980 (incorporated by reference, see §571.5), except that Table 1 of SAE Standard J826–1980 is not applicable. The length of the lower leg and thigh segments of the H-point machine are adjusted to 414 and 401 mm (16.3 and 15.8 inches), respectively.

(2) Pelvic angle. As determined using the pelvic angle gauge (GM drawing 78051–532 incorporated by reference in part 572, Subpart E of this chapter) which is inserted into the H–point gauging hole of the dummy, the angle of the plane of the surface on the lumbar-pelvic adaptor on which the lumbar spine attaches is 23 to 25 degrees from the horizontal, sloping upward toward the front of the vehicle.

(3) *Legs.* The upper legs of each test dummy rest against the seat cushion to the extent permitted by placement of the feet. The left knee of the dummy is positioned such that the distance from the outer surface of the knee pivot bolt to the dummy's midsagittal plane is 152.4 mm (6.0 inches). To the extent practicable, the left leg of the test dummy is in a vertical longitudinal plane.

(4) *Feet.* The right foot of the test dummy rests on the undepressed accelerator with the heel resting as far forward as possible on the floorpan. The left foot is set perpendicular to the lower leg with the heel resting on the floorpan in the same lateral line as the right heel.

S12.1.2 *Positioning a Part 572 Subpart F (SID) dummy in any front outboard passenger seating position.*

(a) *Torso.* Hold the dummy's head in place and push laterally on the non-impacted side of the upper torso in a single stroke with a force of 66.7–89.0 N (15–20 lb) towards the impacted side.

(1) For a bench seat. The upper torso of the test dummy rests against the seat back. The midsagittal plane of the test dummy is vertical and parallel to the vehicle's longitudinal centerline. For vehicles with manually operated driving controls the midsagittal plane of the test dummy is the same distance from the vehicle's longitudinal centerline as would be the midsagittal plane of a test dummy positioned in the driver's seating position under S12.1.1(a)(1). For vehicles without manually operated driving controls the midsagittal plane of the test dummy shall be vertical and parallel to the vehicle's longitudinal centerline, and passes through any front outboard passenger seat's SgRP.

(2) For a bucket seat. The upper torso of the test dummy rests against the seat back. The midsagittal plane of the test dummy is vertical and parallel to the vehicle's longitudinal centerline, and coincides with the longitudinal centerline of the bucket seat.

(b) *Pelvis.*

(1) H-point. The H-points of each test dummy coincide within 12.7 mm (½ inch) in the vertical dimension and 12.7 mm (½ inch) in the horizontal dimension of a point that is located 6.4 mm (¼ inch) below the position of the H-point determined by using the equipment for the 50th percentile and procedures specified in SAE Standard J826–1980 (incorporated by reference, see §571.5), except that Table 1 of SAE J826–1980 is not applicable. The length of the lower leg and thigh segments of the H-point machine are adjusted to 414 and 401 mm (16.3 and 15.8 inches), respectively.

(2) Pelvic angle. As determined using the pelvic angle gauge (GM drawing 78051–532 incorporated by reference in part 572, Subpart E of this chapter) which is inserted into the H–point gauging hole of the dummy, the angle of the plane of the surface on the lumbar-pelvic adaptor on which the lumbar spine attaches is 23 to 25 degrees from the horizontal, sloping upward toward the front of the vehicle.

(c) *Legs.* The upper legs of each test dummy rest against the seat cushion to the extent permitted by placement of the feet. The initial distance between the outboard knee clevis flange surfaces is 292 mm (11.5 inches). To the extent practicable, both legs of the test dummies in outboard passenger positions are in vertical longitudinal planes. Final adjustment to accommodate placement of feet in accordance with S12.1.2(d) for various passenger compartment configurations is permitted.

(d) *Feet.* The feet of the test dummy are placed on the vehicle's toeboard

with the heels resting on the floorpan as close as possible to the intersection of the toeboard and floorpan. If the feet cannot be placed flat on the toeboard, they are set perpendicular to the lower legs and placed as far forward as possible so that the heels rest on the floorpan.

S12.1.3 *Positioning a Part 572 Subpart F (SID) dummy in the rear outboard seating positions.*

(a) *Torso.* Hold the dummy's head in place and push laterally on the non-impacted side of the upper torso in a single stroke with a force of 66.7–89.0 N (15–20 lb) towards the impacted side.

(1) For a bench seat. The upper torso of the test dummy rests against the seat back. The midsagittal plane of the test dummy is vertical and parallel to the vehicle's longitudinal centerline, and, if possible, the same distance from the vehicle's longitudinal centerline as the midsagittal plane of a test dummy positioned in the driver's seating position under S12.1.1(a)(1) or left front passenger seating positioned under S12.1.2(a)(1) in vehicles without manually operated driving controls. If it is not possible to position the test dummy so that its midsagittal plane is parallel to the vehicle longitudinal centerline and is at this distance from the vehicle's longitudinal centerline, the test dummy is positioned so that some portion of the test dummy just touches, at or above the seat level, the side surface of the vehicle, such as the upper quarter panel, an armrest, or any interior trim (*i.e.,* either the broad trim panel surface or a smaller, localized trim feature).

(2) For a bucket or contoured seat. The upper torso of the test dummy rests against the seat back. The midsagittal plane of the test dummy is vertical and parallel to the vehicle's longitudinal centerline, and coincides with the longitudinal centerline of the bucket or contoured seat.

(b) *Pelvis.*

(1) H-point. The H-points of each test dummy coincide within 12.7 mm (½ inch) in the vertical dimension and 12.7 mm (½ inch) in the horizontal dimension of a point that is located 6.4 mm (¼ inch) below the position of the H-point determined by using the equipment for the 50th percentile and procedures specified in SAE Standard J826–1980 (incorporated by reference, see §571.5), except that Table 1 of SAE J826–1980 is not applicable. The length of the lower leg and thigh segments of the H-point machine are adjusted to 414 and 401 mm (16.3 and 15.8 inches), respectively.

(2) Pelvic angle. As determined using the pelvic angle gauge (GM drawing 78051–532 incorporated by reference in part 572, Subpart E of this chapter) which is inserted into the H–point gauging hole of the dummy, the angle of the plane of the surface on the lumbar-pelvic adaptor on which the lumbar spine attaches is 23 to 25 degrees from the horizontal, sloping upward toward the front of the vehicle.

(c) *Legs.* Rest the upper legs of each test dummy against the seat cushion to the extent permitted by placement of the feet. The initial distance between the outboard knee clevis flange surfaces is 292 mm (11.5 inches). To the extent practicable, both legs of the test dummies in outboard passenger positions are in vertical longitudinal planes. Final adjustment to accommodate placement of feet in accordance with S12.1.3(d) for various passenger compartment configurations is permitted.

(d) *Feet.* Place the feet of the test dummy flat on the floorpan and beneath the front seat as far as possible without front seat interference. If necessary, the distance between the knees may be changed in order to place the feet beneath the seat.

S12.2 *50th percentile male test dummy—49 CFR Part 572 Subpart U (ES–2re).*

S12.2.1 *Positioning an ES–2re dummy in all seating positions.* Position a correctly configured ES–2re test dummy, conforming to the applicable requirements of part 572 of this chapter, in the front outboard seating position on the side of the test vehicle to be struck by the moving deformable barrier or pole. Restrain the test dummy using all available belt systems in the seating positions where the belt restraints are provided. Place any adjustable anchorages at the manufacturer's nominal design position for a 50th percentile adult male occupant. Retract any folding armrest.

(a) *Upper torso.*

(1) The plane of symmetry of the dummy coincides with the vertical median plane of the specified seating position.

(2) Bend the upper torso forward and then lay it back against the seat back. Set the shoulders of the dummy fully rearward.

(b) *Pelvis.* Position the pelvis of the dummy according to the following:

(1) Position the pelvis of the dummy such that a lateral line passing through the dummy H-points is perpendicular to the longitudinal center plane of the seat. The line through the dummy H-points is horizontal with a maximum inclination of ±2 degrees. The dummy may be equipped with tilt sensors in the thorax and the pelvis. These instruments can help to obtain the desired position.

(2) The correct position of the dummy pelvis may be checked relative to the H-point of the H-point Manikin by using the M3 holes in the H-point back plates at each side of the ES–2re pelvis. Position the dummy such that the M3 holes are located within a circle of radius 10 mm (0.39 in.) around the H-point of the H-point Manikin.

(c) *Arms.* Place the dummy's upper arms such that the angle between the projection of the arm centerline on the mid-sagittal plane of the dummy and the torso reference line is 40° ±5°. The torso reference line is defined as the thoracic spine centerline. The shoulder-arm joint allows for discrete arm positions at 0, 40, and 90 degree settings forward of the spine.

(d) *Legs and Feet.* Position the legs and feet of the dummy according to the following:

(1) For the driver's seating position, without inducing pelvis or torso movement, place the right foot of the dummy on the un-pressed accelerator pedal with the heel resting as far forward as possible on the floor pan. Set the left foot perpendicular to the lower leg with the heel resting on the floor pan in the same lateral line as the right heel. Set the knees of the dummy such that their outside surfaces are 150 ±10 mm (5.9 ±0.4 inches) from the plane of symmetry of the dummy. If possible within these constraints, place the thighs of the dummy in contact with the seat cushion.

(2) For other seating positions, without inducing pelvis or torso movement, place the heels of the dummy as far forward as possible on the floor pan without compressing the seat cushion more than the compression due to the weight of the leg. Set the knees of the dummy such that their outside surfaces are 150 ±10 mm (5.9 ±0.4 inches) from the plane of symmetry of the dummy.

S12.3 *5th percentile female test dummy—49 CFR Part 572 Subpart V (SID–IIs).* Position a correctly configured 5th percentile female Part 572 Subpart V (SID–IIs) test dummy, conforming to the applicable requirements of part 572 of this chapter, in the front outboard seating position on the side of the test vehicle to be struck by the pole and, for the moving deformable barrier, if the vehicle has a second seat, position a conforming test dummy in the second seat outboard position on the same side of the vehicle (side to be struck) as specified in S12.3.4. Retract any folding armrest. Additional procedures are specified below.

S12.3.1 *General provisions and definitions.*

(a) Measure all angles with respect to the horizontal plane unless otherwise stated.

(b) Adjust the SID–IIs dummy's neck bracket to align the zero degree index marks.

(c) Other seat adjustments. The longitudinal centerline of a bucket seat cushion passes through the SgRP and is parallel to the longitudinal centerline of the vehicle.

(d) *Driver and any front outboard passenger dummy manual belt adjustment.* Use all available belt systems. Place adjustable belt anchorages at the nominal position for a 5th percentile adult female suggested by the vehicle manufacturer.

(e) *Definitions.*

(1) The term ''midsagittal plane'' refers to the vertical plane that separates the dummy into equal left and right halves.

(2) The term ''vertical longitudinal plane'' refers to a vertical plane parallel to the vehicle's longitudinal centerline.

(3) The term ''vertical plane'' refers to a vertical plane, not necessarily parallel to the vehicle's longitudinal centerline.

(4) The term ''transverse instrumentation platform'' refers to the transverse instrumentation surface inside the dummy's skull casting to which the neck load cell mounts. This surface is perpendicular to the skull cap's machined inferior-superior mounting surface.

(5) The term ''thigh'' refers to the femur between, but not including, the knee and the pelvis.

(6) The term ''leg'' refers to the lower part of the entire leg including the knee.

(7) The term ''foot'' refers to the foot, including the ankle.

(8) For leg and thigh angles, use the following references:

(i) Thigh—a straight line on the thigh skin between the center of the ½-13 UNC–2B tapped hole in the upper leg femur clamp and the knee pivot shoulder bolt.

(ii) Leg—a straight line on the leg skin between the center of the ankle shell and the knee pivot shoulder bolt.

(9) The term ''seat cushion reference point'' (SCRP) means a point placed on the outboard side of the seat cushion at a horizontal distance between 150 mm (5.9 in) and 250 mm (9.8 in) from the front edge of the seat used as a guide in positioning the seat.

(10) The term ''seat cushion reference line'' means a line on the side of the seat cushion, passing through the seat cushion reference point, whose projection in the vehicle vertical longitudinal plane is straight and has a known angle with respect to the horizontal.

S12.3.2 *5th percentile female driver dummy positioning.*

(a) *Driver torso/head/seat back angle positioning.*

(1) With the seat in the position determined in S10.3.2, use only the control that moves the seat fore and aft to place the seat in the rearmost position. If the seat cushion reference line angle automatically changes as the seat is moved from the full forward position, maintain, as closely as possible, the seat cushion reference line angle determined in S10.3.2.3.3, for the final forward position when measuring the pelvic angle as specified in S12.3.2(a)(11). The seat cushion reference line angle position may be achieved through the use of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft.

(2) Fully recline the seat back, if adjustable. Install the dummy into the driver's seat, such that when the legs are positioned 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

(3) Bucket seats. Center the dummy on the seat cushion so that its midsagittal plane is vertical and passes through the SgRP within ±10 mm (±0.4 in).

(4) Bench seats. Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and aligned within ±10 mm (±0.4 in) of the center of the steering control rim.

(5) Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

(6) Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

(7) Gently rock the upper torso relative to the lower torso laterally in a side to side motion three times through a ±5 degree arc (approximately 51 mm (2 in) side to side).

(8) If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. Keeping the leg and the thigh in a vertical plane, place the foot in the vertical longitudinal plane that passes through the centerline of the accelerator pedal. Rotate the left thigh outboard about the hip until the center of the knee is the same distance from the midsagittal plane of the dummy as the right knee ±5 mm (±0.2 in). Using only the control

that moves the seat fore and aft, attempt to return the seat to the full forward position. If either of the dummy's legs first contacts the steering control, then adjust the steering control, if adjustable, upward until contact with the steering control is avoided. If the steering control is not adjustable, separate the knees enough to avoid steering control contact. Proceed with moving the seat forward until either the leg contacts the vehicle interior or the seat reaches the full forward position. (The right foot may contact and depress the accelerator and/or change the angle of the foot with respect to the leg during seat movement.) If necessary to avoid contact with the vehicle's brake or clutch pedal, rotate the test dummy's left foot about the leg. If there is still interference, rotate the left thigh outboard about the hip the minimum distance necessary to avoid pedal interference. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seat is a power seat, move the seat fore and aft to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior. If the steering control was moved, return it to the position described in S10.5. If the steering control contacts the dummy's leg(s) prior to attaining this position, adjust it to the next higher detent, or if infinitely adjustable, until there is 5 mm (0.2 in) clearance between the control and the dummy's leg(s).

(9) *Head leveling.*

(i) *Vehicles with fixed seat backs.* Adjust the lower neck bracket to level the transverse instrumentation platform angle of the head to within ±0.5 degrees. If it is not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the neck bracket adjustment position that minimizes the difference between the transverse instrumentation platform angle and level.

(ii) *Vehicles with adjustable seat backs.* While holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform angle of the head is level to within ±0.5 degrees, making sure that the pelvis does not interfere with the seat bight. (If the torso contacts the steering control, use S12.3.2(a)(10) before proceeding with the remaining portion of this paragraph.) If it is not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the seat back adjustment position that minimizes the difference between the transverse instrumentation platform angle and level, then adjust the neck bracket to level the transverse instrumentation platform angle to within ±0.5 degrees if possible. If it is still not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the neck bracket angle position that minimizes the difference between the transverse instrumentation platform angle and level.

(10) If the torso contacts the steering control, adjust the steering control in the following order until there is no contact: Telescoping adjustment, lowering adjustment, raising adjustment. If the vehicle has no adjustments or contact with the steering control cannot be eliminated by adjustment, position the seat at the next detent where there is no contact with the steering control as adjusted in S10.5. If the seat is a power seat, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the steering control as adjusted in S10.5 and the point of contact on the dummy.

(11) Measure and set the dummy's pelvic angle using the pelvic angle gage. The angle is set to 20.0 degrees ±2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible by adjustments specified in S12.3.2(a)(9).

(12) If the dummy is contacting the vehicle interior after these adjustments, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments, the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forwardmost position, move

the seat forward until the contact point is 5 mm (0.2 in) or less from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position without making contact, or until the seat reaches its forwardmost position, whichever occurs first.

(b) *Driver foot positioning.*

(1) If the vehicle has an adjustable accelerator pedal, adjust it to the full forward position. If the heel of the right foot can contact the floor pan, follow the positioning procedure in S12.3.2(b)(1)(i). If not, follow the positioning procedure in S12.3.2(b)(1)(ii).

(i) Rest the right foot of the test dummy on the un-depressed accelerator pedal with the rearmost point of the heel on the floor pan in the plane of the pedal. If the foot cannot be placed on the accelerator pedal, set it initially perpendicular to the leg and then place it as far forward as possible in the direction of the pedal centerline with the rearmost point of the heel resting on the floor pan. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot. If the accelerator pedal in the full rearward position still does not touch the foot, leave the pedal in that position.

(ii) Extend the foot and lower leg by decreasing the knee flexion angle until any part of the foot contacts the un-depressed accelerator pedal or the highest part of the foot is at the same height as the highest part of the pedal. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot.

(2) If the ball of the foot does not contact the pedal, increase the ankle plantar flexion angle such that the toe of the foot contacts or is as close as possible to contact with the un-depressed accelerator pedal.

(3) If, in its final position, the heel is off of the vehicle floor, a spacer block is used under the heel to support the final foot position. The surface of the block in contact with the heel has an inclination of 30 degrees, measured from the horizontal, with the highest surface towards the rear of the vehicle.

(4) Place the left foot on the toe-board with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toe-board and floor pan, and not on or in contact with the vehicle's brake pedal, clutch pedal, wheel-well projection or foot rest, except as provided in S12.3.2(b)(6).

(5) If the left foot cannot be positioned on the toe board, place the foot perpendicular to the lower leg centerline as far forward as possible with the heel resting on the floor pan.

(6) If the left foot does not contact the floor pan, place the foot parallel to the floor and place the leg as perpendicular to the thigh as possible. If necessary to avoid contact with the vehicle's brake pedal, clutch pedal, wheel-well, or foot rest, use the three foot position adjustments listed in S12.3.2(b)(6)(i) through (iii). The adjustment options are listed in priority order, with each subsequent option incorporating the previous. In making each adjustment, move the foot the minimum distance necessary to avoid contact. If it is not possible to avoid all prohibited foot contact, priority is given to avoiding brake or clutch pedal contact:

(i) Rotate (abduction/adduction) the test dummy's left foot about the lower leg;

(ii) Planar flex the foot;

(iii) Rotate the left leg outboard about the hip.

(c) *Driver arm/hand positioning.* Place the dummy's upper arm such that the angle between the projection of the arm centerline on the midsagittal plane of the dummy and the torso reference line is 45° ±5°. The torso reference line is defined as the thoracic spine centerline. The shoulder-arm joint allows for discrete arm positions at 0, ±45, ±90, ±135, and 180 degree settings where positive is forward of the spine.

S12.3.3 *5th percentile female front passenger dummy positioning.*

(a) *Passenger torso/head/seat back angle positioning.*

(1) With the seat at the mid-height in the full-forward position determined in

S10.3.2, use only the control that primarily moves the seat fore and aft to place the seat in the rearmost position, without adjusting independent height controls. If the seat cushion reference line angle automatically changes as the seat is moved from the full forward position, maintain, as closely as possible, the seat cushion reference line angle determined in S10.3.2.3.3, for the final forward position when measuring the pelvic angle as specified in S12.3.3(a)(11). The seat cushion reference line angle position may be achieved through the use of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft.

(2) Fully recline the seat back, if adjustable. Place the dummy into any passenger seat, such that when the legs are positioned 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

(3) Bucket seats. Place the dummy on the seat cushion so that its midsagittal plane is vertical and passes through the SgRP within ±10 mm (±0.4 in).

(4) Bench seats. Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ±10 mm (±0.4 in), as the midsagittal plane of the driver dummy, if there is a driver's seating position. Otherwise, the midsagittal plane of any front outboard passenger dummy shall be vertical, parallel to the vehicle's longitudinal centerline, and pass, within ±10 mm (±0.4 in), through the seating reference point of the seating that it occupies.

(5) Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

(6) Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

(7) Gently rock the upper torso relative to the lower torso laterally in a side to side motion three times through a ±5 degree arc (approximately 51 mm (2 in) side to side).

(8) If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. With the feet perpendicular to the legs, place the heels on the floor pan. If a heel will not contact the floor pan, place it as close to the floor pan as possible. Using only the control that primarily moves the seat fore and aft, attempt to return the seat to the full forward position. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seats are power seats, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior.

(9) *Head leveling.*

(i) *Vehicles with fixed seat backs.* Adjust the lower neck bracket to level the transverse instrumentation platform angle of the head to within ±0.5 degrees. If it is not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the neck bracket adjustment position that minimizes the difference between the transverse instrumentation platform angle and level.

(ii) *Vehicles with adjustable seat backs.* While holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform angle of the head is level to within ±0.5 degrees, making sure that the pelvis does not interfere with the seat bight. If it is not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the seat back adjustment position that minimizes the difference between the transverse instrumentation platform angle and level, then adjust the neck bracket to level the transverse instrumentation platform angle to within ±0.5 degrees if possible. If it is still not possible to

level the transverse instrumentation platform to within ±0.5 degrees, select the neck bracket angle position that minimizes the difference between the transverse instrumentation platform angle and level.

(10) Measure and set the dummy's pelvic angle using the pelvic angle gage. The angle is set to 20.0 degrees ±2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible by adjustments specified in S12.3.2(a)(9).

(11) If the dummy is contacting the vehicle interior after these adjustments, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments, the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forwardmost position, move the seat forward until the contact point is 5 mm (0.2 in) or less from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position without making contact, or until the seat reaches its forwardmost position, whichever occurs first.

(b) *Passenger foot positioning.*

(1) Place the front passenger's feet flat on the toe board.

(2) If the feet cannot be placed flat on the toe board, set them perpendicular to the leg center lines and place them as far forward as possible with the heels resting on the floor pan.

(3) If either foot does not contact the floor pan, place the foot parallel to the floor pan and place the lower leg as perpendicular to the thigh as possible.

(c) *Passenger arm/hand positioning.* Place the dummy's upper arm such that the angle between the projection of the arm centerline on the midsagittal plane of the dummy and the torso reference line is 45° ±5°. The torso reference line is defined as the thoracic spine centerline. The shoulder-arm joint allows for discrete arm positions at 0, ±45, ±90, ±135, and 180 degree settings where positive is forward of the spine.

S12.3.4 *5th percentile female in rear outboard seating positions.*

(a) Set the rear outboard seat at the full rearward, full down position determined in S8.3.3.

(b) Fully recline the seat back, if adjustable. Install the dummy into the passenger's seat, such that when the legs are 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

(c) Place the dummy on the seat cushion so that its midsagittal plane is vertical and coincides with the vertical longitudinal plane through the center of the seating position SgRP within ±10 mm (±0.4 in).

(d) Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

(e) Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

(f) Gently rock the upper torso laterally side to side three times through a ±5 degree arc (approximately 51 mm (2 in) side to side).

(g) If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. With the feet perpendicular to the legs, place the heels on the floor pan. If a heel will not contact the floor pan, place it as close to the floor pan as possible.

(h) Head leveling.

(1) Vehicles with fixed seat backs. Adjust the lower neck bracket to level the transverse instrumentation platform angle of the head to within ±0.5 degrees. If it is not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the neck bracket adjustment position that minimizes the difference between the transverse instrumentation platform angle and level.

(2) Vehicles with adjustable seat backs. While holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform angle of the head is level to within ±0.5 degrees, making sure that the pelvis does not interfere with the seat bight. If it is not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the seat back adjustment position that minimizes the difference between the transverse instrumentation platform angle and level, then adjust the neck bracket to level the transverse instrumentation platform angle to within ±0.5 degrees if possible. If it is still not possible to level the transverse instrumentation platform to within ±0.5 degrees, select the neck bracket angle position that minimizes the difference between the transverse instrumentation platform angle and level.

(i) [Reserved]

(j) Measure and set the dummy's pelvic angle using the pelvic angle gauge. The angle is set to 20.0 degrees ±2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible, as specified in S12.3.4(h).

(k) *Passenger foot positioning.*

(1) Place the rear seat passenger's feet flat on the floor pan and beneath the front seat as far as possible without front seat interference.

(2) If either foot does not contact the floor pan, place the foot parallel to the floor and place the leg as perpendicular to the thigh as possible.

(l) *Passenger arm/hand positioning.* Place the rear dummy's upper arm such that the angle between the projection of the arm centerline on the midsagittal plane of the dummy and the torso reference line is 45° ±5°. The torso reference line is defined as the thoracic spine centerline. The shoulder-arm joint allows for discrete arm positions at 0, ±45, ±90, ±135, and 180 degree settings where positive is forward of the spine.

S13 *Phase-in of moving deformable barrier and vehicle-to-pole performance requirements.*

S13.1 *Vehicles manufactured on or after September 1, 2010 and before September 1, 2014.* At anytime during the production years ending August 31, 2011, August 31, 2012, August 31, 2013, and August 31, 2014, each manufacturer shall, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles (by make, model and vehicle identification number) that have been certified as complying with the moving deformable barrier test with advanced test dummies (S7.2), or the vehicles (by make, model and vehicle identification number) that have been certified as complying with the vehicle-to-pole test requirements (S9.1) of this standard. The manufacturer's designation of a vehicle as a certified vehicle meeting S7.2 or S9.1 is irrevocable.

S13.1.1 *Vehicles manufactured on or after September 1, 2010 and before September 1, 2011.*

(a) Subject to S13.4, for vehicles manufactured on or after September 1, 2010 and before September 1, 2011, the number of vehicles complying with S7.2 shall be not less than 20 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

(b) Subject to S13.4, for vehicles manufactured on or after September 1, 2010 and before September 1, 2011, the number of vehicles complying with S9.1 shall be not less than 20 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

S13.1.2 *Vehicles manufactured on or after September 1, 2011 and before September 1, 2012.*

(a) Subject to S13.4, for vehicles manufactured on or after September 1, 2011 and before September 1, 2012, the number of vehicles complying with S7.2 shall be not less than 40 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

(b) Subject to S13.4, for vehicles manufactured on or after September 1, 2011 and before September 1, 2012, the number of vehicles complying with S9.1 shall be not less than 40 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

S13.1.3 *Vehicles manufactured on or after September 1, 2012 and before September 1, 2013.*

(a) Subject to S13.4, for vehicles manufactured on or after September 1, 2012 and before September 1, 2013, the number of vehicles complying with S7.2 shall be not less than 60 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

(b) Subject to S13.4, for vehicles manufactured on or after September 1, 2012 and before September 1, 2013, the number of vehicles complying with S9.1 shall be not less than 60 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

S13.1.4 *Vehicles manufactured on or after September 1, 2013 and before September 1, 2014.*

(a) Subject to S13.4, for vehicles manufactured on or after September 1, 2013 and before September 1, 2014, the number of vehicles complying with S7.2 shall be not less than 80 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

(b) Subject to S13.4, for vehicles manufactured on or after September 1, 2013 and before September 1, 2014, the number of vehicles complying with S9.1 shall be not less than 80 percent of:

(1) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(2) The manufacturer's production in the current production year.

S13.2 *Vehicles produced by more than one manufacturer.*

S13.2.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S13.1.1 and S13.1.2, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S13.2.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S13.2.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S13.2.1.

S13.3(a) For the purposes of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S13.1.1(a), S13.1.2(a), S13.1.3(a), and S13.1.4(a), do not count any vehicle that is excluded by Standard No. 214 from the moving deformable barrier test with the ES–2re or SID–IIs test dummies (S7.2).

(b) For the purposes of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S13.1.1(b), S13.1.2(b), S13.1.3(b), and S13.1.4(b), do not count any vehicle that is excluded by Standard No. 214 from the vehicle-to-pole test (S9).

S13.4 *Calculation of complying vehicles.*

(a) For the purposes of calculating the vehicles complying with S13.1.1, a manufacturer may count a vehicle if it is manufactured on or after October 11, 2007 but before September 1, 2011.

(b) For purposes of complying with S13.1.2, a manufacturer may count a vehicle if it—

(1) Is manufactured on or after October 11, 2007 but before September 1, 2012 and,

(2) Is not counted toward compliance with S13.1.1.

(c) For purposes of complying with S13.1.3, a manufacturer may count a vehicle if it—

(1) Is manufactured on or after October 11, 2007 but before September 1, 2013 and,

(2) Is not counted toward compliance with S13.1.1 or S13.1.2.

(d) For purposes of complying with S13.1.4, a manufacturer may count a vehicle if it—

(1) Is manufactured on or after October 11, 2007 but before September 1, 2014 and,

(2) Is not counted toward compliance with S13.1.1, S13.1.2, or S13.1.3.

(e) For the purposes of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer, each vehicle that is excluded from having to meet the applicable requirement is not counted.

[72 FR 51957, Sept. 11, 2007, as amended at 73 FR 32483, June 9, 2008; 75 FR 12139, Mar. 15, 2010; 77 FR 767, Jan. 6, 2012; 76 FR 52884, Aug. 24, 2011; 77 FR 70914, Nov. 28, 2012; 85 FR 85535, Dec. 29, 2020; 87 FR 39310, June 30, 2022; 87 FR 18597, Mar. 30, 2022]

§571.215 [Reserved]

§571.216 Standard No. 216; Roof crush resistance; Applicable unless a vehicle is certified to §571.216a.

S1. *Scope*. This standard establishes strength requirements for the passenger compartment roof.

S2. *Purpose*. The purpose of this standard is to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes.

S3. *Application*. (a) This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses with a GVWR of 2,722 kilograms (6,000 pounds) or less. However, it does not apply to—

(a) School buses;

(b) Vehicles that conform to the rollover test requirements (S5.3) of Standard No. 208 (§571.208) by means that require no action by vehicle occupants;

(c) Convertibles, except for optional compliance with the standard as an alternative to the rollover test requirements in S5.3 of Standard No. 208; or

(d) Vehicles certified to comply with §571.216a.

S4. *Definitions*.

Altered roof means the replacement roof on a motor vehicle whose original roof has been removed, in part or in total, and replaced by a roof that is higher than the original roof. The replacement roof on a motor vehicle whose original roof has been replaced, in whole or in part, by a roof that consists of glazing materials, such as those in T-tops and sunroofs, and is located at the level of the original roof, is not considered to be an altered roof.

Raised roof means, with respect to a roof which includes an area that protrudes above the surrounding exterior roof structure, that protruding area of the roof.

Roof over the front seat area means the portion of the roof, including windshield trim, forward of a transverse vertical plane passing through a point 162 mm rearward of the SgRP of the rearmost front outboard seating position.

Windshield trim means molding of any material between the windshield glazing and the exterior roof surface, including material that covers a part of either the windshield glazing or exterior roof surface.

S5. *Requirements*. Subject to S5.1, when the test device described in S6 is used to apply a force to either side of the forward edge of a vehicle's roof in accordance with the procedures of S7, the lower surface of the test device must not move more than 127 millimeters. The applied force in Newtons is equal to 1.5 times the unloaded vehicle weight of the vehicle, measured in kilograms and multiplied by 9.8, but does not exceed 22,240 Newtons for passenger cars. Both the left and right front portions of the vehicle's roof structure must be capable of meeting the requirements. A particular vehicle need not meet further requirements after being tested at one location.

S5.1 For multipurpose passenger vehicles, trucks and buses that have a raised roof or altered roof, manufacturers have the option of using the test

procedures of S8 instead of the procedures of S7 until October 25, 2000. The option of using the test procedures of S8 ceases to be available on that date.

S6. *Test device.* The test device is a rigid unyielding block whose lower surface is a flat rectangle measuring 762 millimeters by 1,829 millimeters.

S7. *Test procedure.* Each vehicle must be capable of meeting the requirements of S5 when tested in accordance with the procedure in S7.1 through 7.6.

S7.1 Place the sills or the chassis frame of the vehicle on a rigid horizontal surface, fix the vehicle rigidly in position, close all windows, close and lock all doors, and secure any convertible top or removable roof structure in place over the occupant compartment. Remove roof racks or other non-structural components.

S7.2 Orient the test device as shown in Figure 1 of this section, so that—

(a) Its longitudinal axis is at a forward angle (in side view) of 5 degrees below the horizontal, and is parallel to the vertical plane through the vehicle's longitudinal centerline;

(b) Its transverse axis is at an outboard angle, in the front view projection, of 25 degrees below the horizontal.

S7.3 Maintaining the orientation specified in S7.2—

(a) Lower the test device until it initially makes contact with the roof of the vehicle.

(b) Position the test device so that—

(1) The longitudinal centerline on its lower surface is on the initial point of contact, or on the center of the initial contact area, with the roof; and

(2) Except as specified in S7.4, the midpoint of the forward edge of the lower surface of the test device is within 10 mm of the transverse vertical plane 254 mm forward of the forwardmost point on the exterior surface of the roof, including windshield trim, that lies in the longitudinal vertical plane passing through the vehicle's longitudinal centerline.

S7.4 If the vehicle being tested is a multipurpose passenger vehicle, truck, or bus that has a raised roof or altered roof, and the initial contact point of the test device is on the raised roof or altered roof to the rear of the roof over the front seat area, the plate is positioned so that the midpoint of the rearward edge of the lower surface of the test device is within 10 mm of the transverse vertical plane located at the rear of the roof over the front seat area.

S7.5 Apply force so that the test device moves in a downward direction perpendicular to the lower surface of the test device at a rate of not more than 13 millimeters per second until reaching the force level specified in S5. Guide the test device so that throughout the test it moves, without rotation, in a straight line with its lower surface oriented as specified in S7.2(a) and S7.2(b). Complete the test within 120 seconds.

S7.6 Measure the distance that the test device moved, i.e., the distance between the original location of the lower surface of the test device and its location as the force level specified in S5 is reached.

S8 *Alternate test procedure for multipurpose passenger vehicles, trucks and buses that have a raised roof or altered roof manufactured until October 25, 2000 (see S5.1).* Each vehicle shall be capable of meeting the requirements of S5 when tested in accordance with the following procedure.

S8.1 Place the sills or the chassis frame of the vehicle on a rigid horizontal surface, fix the vehicle rigidly in position, close all windows, close and lock all doors, and secure any convertible top or removable roof structure in place over the passenger compartment.

S8.2 Orient the test device as shown in Figure 2, so that—

(a) Its longitudinal axis is at a forward angle (side view) of 5° below the horizontal, and is parallel to the vertical plane through the vehicle's longitudinal centerline;

(b) Its lateral axis is at a lateral outboard angle, in the front view projection, of 25° below the horizontal;

(c) Its lower surface is tangent to the surface of the vehicle; and

(d) The initial contact point, or center of the initial contact area, is on the longitudinal centerline of the lower surface of the test device and 254 millimeters from the forwardmost point of that centerline.

S8.3 Apply force in a downward direction perpendicular to the lower surface of the test device at a rate of not

more than 13 millimeters per second until reaching a force in Newtons of 1½ times the unloaded vehicle weight of the tested vehicle, measured in kilograms and multiplied by 9.8. Complete the test within 120 seconds. Guide the test device so that throughout the test it moves, without rotation, in a straight line with its lower surface oriented as specified in S8.2(a) through S8.2(d).

S8.4 Measure the distance that the test device moves, *i.e.*, the distance between the original location of the lower surface of the test device and its location as the force level specified in S8.3 is reached.

FIGURE 1 TO § 571.216

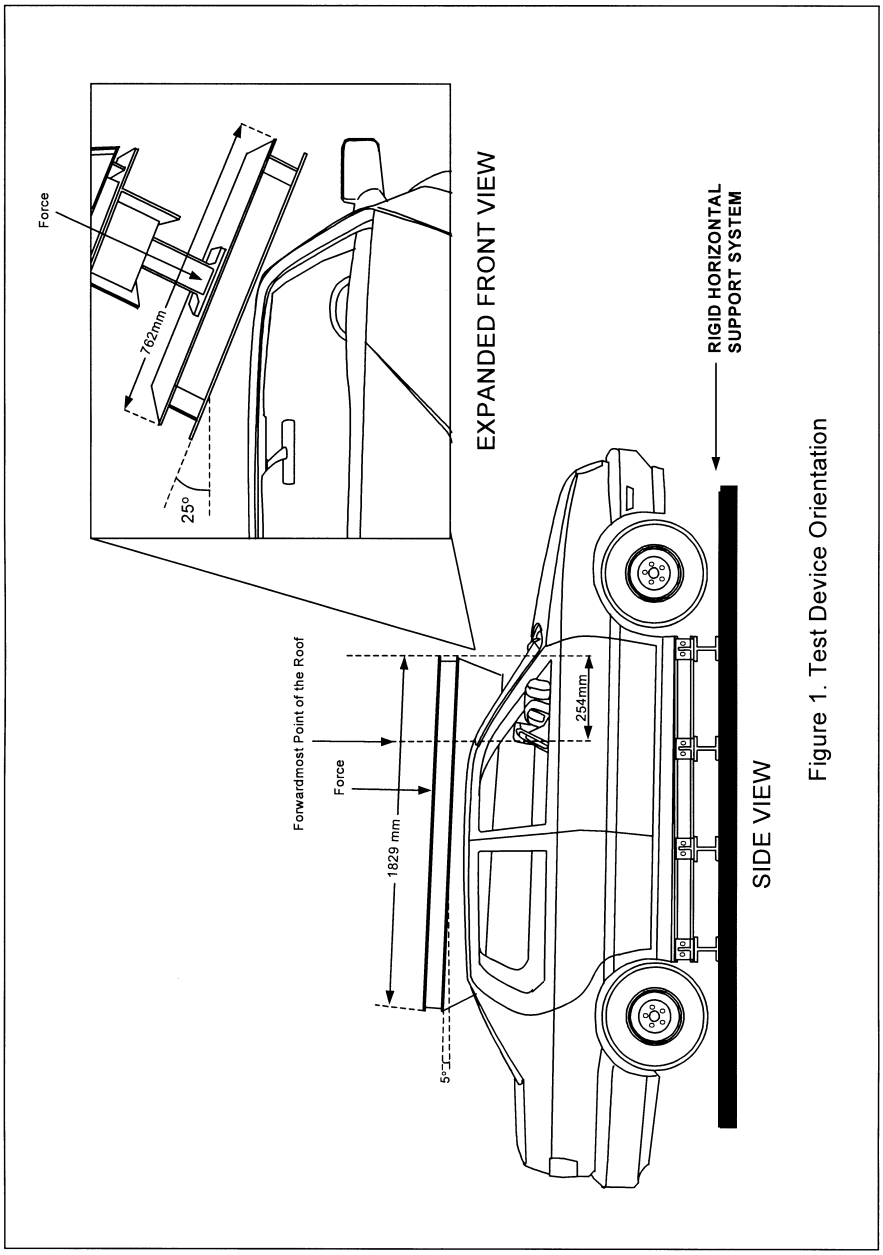


Figure 1. Test Device Orientation

FIGURE 2 TO §571.216

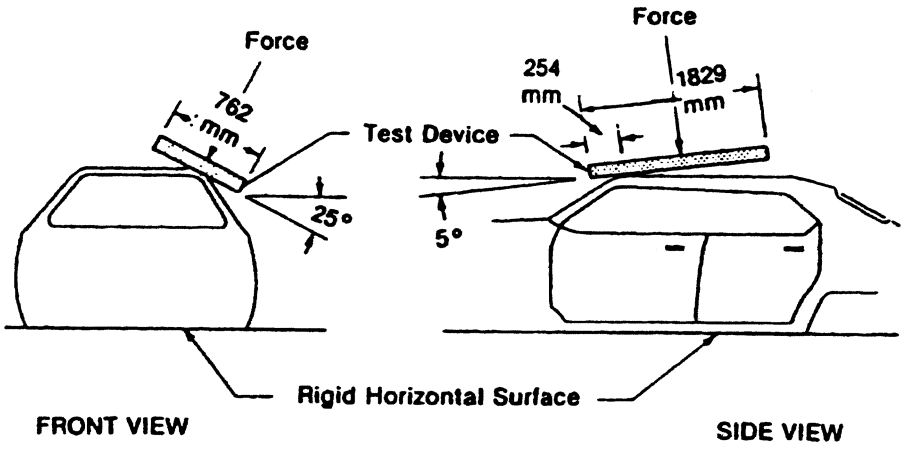


Figure 2.- Test Device Location And Application To The Roof

[36 FR 23300, Dec. 8, 1971, as amended at 38 FR 21930, Aug. 14, 1973; 56 FR 15517, Apr. 17, 1991; 58 FR 5633, Jan. 22, 1993; 60 FR 13647, Mar. 14, 1995; 64 FR 22578, Apr. 27, 1999; 65 FR 4581, Jan. 31, 2000; 74 FR 22384, May 12, 2009]

§571.216a Standard No. 216a; Roof crush resistance; Upgraded standard.

S1. *Scope.* This standard establishes strength requirements for the passenger compartment roof.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes.

S3 *Application and selection of compliance options.*

S3.1 *Application.*

(a) This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks designed to carry at least one person, and buses with a GVWR of 4,536 kilograms (10,000 pounds) or less, according to the implementation schedule specified in S8 and S9 of this section. However, it does not apply to—

(1) School buses;

(2) Vehicles that conform to the rollover test requirements (S5.3) of Standard No. 208 (§571.208) by means that require no action by vehicle occupants;

(3) Convertibles, except for optional compliance with the standard as an alternative to the rollover test requirement (S5.3) of Standard No. 208; or

(4) Trucks built in two or more stages with a GVWR greater than 2,722 kilograms (6,000 pounds) not built using a chassis cab or using an incomplete vehicle with a full exterior van body.

(b) At the option of the manufacturer, vehicles within either of the following categories may comply with the roof crush requirements (S4) of Standard No. 220 (§571.220) instead of the requirements of this standard:

(1) Vehicles built in two or more stages, other than vehicles built using a chassis cab;

(2) Vehicles with a GVWR greater than 2,722 kilograms (6,000 pounds) that have an altered roof as defined by S4 of this section.

(c) Manufacturers may comply with the standard in this §571.216a as an alternative to §571.216.

S3.2 *Selection of compliance option.* Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon the request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it selected for a particular vehicle or make/model.

S4. *Definitions.*

Altered roof means the replacement roof on a motor vehicle whose original roof has been removed, in part or in total, and replaced by a roof that is higher than the original roof. The replacement roof on a motor vehicle whose original roof has been replaced, in whole or in part, by a roof that consists of glazing materials, such as those in T-tops and sunroofs, and is located at the level of the original roof, is not considered to be an altered roof.

Convertible means a vehicle whose A-pillars are not joined with the B-pillars (or rearmost pillars) by a fixed, rigid structural member.

S5. *Requirements.*

S5.1 When the test device described in S6 is used to apply a force to a vehicle's roof in accordance with S7, first to one side of the roof and then to the other side of the roof:

(a) The lower surface of the test device must not move more than 127 millimeters, and

(b) No load greater than 222 Newtons (50 pounds) may be applied to the head form specified in S5.2 of 49 CFR 571.201 located at the head position of a 50th percentile adult male in accordance with S7.2 of this section.

S5.2 The maximum applied force to the vehicle's roof in Newtons is:

(a) For vehicles with a GVWR of 2,722 kilograms (6,000 pounds) or less, any value up to and including 3.0 times the unloaded vehicle weight of the vehicle, measured in kilograms and multiplied by 9.8, and

(b) For vehicles with a GVWR greater than 2,722 kilograms (6,000 pounds), any value up to and including 1.5 times the unloaded vehicle weight of the vehicle, measured in kilograms and multiplied by 9.8.

S6. *Test device.* The test device is a rigid unyielding block whose lower surface is a flat rectangle measuring 762 millimeters by 1,829 millimeters.

S7. *Test procedure.* Each vehicle must be capable of meeting the requirements of S5 when tested in accordance with the procedure in S7.1 through S7.6.

S7.1 Support the vehicle off its suspension and rigidly secure the sills and the chassis frame (when applicable) of the vehicle on a rigid horizontal surface(s) at a longitudinal attitude of 0 degrees ±0.5 degrees. Measure the longitudinal vehicle attitude along both the left and right front sill. Determine the lateral vehicle attitude by measuring the vertical distance between a level surface and a standard reference point on the bottom of the left and right front side sills. The difference between the vertical distance measured on the left front side and the right front side sills is not more than ±10 mm. Close all windows, close and lock all doors, and close and secure any moveable roof panel, moveable shade, or removable roof structure in place over the occupant compartment. Remove roof racks or other non-structural components. For a vehicle built on a chassis-cab incomplete vehicle that has some portion of the added body structure above the height of the incomplete vehicle, remove the entire added body structure prior to testing (the vehicle's unloaded vehicle weight as specified in S5 includes the weight of the added body structure).

S7.2 Adjust the seats in accordance with S8.3.1 of 49 CFR 571.214. Position the top center of the head form specified in S5.2 of 49 CFR 571.201 at the location of the top center of the Head Restraint Measurement Device (HRMD) specified in 49 CFR 571.202a, in the front outboard designated seating position on the side of the vehicle being tested as follows:

(a) Position the three dimensional manikin specified in SAE Standard J826 JUL95 (incorporated by reference, see § 571.5), in accordance to the seating procedure specified in that document, except that the length of the lower leg and thigh segments of the H-point machine are adjusted to 414 and 401 millimeters, respectively, instead of the

50th percentile values specified in Table 1 of SAE J826 JUL95.

(b) Remove four torso weights from the three-dimensional manikin specified in SAE J826 (July 1995) (two from the left side and two from the right side), replace with two HRMD torso weights (one on each side), and attach and level the HRMD head form.

(c) Mark the location of the top center of the HRMD in three dimensional space to locate the top center of the head form specified in S5.2 of 49 CFR 571.201.

S7.3 Orient the test device as shown in Figure 1 of this section, so that—

(a) Its longitudinal axis is at a forward angle (in side view) of 5 degrees (±0.5 degrees) below the horizontal, and is parallel to the vertical plane through the vehicle's longitudinal centerline;

(b) Its transverse axis is at an outboard angle, in the front view projection, of 25 degrees below the horizontal (±0.5 degrees).

S7.4 Maintaining the orientation specified in S7.3 of this section—

(a) Lower the test device until it initially makes contact with the roof of the vehicle.

(b) Position the test device so that—

(1) The longitudinal centerline on its lower surface is within 10 mm of the initial point of contact, or on the center of the initial contact area, with the roof; and

(2) The midpoint of the forward edge of the lower surface of the test device is within 10 mm of the transverse vertical plane 254 mm forward of the forwardmost point on the exterior surface of the roof, including windshield trim, that lies in the longitudinal vertical plane passing through the vehicle's longitudinal centerline.

S7.5 Apply force so that the test device moves in a downward direction perpendicular to the lower surface of the test device at a rate of not more than 13 millimeters per second until reaching the force level specified in S5. Guide the test device so that throughout the test it moves, without rotation, in a straight line with its lower surface oriented as specified in S7.3(a) and S7.3(b). Complete the test within 120 seconds.

S7.6 Repeat the test on the other side of the vehicle.

S8. *Phase-in schedule for vehicles with a GVWR of 2,722 kilograms (6,000 pounds) or less.*

S8.1 *Vehicles manufactured on or after September 1, 2012, and before September 1, 2013.* For vehicles manufactured on or after September 1, 2012, and before September 1, 2013, the number of vehicles complying with this standard must not be less than 25 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2009, and before September 1, 2012; or

(b) The manufacturer's production on or after September 1, 2012, and before September 1, 2013.

S8.2 *Vehicles manufactured on or after September 1, 2013, and before September 1, 2014.* For vehicles manufactured on or after September 1, 2013, and before September 1, 2014, the number of vehicles complying with this standard must not be less than 50 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2010, and before September 1, 2013; or

(b) The manufacturer's production on or after September 1, 2013, and before September 1, 2014.

S8.3 *Vehicles manufactured on or after September 1, 2014, and before September 1, 2015.* For vehicles manufactured on or after September 1, 2014, and before September 1, 2015, the number of vehicles complying with this standard must not be less than 75 percent of:

(a) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2011, and before September 1, 2014; or

(b) The manufacturer's production on or after September 1, 2014, and before September 1, 2015.

S8.4 *Vehicles manufactured on or after September 1, 2015.* Except as provided in S8.8, each vehicle manufactured on or after September 1, 2015 must comply with this standard.

S8.5 *Calculation of complying vehicles.*

(a) For purpose of complying with S8.1, a manufacturer may count a vehicle if it is certified as complying with this standard and is manufactured on or after September 1, 2012, but before September 1, 2013.

(b) For purposes of complying with S8.2, a manufacturer may count a vehicle if it:

(1) Is certified as complying with this standard and is manufactured on or after September 1, 2012, but before September 1, 2014; and

(2) Is not counted toward compliance with S8.1.

(c) For purposes of complying with S8.3, a manufacturer may count a vehicle if it:

(1) Is certified as complying with this standard and is manufactured on or after September 1, 2012, but before September 1, 2015; and

(2) Is not counted toward compliance with S8.1 or S8.2.

S8.6 *Vehicles produced by more than one manufacturer*.

S8.6.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S8.1 through S8.3, a vehicle produced by more than one manufacturer must be attributed to a single manufacturer as follows, subject to S8.6.2:

(a) A vehicle that is imported must be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, must be attributed to the manufacturer that markets the vehicle.

S8.6.2 A vehicle produced by more than one manufacturer must be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR Part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S8.6.1.

S8.7 *Small volume manufacturers*. Vehicles manufactured during any of the three years of the September 1, 2012 through August 31, 2015 phase-in by a manufacturer that produces fewer than 5,000 vehicles for sale in the United States during that year are not subject to the requirements of S8.1, S8.2, and S8.3.

S8.8 *Final-stage manufacturers and alterers*.

Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter are not subject to the requirements of S8.1 through S8.3. Instead, all vehicles produced by these manufacturers on or after September 1, 2016 must comply with this standard.

S9 *Vehicles with a GVWR above 2,722 kilograms (6,000 pounds)*.

(a) Except as provided in S9(b), each vehicle manufactured on or after September 1, 2016 must comply with this standard.

(b) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S8.1 through S8.3. Instead, all vehicles produced by these manufacturers on or after September 1, 2017 must comply with this standard.

Figure 1 to §571.216

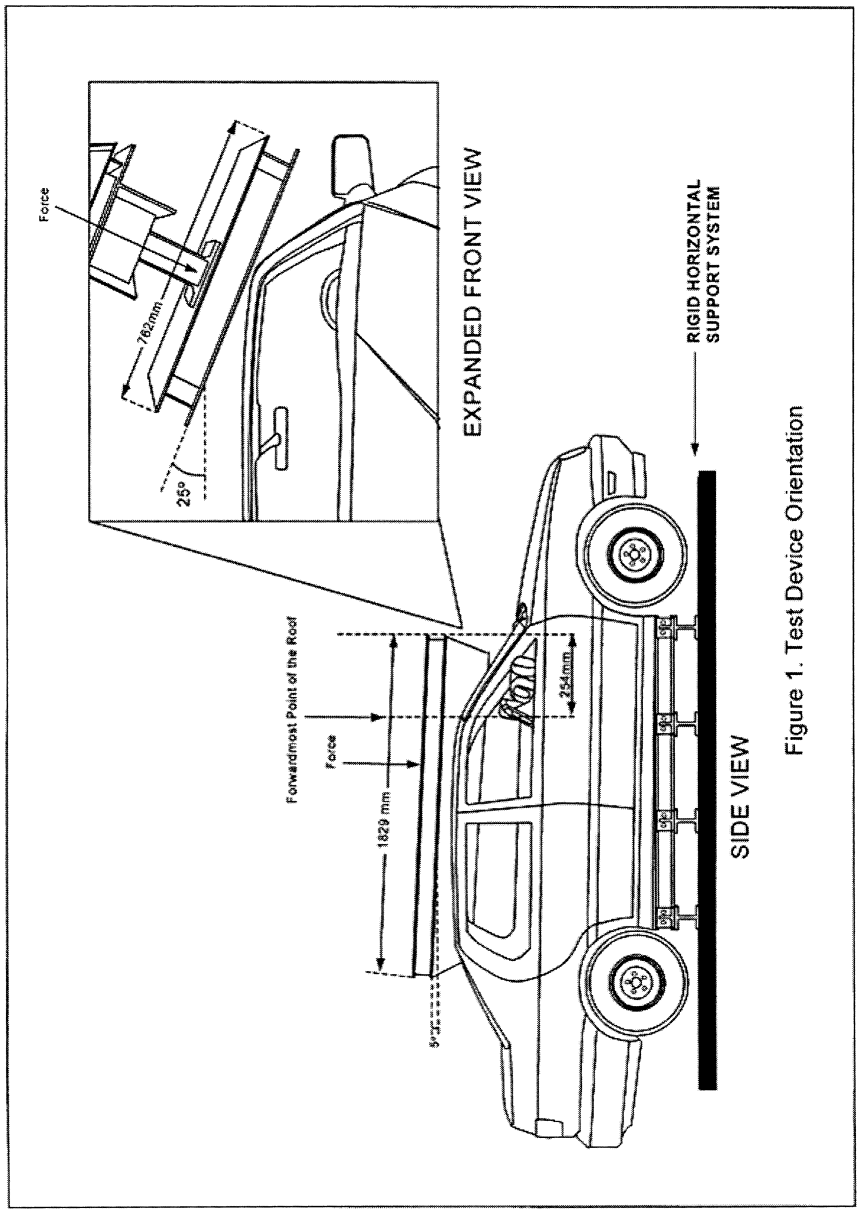


Figure 1. Test Device Orientation

[74 FR 22384, May 12, 2009, as amended at 75 FR 17605, Apr. 7, 2010; 77 FR 768, Jan. 6, 2012; 87 FR 18599, Mar. 30, 2022]

§ 571.217 Standard No. 217; Bus emergency exits and window retention and release.

S1. *Scope.* This standard establishes requirements for the retention of windows other than windshields in buses, and establishes operating forces, opening dimensions, and markings for bus emergency exits.

S2. *Purpose.* The purpose of this standard is to minimize the likelihood of occupants being thrown from the bus and to provide a means of readily accessible emergency egress.

S3. *Application.* This standard applies to buses, except buses manufactured for the purpose of transporting persons under physical restraint.

S4. *Definitions. Adjacent seat* means a designated seating position located so that some portion of its occupant space is not more than 10 inches from an emergency exit, for a distance of at least 15 inches measured horizontally and parallel to the exit.

Mid-point of the passenger compartment means any point on a vertical transverse plane bisecting the vehicle longitudinal centerline that extends between the two vertical transverse planes which define the foremost and rearmost limits of the passenger compartment.

Occupant space means the space directly above the seat and footwell, bounded vertically by the ceiling and horizontally by the normally positioned seat back and the nearest obstruction of occupant motion in the direction the seat faces.

Passenger compartment means space within the school bus interior that is between a vertical transverse plane located 76 centimeters in front of the forwardmost passenger seating reference point and a vertical transverse plane tangent to the rear interior wall of the bus at the vehicle centerline.

Post and roof bow panel space means the area between two adjacent post and roof bows.

Push-out window means a vehicle window designed to open outward to provide for emergency egress.

Sliding window means a bus window designed to open by moving vertically or horizontally to provide emergency egress.

Wheelchair means a wheeled seat frame for the support and conveyance of a physically disabled person, comprising at least a frame, seat, and wheels.

Wheelchair securement anchorage means the provision for transferring wheelchair securement device loads to the vehicle structure.

Wheelchair securement device means a strap, webbing or other device used for securing a wheelchair to the school bus, including all necessary buckles and other fasteners.

S5. *Requirements.*

S5.1 *Window retention.* Except as provided in S5.1.2, each piece of window glazing and each surrounding window frame when tested in accordance with the procedure in S5.1.1 under the conditions of S6.1 through S6.3, shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the passage of a 4-inch diameter sphere under a force, including the weight of the sphere, of 5 pounds until any one of the following events occurs:

(a) A force of 1,200 pounds is reached.

(b) At least 80 percent of the glazing thickness has developed cracks running from the load contact region to the periphery at two or more points, or shattering of the glazing occurs.

(c) The inner surface of the glazing at the center of force application has moved relative to the window frame, along a line perpendicular to the undisturbed inner surface, a distance equal to one-half of the square root of the minimum surface dimension measured through the center of the area of the entire sheet of window glazing.

S5.1.1 An increasing force shall be applied to the window glazing through the head form specified in Figure 4, outward and perpendicular to the undisturbed inside surface at the center of the area of each sheet of window glazing, with a head form travel of 2 inches per minute.

S5.1.2 The requirements of this standard do not apply to a window whose minimum surface dimension measured through the center of its area is less than 8 inches.

S5.2 *Provision of emergency exits.*

S5.2.1 Buses other than school buses shall meet the requirements of either

S5.2.2 or S5.2.3. School buses shall meet the requirements of S5.2.3.

S5.2.1.1 A bus with GVWR of more than 10,000 pounds may satisfy the unobstructed openings requirement by providing at least one side door for each three passenger seating positions in the vehicle.

S5.2.2 *Buses other than school buses.*

S5.2.2.1 Buses other than school buses shall provide unobstructed openings for emergency exit which collectively amount, in total square centimeters, to at least 432 times the number of designated seating positions on the bus. At least 40 percent of the total required area of unobstructed openings, computed in the above manner, shall be provided on each side of a bus. However, in determining the total unobstructed openings provided by a bus, no emergency exit, regardless of its area, shall be credited with more than 3,458 square centimeters of the total area requirement.

S5.2.2.2 *Buses with GVWR of more than 10,000 pounds.* Buses with a GVWR of more than 10,000 pounds shall meet the unobstructed openings requirements in S5.2.2.1 by providing side exits and at least one rear exit that conforms to S5.3 through S5.5. The rear exit shall meet the requirements of S5.3 through S5.5 when the bus is upright and when the bus is overturned on either side, with the occupant standing facing the exit. When the bus configuration precludes installation of an accessible rear exit, a roof exit that meets the requirements of S5.3 through S5.5 when the bus is overturned on either side, with the occupant standing facing the exit, shall be provided in the rear half of the bus.

S5.2.2.3 *Buses with GVWR of 10,000 pounds or less.* Buses other than school buses with GVWR of 10,000 pounds or less may meet the unobstructed openings requirement in S5.2.2.1 by providing:

(a) Devices that meet the requirements of S5.3 through S5.5 without using remote controls or central power systems;

(b) Windows that can be opened manually to a position that provides an opening large enough to admit unobstructed passage, keeping a major axis horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 50 centimeters and a minor axis of 33 centimeters; or

(c) Doors.

S5.2.3 *School buses.* Except as provided in S5.2.3.4, each school bus shall comply with S5.2.3.1 through S5.2.3.3.

S5.2.3.1. Each school bus shall be equipped with the exits specified in either S5.2.3.1(a) or S5.2.3.1(b), chosen at the option of the manufacturer.

(a) One rear emergency door that opens outward and is hinged on the right side (either side in the case of a bus with a GVWR of 10,000 pounds or less), and the additional exits, if any, specified by Table 1.

(b) One emergency door on the vehicle's left side that is hinged on its forward side and meets the requirements of S5.2.3.2(a), and a push-out rear window that provides a minimum opening clearance 41 centimeters high and 122 centimeters wide and meets the requirements of S5.2.3.2(c), and the additional exits, if any, specified by Table 2.

TABLE 1

Seating capacity	Additional exits required*
1–45	None.
46–62	1 left side exit door or 2 exit windows.
63–70	1 left side exit door or 2 exit windows, and 1 roof exit.
71 and above.	1 left side exit door or 2 exit windows, and 1 roof exit, and any combination of door, roof, or windows such that the total capacity credit specified in Table 3 for these exits, plus 70, is greater than the seating capacity of the bus.

*Side emergency exit doors must meet the requirements of S5.2.3.2(a), emergency roof exits must meet the requirements of S5.2.3.2(b), emergency window exits must meet the requirements of S5.2.3.2(c).

TABLE 2

Seating capacity	Additional exits required*
1–57	None.
58–74	1 right side exit door or 2 exit windows.
75–82	1 right side exit door or 2 exit windows, and 1 roof exit.
83 and above.	1 right side exit door or 2 windows, and 1 roof exit, and any combination of door, roof, or windows such that the total capacity credit specified in Table 3 for these exits plus 82 is greater than the capacity of the bus.

*Side emergency exit doors must meet the requirements of S5.2.3.2(a), emergency roof exits must meet the requirements of S5.2.3.2(b), emergency window exits must meet the requirements of S5.2.3.2(c).

TABLE 3

Exit Type	Capacity Credit
Side Door	16
Window	8
Roof Exit	8

(c) The area of an opening equipped with a wheelchair lift may be credited toward the required additional exits if it meets the requirements of paragraphs (a) or (b) of S5.2.3.1 and if the lift folds or stows in such a manner that the area is available for use by persons not needing the lift. With the lift in the folded or stowed position, such opening is considered a side emergency exit door.

S5.2.3.2 All emergency exits required by S5.2.3.1(a) and S5.2.3.1(b) shall meet the following criteria:

(a) *Side emergency exit doors.*

(1) Each side emergency exit door shall be hinged on its forward side.

(2) The first side emergency exit door installed pursuant to Table 1, shall be located on the left side of the bus and as near as practicable to the mid-point of the passenger compartment. A second side emergency exit door installed pursuant to Table 1 shall be located on the right side of the bus. In the case of a bus equipped with three side emergency door exits pursuant to Table 1, the third shall be located on the left side of the bus.

(3) The first side emergency exit door installed pursuant to Table 2 shall be located on the right side of the bus. A second side emergency door exit installed pursuant to Table 2 shall be located on the left side of the bus. In the case of a bus equipped with three side emergency door exits pursuant to Table 2, the third shall be located on the right side of the bus.

(4) No two side emergency exit doors shall be located, in whole or in part, within the same post and roof bow panel space.

(b) *Emergency roof exit.* (1) Each emergency roof exit shall be hinged on its forward side, and shall be operable from both inside and outside the vehicle.

(2) In a bus equipped with a single emergency roof exit, the exit shall be located as near as practicable to the midpoint of the passenger compartment.

(3) In a bus equipped with two emergency roof exits, one shall be located as near as practicable to a point equidistant between the midpoint of the passenger compartment and the foremost limit of the passenger compartment and the other shall be located as near as practicable to a point equidistant between the midpoint of the passenger compartment and the rearmost point of the passenger compartment.

(4) In a bus equipped with three or more emergency roof exits, the roof exits shall be installed so that, to the extent practicable, the longitudinal distance between each pair of adjacent roof exits is the same and equal to the distance from the foremost point of the passenger compartment to the foremost roof exit and to the distance from the rearmost point of that compartment to the rearmost roof exit.

(5) Except as provided in paragraph (b)(6) of this section, each emergency roof exit shall be installed with its longitudinal centerline coinciding with a longitudinal vertical plane passing through the longitudinal centerline of the school bus.

(6) In a bus equipped with two or more emergency roof exits, for each roof exit offset from the longitudinal vertical plane specified in paragraph (b)(5) of this section, there shall be another roof exit offset from that plane an equal distance to the other side.

(c) *Emergency exit windows.* A bus equipped with emergency exit windows shall have an even number of such windows, not counting the push-out rear window required by S5.2.3.1(b). Any side emergency exit windows shall be evenly divided between the right and left sides of the bus. School buses shall not be equipped with horizontally-sliding emergency exit windows. Further, except for buses equipped with rear push-out emergency exit windows in accordance with S5.2.3.1(b), school buses shall not be equipped with both sliding and push-out emergency exit windows.

S5.2.3.3 The engine starting system of a bus shall not operate if any emergency exit is locked from either inside or outside the bus. For purposes of this

requirement, ''locked'' means that the release mechanism cannot be activated and the exit opened by a person at the exit without a special device such as a key or special information such as a combination.

S5.2.3.4 Each school bus manufactured before September 1, 1994 may, at the manufacturer's option, comply with either S5.2.3.4(a) or S5.2.3.4(b) instead of S5.2.3.1 through S5.2.3.3.

(a) Each bus shall be equipped with one rear emergency door that opens outward and is hinged on the right side (either side in the case of a bus with a GVWR of 4,536 kilograms or less); or

(b) Each bus shall be equipped with one emergency door on the vehicle's left side that is hinged on its forward side and meets the requirements of S5.2.3.2(a), and a push-out rear window that provides a minimum opening clearance 41 centimeters high and 122 centimeters wide and meets the requirements of S5.2.3.2(c).

S5.3 *Emergency exit release.*

S5.3.1 Each emergency exit not required by S5.2.3 shall be releasable by operating one or two mechanisms located within the regions specified in Figure 1, Figure 2, or Figure 3. The lower edge of the region in Figure 1, and Region B in Figure 2, shall be located 13 centimeters above the adjacent seat, or 5 centimeters above the arm rest, if any, whichever is higher.

S5.3.2 (a) When tested under the conditions of S6, both before and after the window retention test required by S5.1, each emergency exit not required by S5.2.3 shall allow manual release of the exit by a single person, from inside the passenger compartment, using force applications each of which conforms, at the option of the manufacturer, either to S5.3.2.1(a) or S5.3.2.1(b).

(b) Each exit described in S5.3.2(a) shall have no more than two release mechanisms. For exits with one release mechanism, the exit shall require two force applications to open the exit: One force application shall be applied to the mechanism and another force application shall be applied to open the exit. The force application for the release mechanism must differ by not less than 90 degrees and not more than 180 degrees from the direction of the initial motion to open the exit. For exits with two release mechanisms, there shall be a total of three force applications to open the exit: One force application shall be applied to each of the two mechanisms to release each mechanism, and another force shall be applied to open the exit. The force application for at least one of the release mechanisms must differ by not less than 90 degrees and not more than 180 degrees from the direction of the initial motion to open the exit. The force applications for the mechanism(s) must conform to either S5.3.2.1(a) or S5.3.2.1(b), as appropriate.

S5.3.2.1(a) *Low-force application.*

(1) Location: As shown in Figure 1 or Figure 3.

(2) Type of motion: Rotary or straight.

(3) Magnitude: Not more than 90 N.

(b) *High-force application.*

(1) Location: As shown in Figure 2 or Figure 3.

(2) Type of motion: Straight and perpendicular to the undisturbed exit surface.

(3) Magnitude: Not more than 270 N.

S5.3.3 *School bus emergency exit release.*

S5.3.3.1 When tested under the conditions of S6., both before and after the window retention test required by S5.1, each school bus emergency exit door shall allow manual release of the door by a single person, from both inside and outside the passenger compartment, using a force application that conforms to S5.3.3.1 (a) through (c) of this section, except a school bus with a GVWR of 10,000 pounds or less is not required to conform to S5.3.3.1 (a). The release mechanism shall operate without the use of remote controls or tools, and notwithstanding any failure of the vehicle's power system. When the release mechanism is not in the position that causes an emergency exit door to be closed and the vehicle's ignition is in the ''on'' position, a continuous warning sound shall be audible at the driver's seating position and in the vicinity of the emergency exit door.

(a) *Location:* Within the high force access region shown in Figure 3A for a side emergency exit door, within the high force access region shown in both Figure 3D(1) and Figure 3D(2) for an interior release mechanism for a rear

emergency exit door, and within the high force access region shown in Figure 3D(1) for an exterior release mechanism for a rear emergency exit door.

(b) Type of motion: Upward from inside the bus and, at the discretion of the manufacturer, from outside the bus. Buses with a GVWR of 10,000 pounds or less shall provide interior release mechanisms that operate by either an upward or pull-type motion. The pull-type motion shall be used only when the release mechanism is recessed in such a manner that the handle, level, or other activating device, before being activated, does not protrude beyond the rim of the recessed receptacle.

(c) *Magnitude of force:* Not more than 178 newtons.

S5.3.3.2 When tested under the conditions of S6., both before and after the window retention test required by S5.1, each school bus emergency exit window shall allow manual release of the exit by a single person, from inside the passenger compartment, using not more than two release mechanisms located in specified low-force or high-force regions (at the option of the manufacturer) with force applications and types of motions that conform to either S5.3.3.2 (a) or (b) of this section. In the case of windows with one release mechanism, the mechanism shall require two force applications to release the exit. In the case of windows with two release mechanisms, each mechanism shall require one application to release the exit. At least one of the force applications for each window shall differ from the direction of the initial motion to open the exit by no less than 90° and no more than 180°. Each release mechanism shall operate without the use of remote controls or tools, and notwithstanding any failure of the vehicle's power system. When a release mechanism is open and the vehicle's ignition is in the ''on'' position, a continuous warning shall be audible at the drivers seating position and in the vicinity of that emergency exit.

(a) Emergency exit windows—Low-force application.

(1) *Location:* Within the low-force access regions shown in Figures 1 and 3 for an emergency exit window.

(2) *Type of motion:* Rotary or straight.

(3) *Magnitude:* Not more than 89 newtons.

(b) Emergency exit windows—High-force application.

(1) *Location:* Within the high-force access regions shown in Figures 2 and 3 for an emergency exit window.

(2) *Type of motion:* Straight and perpendicular to the undisturbed exit surface.

(3) *Magnitude:* Not more than 178 newtons.

S5.3.3.3 When tested under the conditions of S6., both before and after the window retention test required by S5.1, each school bus emergency roof exit shall allow manual release of the exit by a single person from both inside and outside the passenger compartment, using not more than two release mechanisms located at specified low-force or high-force regions (at the option of the manufacturer) with force applications and types of motions that conform either to S5.3.3.3 (a) or (b) of this section. In the case of roof exits with one release mechanism, the mechanism shall require two force applications to release the exit. In the case of roof exits with two release mechanisms, each mechanism shall require one application to release the exit. At least one of the force applications for each roof exit shall differ from the direction of the initial push-out motion of the exit by no less than 90° and no more than 180°.

(a) Emergency roof exits—Low-force application.

(1) *Location:* Within the low force access regions shown in Figure 3B, in the case of buses whose roof exits are not offset from the plane specified in S5.2.3.2(b)(5). In the case of buses which have roof exits offset from the plane specified in S5.2.3.2(b)(5), the amount of offset shall be used to recalculate the dimensions in Figure 3B for the offset exits.

(2) *Type of motion:* Rotary or straight.

(3) *Magnitude:* Not more than 89 newtons.

(b) Emergency roof exits—High-force application.

(1) *Location:* Within the high force access regions shown in Figure 3B, in the case of buses whose roof exits are not offset from the plane specified in S5.2.3.2(b)(5). In the case of buses which have roof exits offset from the plane

specified in S5.2.3.2(b)(5), the amount of offset shall be used to recalculate the dimensions in Figure 3B for the offset exits.

(2) *Type of motion:* Straight and perpendicular to the undisturbed exit surface.

(3) *Magnitude:* Not more than 178 newtons.

S5.4 *Emergency exit opening.*

S5.4.1 After the release mechanism has been operated, each emergency exit not required by S5.2.3 shall, under the conditions of S6., both before and after the window retention test required by S5.1, using the reach distances and corresponding force levels specified in S5.3.2, allow manual opening by a single occupant to a position that provides an opening large enough to admit unobstructed passage, keeping a major axis horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 50 centimeters and a minor axis of 33 centimeters.

S5.4.2 *School bus emergency exit opening.*

S5.4.2.1 *School buses with a GVWR of more than 10,000 pounds.*

(a) *Emergency exit doors.* After the release mechanism has been operated, each emergency exit door of a school bus shall, under the conditions of S6., before and after the window retention test required by S5.1, using the force levels specified in S5.3.3, be manually extendable by a single person to a position that permits:

(1) In the case of a rear emergency exit door, an opening large enough to permit unobstructed passage into the bus of a rectangular parallelepiped 1,145 millimeters (45 inches) high, 610 millimeters (24 inches) wide, and 305 millimeters (12 inches) deep, keeping the 1,145 millimeter (45 inch) dimension vertical, the 610 (24 inch) millimeter dimension parallel to the opening, and the lower surface in contact with the floor of the bus at all times, until the bottom edge of the rearmost surface of the parallelepiped is tangent to the plane of the door opening; and

(2) In the case of a side emergency exit door, an opening at least 114 centimeters high and 61 centimeters wide.

(i) Except as provided in paragraph (a)(2)(ii) of this section, no portion of a seat or a restraining barrier shall be installed within the area bounded by the opening of a side emergency exit door, a vertical transverse plane tangent to the rearward edge of the door opening frame, a vertical transverse plane parallel to that plane at a distance of 30 centimeters forward of that plane, and a longitudinal vertical plane passing through the longitudinal centerline of the bus. (See Figure 5A).

(ii) A seat bottom may be located within the area described in paragraph (a)(2)(i) of this section if the seat bottom pivots and automatically assumes and retains a vertical position when not in use, so that no portion of the seat bottom is within the area described in paragraph (i) when the seat bottom is vertical. (See Figure 5B).

(iii) No portion of a seat or restraining barrier located forward of the area described in paragraph (a)(2)(i) of this section and between the door opening and a longitudinal vertical plane passing through the longitudinal centerline of the bus shall extend rearward of a vertical transverse plane tangent to the forwardmost portion of a latch mechanism on the door. (See Figures 5B and 5C.)

(3)(i) Each emergency exit door of a school bus shall be equipped with a positive door opening device that, after the release mechanism has been operated, under the conditions of S6, before and after the window retention test required by S5.1—

(A) Bears the weight of the door;

(B) Keeps the door from closing past the point at which the door is perpendicular to the side of the bus body, regardless of the body's orientation; and

(C) Provides a means for release or override.

(ii) The positive door opening device shall perform the functions specified in paragraph (a)(3)(i) (A) and (B) of this section without the need for additional action beyond opening the door past the point at which the door is perpendicular to the side of the bus body.

(b) *Emergency roof exits.* After the release mechanism has been operated, each emergency roof exit of a school bus shall, under the conditions of S6, before and after the window retention test required by S5.1, using the force levels specified in S5.3.3, be manually

extendable by a single person to a position that permits an opening at least 41 centimeters high and 41 centimeters wide.

(c) *Emergency exit windows.* After the release mechanism has been operated, each emergency exit window of a school bus shall, under the conditions of S6., both before and after the window retention test of S5.1, using force levels specified in S5.3.3.2, be manually extendable by a single occupant to a position that provides an opening large enough to admit unobstructed passage, keeping a major axis horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 50 centimeters and a minor axis of 33 centimeters.

S5.4.2.2 *School buses with a GVWR of 10,000 pounds or less.* A school bus with a GVWR of 10,000 pounds or less shall conform to all the provisions of S5.4.2, except that the parallelepiped dimension for the opening of the rear emergency door or doors shall be 45 inches high, 22 inches wide, and six inches deep.

S5.4.3 Restriction on wheelchair anchorage location.

S5.4.3.1 Except as provided in paragraph S5.4.3.2 of this section, no portion of a wheelchair securement anchorage shall be located in a school bus such that:

(a) In the case of side emergency exit doors, any portion of the wheelchair securement anchorage is within the space bounded by the interior side wall and emergency exit door opening, transverse vertical planes 305 mm (12 inches) forward and rearward of the center of any side emergency exit door restricted area, and a longitudinal vertical plane through the longitudinal centerline of the school bus, as shown in Figure 6A.

(b) In the case of rear emergency exit doors in school buses, using the parallelepiped described in S5.4.2.1(a)(1) (for school buses with a GVWR greater than 10,000 lb) or S5.4.2.2 (for school buses with a GVWR of 10,000 lb or less), when the parallelepiped is positioned, as described in S5.4.2.1(a), flush with the floor and with the rear surface of the parallelepiped tangent to the opening of the rear emergency exit door, there must not be any portion of a wheelchair securement anchorage within the space occupied by the parallelepiped or within the downward vertical projection of the parallelepiped, as shown in Figure 6C.

S5.4.3.2 The restriction in S5.4.3.1(a) of this section does not apply to tracks or track-type devices that are used for mounting seats and/or for wheelchair securement devices.

S5.4.4 *Protrusion Limit on Emergency Exit Window Latches and other related mechanisms.* For buses applicable under S3 of this standard, manufactured on or after October 30, 2027, any emergency exit window latch and other related release mechanisms shall not protrude more than 25 mm (1 inch) into the opening of the emergency exit window when that window is in the open position as described under S5.4.1 and S5.4.2.

S5.5 *Emergency exit identification.*

S5.5.1 In buses other than school buses, and except for windows serving as emergency exits in accordance with S5.2.2.3(b) and doors in buses with a GVWR of 10,000 pounds or less, each emergency exit door shall have the designation ''Emergency Door'' or ''Emergency Exit,'' and every other emergency exit shall have the designation ''Emergency Exit'' followed by concise operating instructions describing each motion necessary to unlatch and open the exit, located within 16 centimeters of the release mechanism.

Examples: (1) Lift to Unlatch, Push to Open (2) Lift Handle and Push out to Open

When a release mechanism is not located within an occupant space of an adjacent seat, a label meeting the requirements of S5.5.2 that indicates the location of the nearest release mechanism shall be placed within the occupant space.

Example: ''Emergency Exit Instructions Located Next to Seat Ahead''

S5.5.2 *In buses other than school buses.* Except as provided in S5.5.2.1, each marking shall be legible, when the only source of light is the normal nighttime illumination of the bus interior, to occupants having corrected visual acuity of 20/40 (Snellen ratio) seated in the adjacent seat, seated in the seat directly adjoining the adjacent seat, and standing in the aisle location

that is closest to that adjacent seat. The marking shall be legible from each of these locations when the other two corresponding locations are occupied.

S5.5.2.1 If the exit has no adjacent seat, the marking must meet the legibility requirements of S5.5.2 for occupants standing in the aisle location nearest to the emergency exit, except for a roof exit, which must meet the legibility requirements for occupants positioned with their backs against the floor opposite the roof exit.

S5.5.3 *School Bus.*

(a) Each school bus emergency exit provided in accordance with S5.2.3.1 shall have the designation ''Emergency Door'' or ''Emergency Exit,'' as appropriate, in letters at least 5 centimeters high, of a color that contrasts with its background. For emergency exit doors, the designation shall be located at the top of, or directly above, the emergency exit door on both the inside and outside surfaces of the bus. The designation for roof exits shall be located on an inside surface of the exit, or within 30 centimeters of the roof exit opening. For emergency window exits, the designation shall be located at the top of, or directly above, or at the bottom of the emergency window exit on both the inside and outside surfaces of the bus.

(b) Concise operating instructions describing the motions necessary to unlatch and open the emergency exit shall be located within 15 centimeters of the release mechanism on the inside surface of the bus. These instructions shall be in letters at least 1 centimeter high and of a color that contrasts with its background.

Examples: (1) Lift to Unlatch, Push to Open

(2) Turn Handle, Push Out to Open

(c) Each opening for a required emergency exit shall be outlined around its outside perimeter with a retroreflective tape with a minimum width of 2.5 centimeters and either red, white, or yellow in color, that when tested under the conditions specified in S6.1 of Standard No. 131 (49 CFR 571.131), meets the criteria specified in Table 1 of that section.

(d) On the inside surface of each school bus with one or more wheelchair anchorage positions, there shall be a label directly beneath or above each ''Emergency Door'' or ''Emergency Exit'' designation specified by paragraph (a) of S5.5.3 of this standard for an emergency exit door or window. The label shall state in letters at least 25 mm (one inch) high, the words ''DO NOT BLOCK'' in a color that contrasts with the background of the label.

S6. *Test conditions.*

S6.1 The vehicle is on a flat, horizontal surface.

S6.2 The inside of the vehicle and the outside environment are kept at any temperature from 70° to 85 °Fahrenheit for 4 hours immediately preceding the tests, and during the tests.

S6.3 For the window retention test, windows are installed, closed, and latched (where latches are provided) in the condition intended for normal bus operation.

S6.4 For the emergency exit release and extension tests, windows are installed as in S6.3, seats, armrests, and interior objects near the windows are installed as for normal use, and seats are in the upright position.

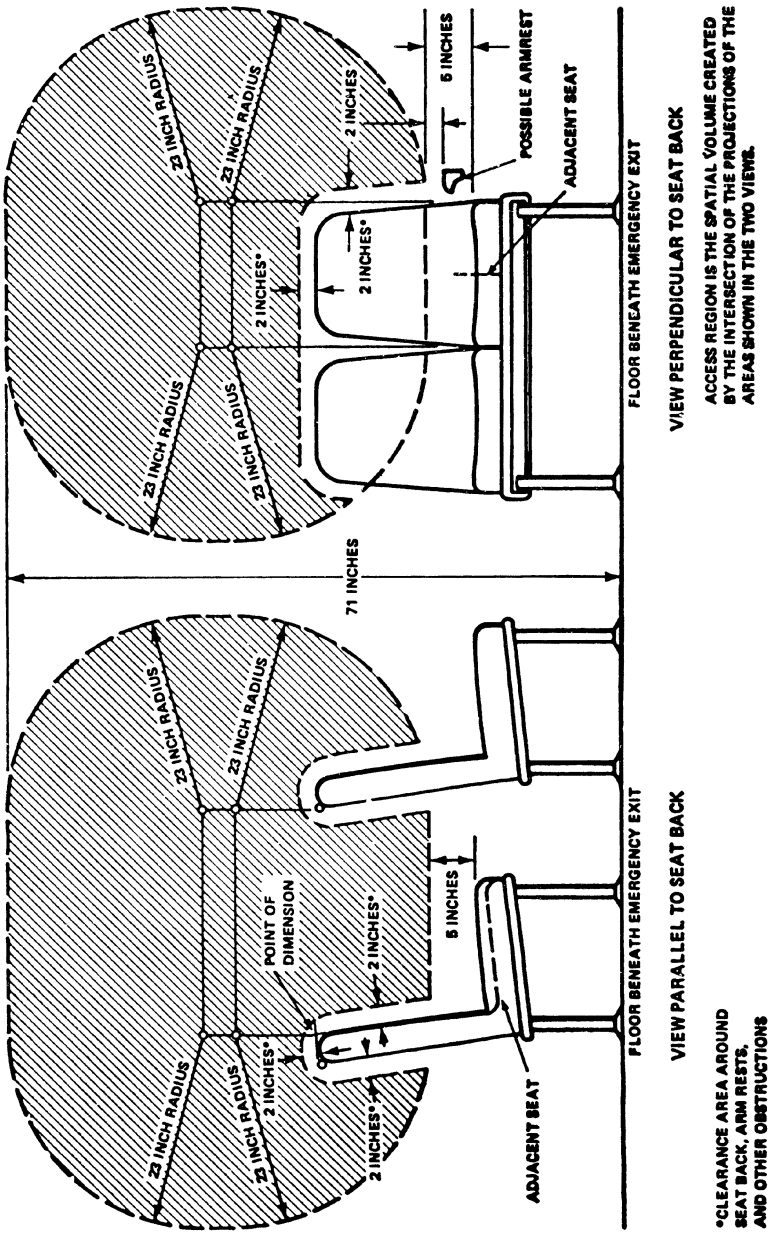


FIGURE 1 LOW-FORCE ACCESS REGION FOR EMERGENCY EXITS HAVING ADJACENT SEATS

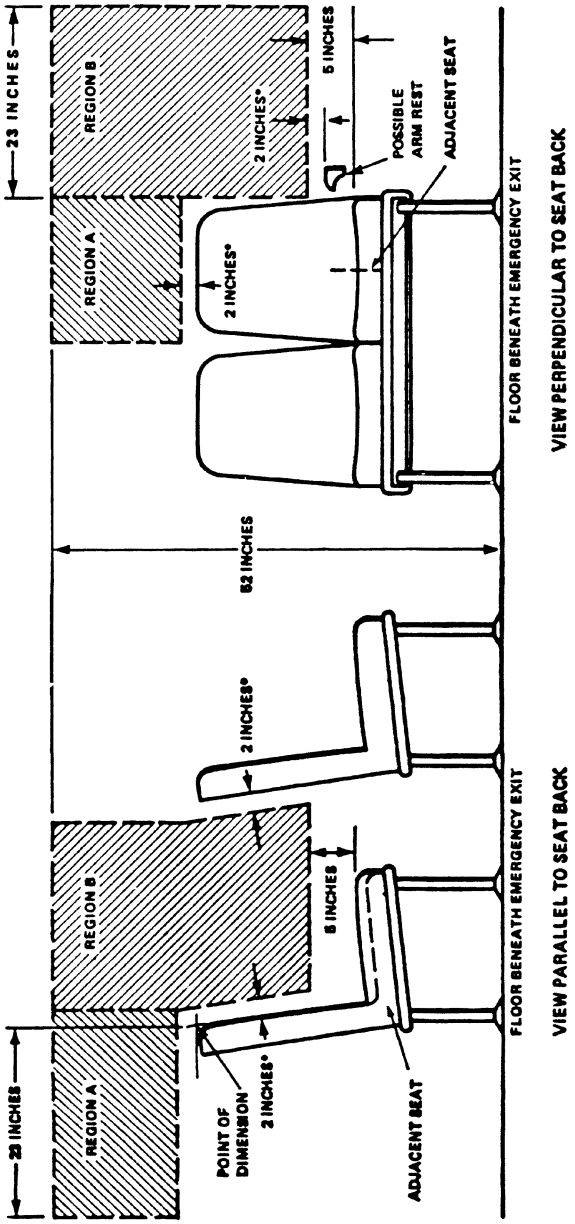
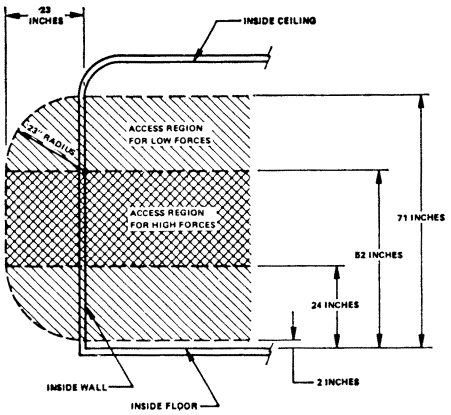
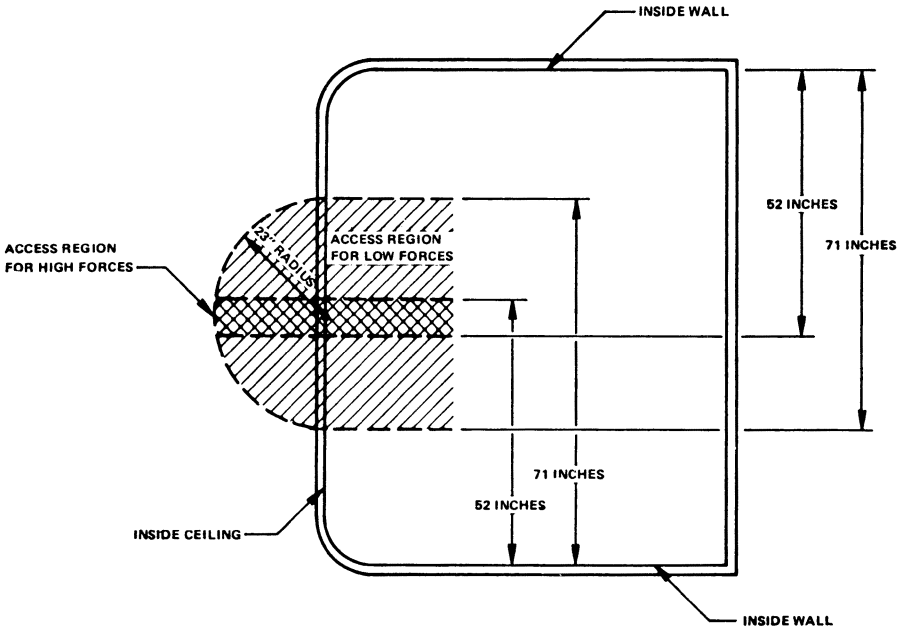


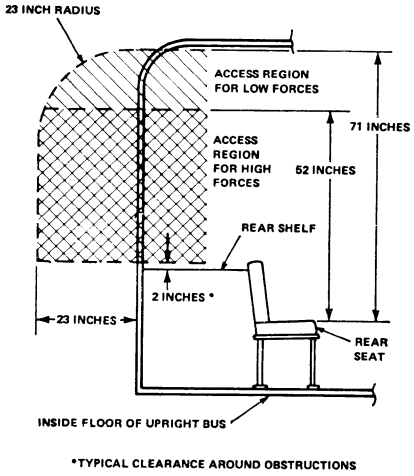
FIGURE 2 HIGH-FORCE ACCESS REGIONS FOR EMERGENCY EXITS HAVING ADJACENT SEATS



3A. SIDE EMERGENCY EXIT



3B. ROOF EMERGENCY EXIT



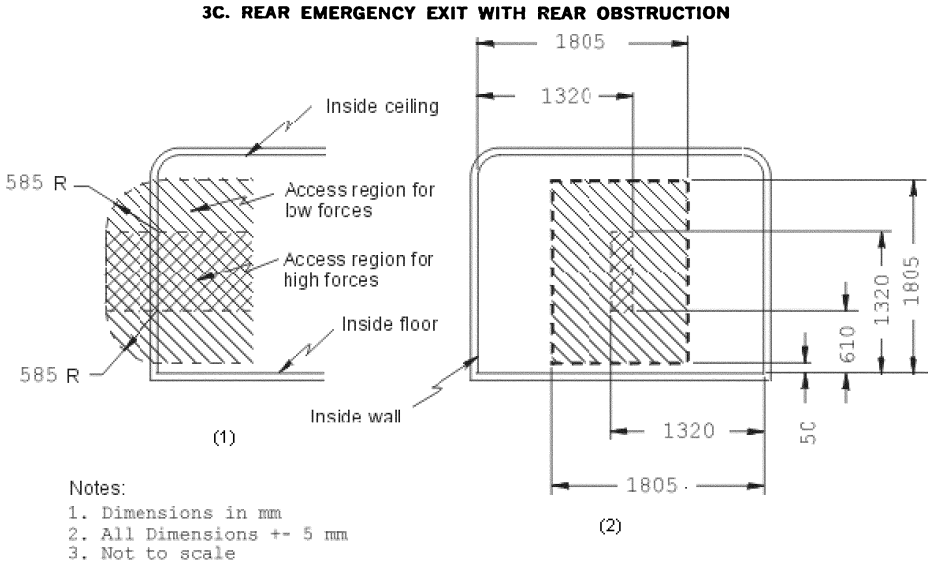


Figure 3D

FIGURE 3 LOW AND HIGH-FORCE ACCESS REGIONS FOR EMERGENCY EXITS WITHOUT ADJACENT SEATS

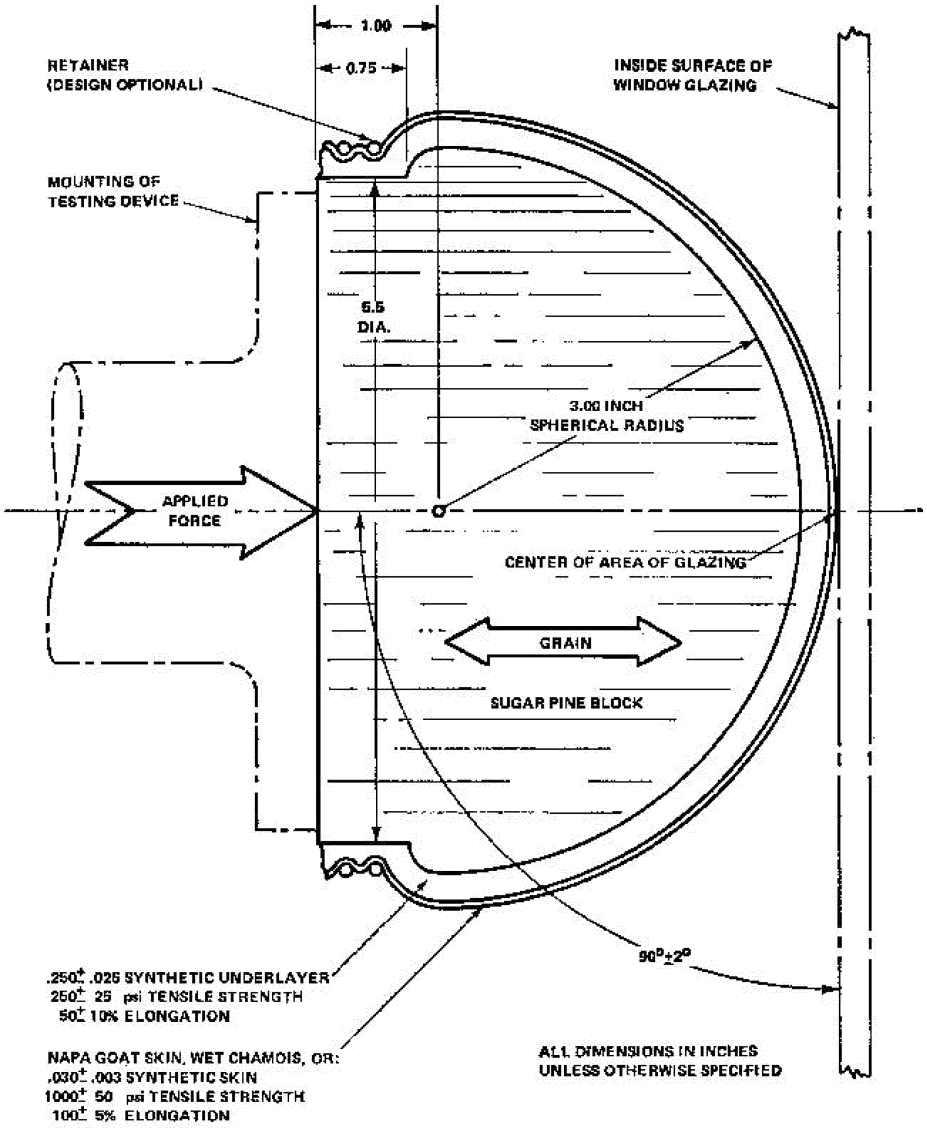


FIGURE 4 HEAD FORM

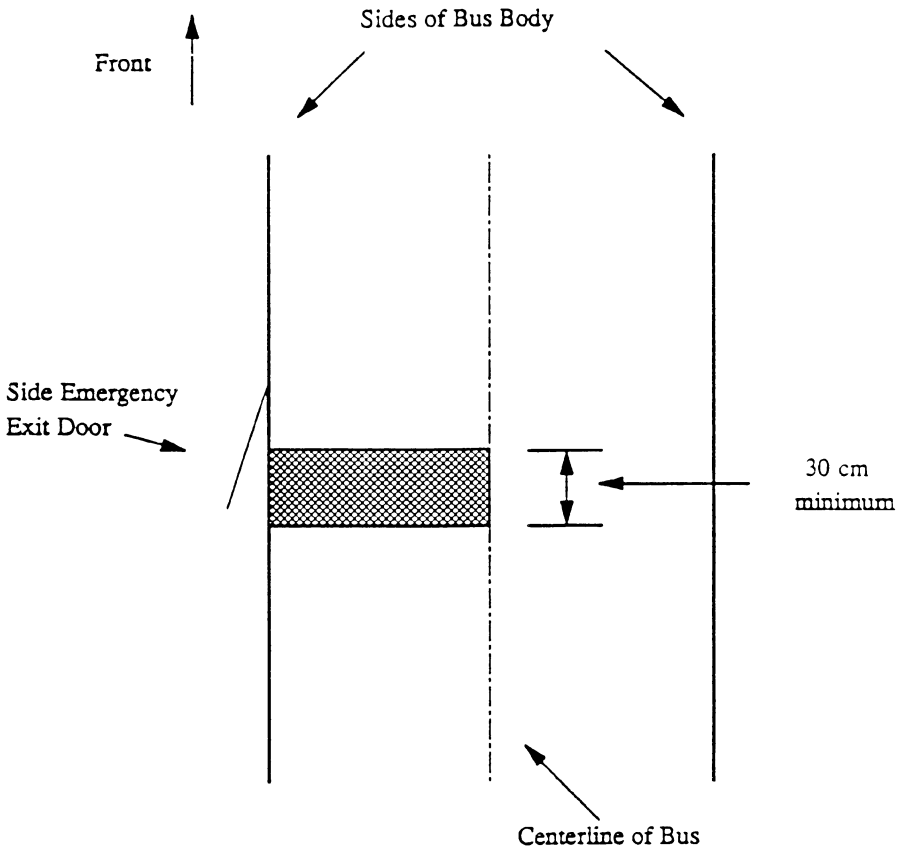


Figure 5A. Minimum Side Emergency Exit Clearance Specifications (Plan View)

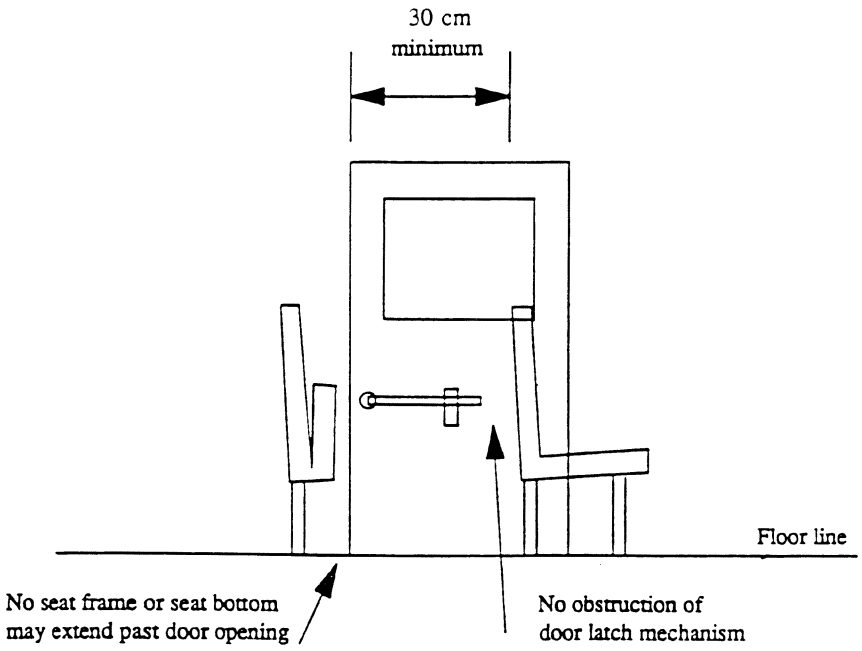


Figure 5B. Minimum Side Emergency Exit Flip-Up Seat Clearance Specifications

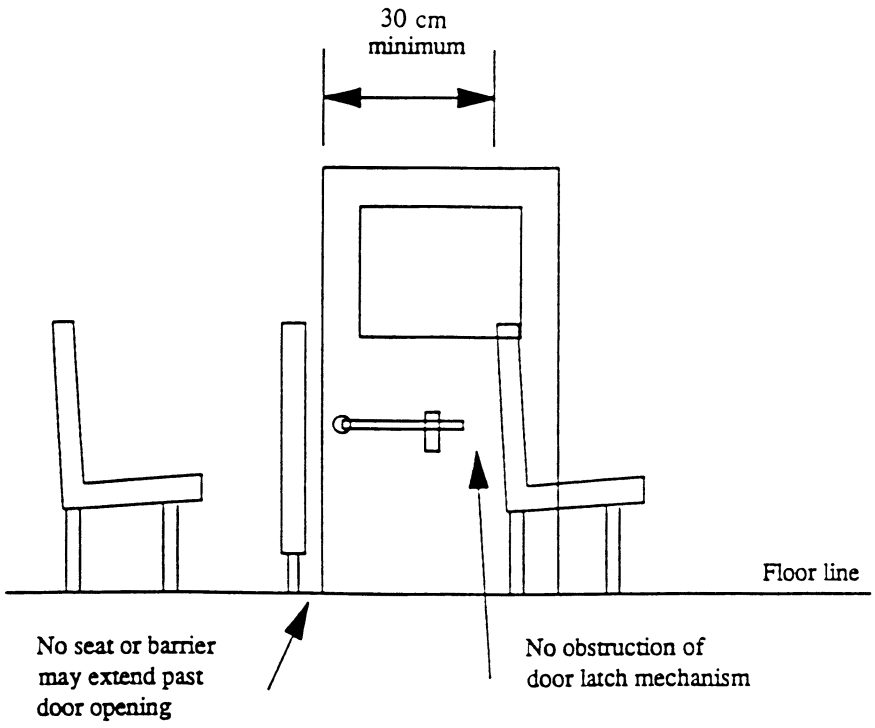


Figure 5C. Minimum Side Emergency Exit Clearance Specifications

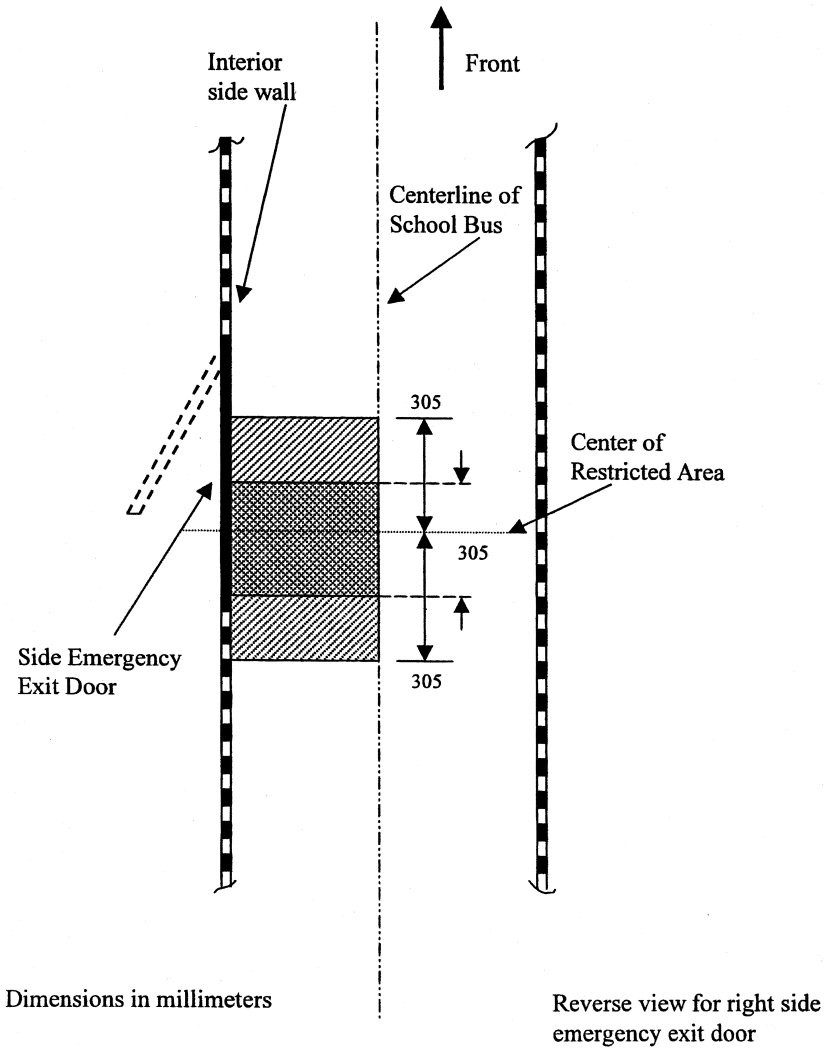
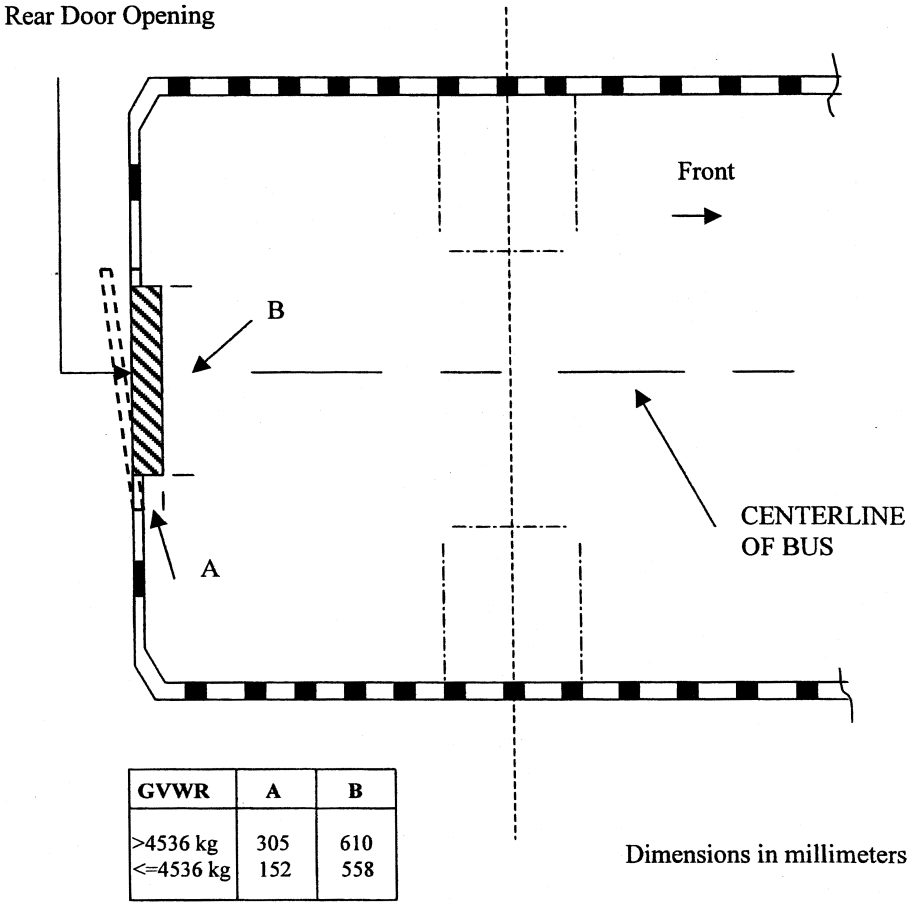


Figure 6A. Side Emergency Exit – No Wheelchair Anchorages within the shaded region

FIGURE 6B [RESERVED]



GVWR	A	B
>4536 kg	305	610
<=4536 kg	152	558

Figure 6C. Rear Door Emergency Exit - No Wheelchair Anchorages within the shaded region

FIGURE 6D [RESERVED]

Table 1. Minimum Specific Intensity Per Unit Area (SIA)

(Candelas per Footcandle Per Square Foot)

Type III Retroreflective Material

A - Glass Bead Retroreflective Element Material

Observation Angle (°)	Entrance Angle (°)	White	Red	Yellow
0.2	-4	250	45	170
0.2	+30	150	25	100
0.5	-4	95	15	62
0.5	+30	65	10	45

B - Prismatic Retroreflectve Element Material

Observation Angle (°)	Entrance Angle (°)	White	Red	Yellow
0.2	-4	250	45	170
0.2	+30	95	13.3	64
0.5	-4	200	28	136
0.5	+30	65	10	45

[37 FR 9395, May 10, 1972]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.217, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.217a Standard No. 217a; Anti-ejection glazing for bus portals; Mandatory applicability beginning October 30, 2027.

S1. *Scope.* This standard establishes requirements to improve side and roof bus portals by way of glazing that is highly resistant to partial or complete occupant ejection in all types of crashes.

S2. *Purpose.* The purpose of this standard is to reduce death and injuries resulting from complete and partial ejections of bus occupants through side and roof portals during rollovers and other crashes.

S3. *Application.*

(a) Subject to S3(b) of this section, this standard applies to:

(1) Over-the-road buses manufactured on or after October 30, 2027, and

(2) Buses, other than over-the-road buses, that have a gross vehicle weight rating (GVWR) greater than 11,793 kilograms (kg) manufactured on or after October 30, 2027.

(b) This standard does not apply to school buses, transit buses, prison buses, and perimeter-seating buses.

S4. *Definitions*.

Daylight opening means, for openings on the side of the vehicle (other than a door opening), the locus of all points where a horizontal line, perpendicular to the vehicle longitudinal centerline, is tangent to the periphery of the opening. For openings on the roof of the vehicle, daylight opening means the locus of all points where a vertical line is tangent to the periphery of the opening. The periphery includes surfaces 100 millimeters (mm) inboard of the inside surface of the window glazing and 25 mm outboard of the outside surface of the window glazing. The periphery excludes the following: Any flexible gasket material or weather stripping used to create a waterproof seal between the glazing and the vehicle interior; grab handles used to facilitate occupant egress and ingress; and any part of a seat.

Over-the-road bus means a bus characterized by an elevated passenger deck located over a baggage compartment.

Perimeter-seating bus means a bus with 7 or fewer designated seating positions rearward of the driver's seating position that are forward-facing or can convert to forward-facing without the use of tools.

Portal means an opening that could, in the event of a crash involving the vehicle, permit the partial or complete ejection of an occupant from the vehicle, including a young child.

Prison bus means a bus manufactured for the purpose of transporting persons subject to involuntary restraint or confinement and has design features consistent with that purpose.

Stop-request system means a vehicle-integrated system for passenger use to signal to a vehicle operator that they are requesting a stop.

Transit bus means a bus that is equipped with a stop-request system sold for public transportation provided by, or on behalf of, a Federal, State, or local government and that is not an over-the-road bus.

S5. *Requirements*. When tested according to the procedures specified in S6 of this section and under the conditions specified in paragraph S7 of this section, each applicable bus shall meet the following requirements specified in this section. The requirements of this paragraph S5 n do not apply to portals other than side and roof portals, and do not apply to a side or roof portal whose minimum surface dimension measured through the center of its area is less than 279 mm.

S5.1 *Edge impact*.

(a) When the ejection impactor described in S8 of this section contacts the target location specified in S6.1.1 of this section of each side or roof daylight opening of a vehicle at 21.6 km/h ± 0.4 km/h, no portion of the window (excluding glazing shards) may pass the ejection reference plane defined under the procedures of S6 of this section.

(b) Each piece of window glazing and each surrounding window frame shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the complete passage of a 102 mm diameter sphere when a force of no more than 22 newtons (N) is applied with the sphere at any vector in a direction from the interior to the exterior of the vehicle.

S5.2 *Center impact*.

(a) When the ejection impactor described in paragraph S8 of this section contacts the target location specified in paragraph S6.1.2 of this section of each side or roof daylight opening of a vehicle at 21.6 km/h ± 0.4 km/h, no portion of the window (excluding glazing shards) may pass the ejection reference plane defined under the procedures of paragraph S6.3 of this section.

(b) Each piece of window glazing and each surrounding window frame shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the complete passage of a 102 mm diameter sphere when a force of no more than 22 N is applied with the

sphere at any vector in a direction from the interior to the exterior of the vehicle.

S5.3 *Center impact to pre-broken glazing.*

(a) When the ejection impactor described in S8 of this section contacts the target location specified in S6.1.3 of this section of each side or roof daylight opening of a vehicle at 21.6 km/h ± 0.4 km/h, no portion of the impactor may displace more than 175 mm past where the surface of the glazing had been in an unbroken condition.

(b) Each piece of window glazing and each surrounding window frame shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the complete passage of a 102 mm diameter sphere when a force of no more than 22 N is applied with the sphere at any vector in a direction from the interior to the exterior of the vehicle.

S5.4 *Post-Impact Emergency Exit Release and Operability.* After the impacts described in paragraphs S5.1, S5.2, and S5.3 of this section, each emergency exit provided in accordance with Standard No. 217 (§ 571.217) shall be capable of releasing and opening according to the requirements specified in that standard.

S6. *Test procedures.*

S6.1 *Target locations.*

S6.1.1 *Edge impact.* Position the impactor face on the glazing adjacent to a latch or discrete attachment point such that, when viewed perpendicular to the glazing surface, the center of the impactor face plate is as close as practicable to the center of the latch attachment point or discrete attachment point with the impactor face plate either horizontal or vertical, whichever orientation provides the shortest distance between the two centers, while maintaining at least a 25 mm ± 2 mm distance between the impactor face plate edge and the window frame. ''Window frame'' includes latches, handles, attachments, and any solid structures other than the glazing material or flexible gaskets. If the window does not have any latches or discrete attachment points (*e.g.,* it is fully rubber bonded or glued), position the impactor as follows:

(a) For side windows, directly above the center of the lower window edge, with the impactor face plate either horizontal or vertical, whichever orientation provides the shortest distance between the two centers, with the bottom edge of the impactor face plate 25 mm ± 2 mm above the daylight opening periphery when viewed perpendicular to the glazing surface.

(b) For roof glazing panels or roof windows, directly forward of the center of the rearmost window edge, with the impactor face plate either horizontal or vertical, whichever orientation provides the shortest distance between the two centers, with the rearmost edge of the impactor face plate 25 mm ± 2 mm forward of the daylight opening periphery when viewed perpendicular to the glazing surface.

S6.1.2 *Center impact.*

Position the center of the impactor face, with the long axis of the impactor face plate either vertical or horizontal, at the center of the daylight opening area of the window with the glazing intact.

S6.1.3 *Center impact to pre-broken glazing.*

Position the center of the impactor face, with the long axis of the impactor face plate either vertical or horizontal, at the center of the daylight opening area of the window with the glazing pre-broken following the procedure in paragraphs S6.2.1 and S6.2.2 of this section.

S6.2 *Window glazing pre-breaking procedure.*

S6.2.1 Breakage pattern. Locate the geometric center of the daylight opening. Mark the surface of the window glazing in a horizontal and vertical grid of points separated by 75 mm ± 2 mm with one point coincident within ± 2 mm of the geometric center of the daylight opening (Figure 2).

(a) If the window is a single-pane unit, then both the occupant space interior and outside exterior surfaces of the glass pane are marked with the 75 mm grid pre-break pattern. The patterns are offset diagonally from one another (the points on one surface of the glass pane are offset 37.5 mm ± 2 mm horizontally and 37.5 mm ± 2 mm vertically from the points on the

contralateral surface of the glass pane).

(b) If the window is an insulated unit or double-glazed window, then both the occupant space side of the interior pane and the outside of the exterior pane are marked with the 75 mm grid prebreak pattern.

(1) If one of the glass panes is constructed of tempered or toughened glass, the insulated surface of the remaining glass pane (within the air gap) is marked with the 75 mm grid prebreak pattern. The patterns are offset diagonally from the remaining glass pane's contralateral surface.

(2) If neither pane is tempered glass, then both the occupant space side of the interior pane and the outside of the exterior pane are marked with the 75 mm grid pre-break pattern. The patterns are not diagonally offset from one another. The insulated surfaces of the glass panes (within the air gap) are not marked.

S6.2.2 *Breakage method.*

(a) Use a 100 mm ± 10 mm × 100 mm ± 10 mm piece of rigid material as a reaction surface on the opposite side of the glazing to prevent to the extent possible the window surface from deforming by more than 10 mm when pressure is being applied by the staple gun.

(b) Start with the inside surface of the window and forwardmost, lowest mark made as specified in S6.2.1 of this section. Use an electric staple gun without any staples to apply a load along a line of 12 to 14 mm onto the glazing. The applied force shall be 4,200 N ± 850 N. Apply the line load only once at each marked location, even if the glazing does not break or no perceptible mark or hole results.

(c) Continue applying the line load with the electric staple gun by moving rearward in the grid until the end of a row is reached. Then move to the forwardmost mark on the next higher row and apply the line load. Continue in this pattern until the line load has been applied to all grid points on the inside surface of the glazing.

(d) Repeat the process on the outside surface of the window.

(e) If applying the line load causes the glazing to disintegrate, halt the breakage procedure and proceed with the next step in the compliance test.

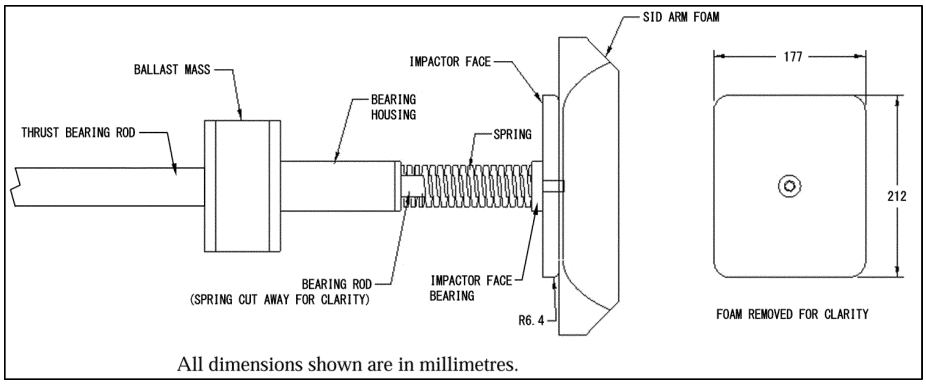
S6.3 *Determination of ejection reference planes.*

(a) For side windows, the ''ejection reference plane'' is a vertical plane parallel to the longitudinal vertical center plane of the bus passing through a point located at a lateral distance of 102 mm from the lateral most point on the glazing and surrounding frame, with the window in the closed position.

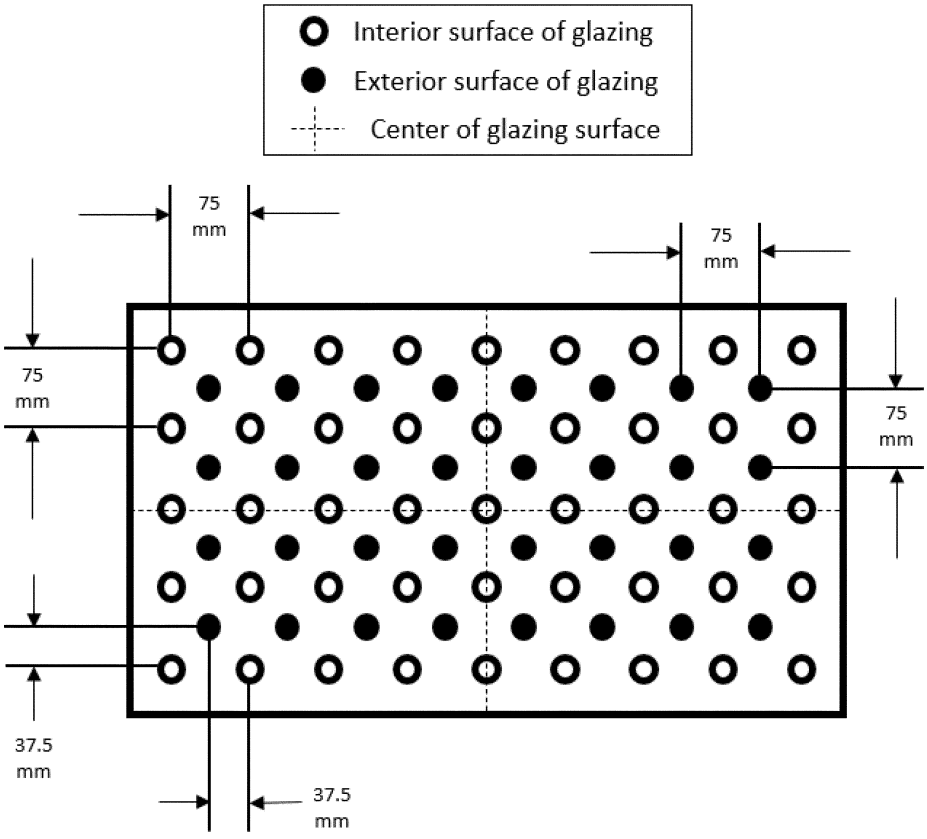
(b) For roof glazing panels/windows, the ''ejection reference plane'' is a horizontal plane passing through a point located at a vertical distance of 102 mm from the highest point on the glazing and surrounding frame, with the window/panel in the closed position.

S7. *Test conditions.* During testing, the ambient temperature is between 18 degrees C. and 29 degrees C., at any relative humidity between 10 percent and 70 percent.

S8. *Guided impactor.* The impactor test device has the dimensions shown in Figure 1 of this section. It has a total impactor mass of 26 kg ± 1.0 kg and a spring stiffness of 258 N/mm ± 39 N/mm. The impactor is propelled in the horizontal direction in impacts to the side daylight openings and is propelled vertically in impacts to the roof daylight openings.



All dimensions shown are in millimetres.



[89 FR 86282, Oct. 30, 2024]

§ 571.218 Standard No. 218; Motorcycle helmets.

S1. *Scope*. This standard establishes minimum performance requirements

for helmets designed for use by motorcyclists and other motor vehicle users.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries to motorcyclists and other motor vehicle users resulting from head impacts.

S3. *Application.* This standard applies to all helmets designed for use by motorcyclists and other motor vehicle users.

S4. *Definitions.*

Basic plane means a plane through the centers of the right and left external ear openings and the lower edge of the eye sockets (Figure 1) of a reference headform (Figure 2) or test headform.

Discrete size means a numerical value that corresponds to the diameter of an equivalent circle representing the helmet interior in inches (±0.25 inch) or to the circumference of the equivalent circle in centimeters (±0.64 centimeters).

Helmet positioning index means the distance in inches, as specified by the manufacturer, from the lowest point of the brow opening at the lateral midpoint of the helmet to the basic plane of a reference headform, when the helmet is firmly and properly positioned on the reference headform.

Impact site means the point on the helmet where the helmet shell first contacts the test anvil during the impact attenuation test.

Midsagittal plane means a longitudinal plane through the apex of a reference headform or test headform that is perpendicular to the basic plane (Figure 3).

Reference headform means a measuring device contoured to the dimensions of one of the three headforms described in Table 2 and Figures 5 through 8 with surface markings indicating the locations of the basic, midsagittal, and reference planes, and the centers of the external ear openings.

Reference plane means a plane above and parallel to the basic plane on a reference headform or test headform (Figure 2) at the distance indicated in Table 2.

Retention system means the complete assembly by which the helmet is retained in position on the head during use.

Test headform means a test device contoured to the dimensions of one of the three headforms described in Table 2 and Figures 5 through 8 with surface markings indicating the locations of the basic, mid-sagittal, and reference planes.

S5. *Requirements.* Each helmet shall meet the requirements of S5.1, S5.2, and S5.3 when subjected to any conditioning procedure specified in S6.4, and tested in accordance with S7.1, S7.2, and S7.3.

S5.1 *Impact attenuation.* When an impact attenuation test is conducted in accordance with S7.1, all of the following requirements shall be met:

(a) Peak accelerations shall not exceed 400g;

(b) Accelerations in excess of 200g shall not exceed a cumulative duration of 2.0 milliseconds; and

(c) Accelerations in excess of 150g shall not exceed a cumulative duration of 4.0 milliseconds.

S5.2 *Penetration.* When a penetration test is conducted in accordance with S7.2, the striker shall not contact the surface of the test headform.

S5.3 *Retention system.*

S5.3.1 When tested in accordance with S7.3:

(a) The retention system or its components shall attain the loads specified without separation; and

(b) The adjustable portion of the retention system test device shall not move more than 1 inch (2.5 cm) measured between preliminary and test load positions.

S5.3.2 Where the retention system consists of components which can be independently fastened without securing the complete assembly, each such component shall independently meet the requirements of S5.3.1.

S5.4 *Configuration.* Each helmet shall have a protective surface of continuous contour at all points on or above the test line described in S6.2.3. The helmet shall provide peripheral vision clearance of at least 105° to each side of the mid-sagittal plane, when the helmet is adjusted as specified in S6.3. The vertex of these angles, shown in Figure 3, shall be at the point on the anterior surface of the reference headform at the intersection of the mid-sagittal and basic planes. The brow opening of the

helmet shall be at least 1 inch (2.5 cm) above all points in the basic plane that are within the angles of peripheral vision (see Figure 3).

S5.5 *Projections.* A helmet shall not have any rigid projections inside its shell. Rigid projections outside any helmet's shell shall be limited to those required for operation of essential accessories, and shall not protrude more than 0.20 inch (5 mm).

S5.6 *Labeling.*

S5.6.1 On a label or labels separate from the certification label required by S5.6.2, each helmet shall be labeled permanently and legibly, in a manner such that the label(s) can be read easily without removing padding or any other permanent part, with the following:

(a) Manufacturer's name.

(b) Discrete size.

(c) Month and year of manufacture. This may be spelled out (for example, June 2010), or expressed in numerals (for example, 6/10).

(d) Instructions to the purchaser as follows:

(1) ''Shell and liner constructed of (identify type(s) of materials).''

(2) ''Helmet can be seriously damaged by some common substances without damage being visible to the user. Apply only the following: (Recommended cleaning agents, paints, adhesives, etc., as appropriate).''

(3) ''Make no modifications. Fasten helmet securely. If helmet experiences a severe blow, return it to the manufacturer for inspection, or destroy it and replace it.''

(4) Any additional relevant safety information should be applied at the time of purchase by means of an attached tag, brochure, or other suitable means.

S5.6.2 Certification. Each helmet shall be labeled permanently and legibly with a label, constituting the manufacturer's certification that the helmet conforms to the applicable Federal motor vehicle safety standards, that is separate from the label(s) used to comply with S5.6.1, and complies with paragraphs (a) through (c) of this section.

(a) Content, format, and appearance. The label required by paragraph S5.6.2 shall have the following content, format, and appearance:

(1) The symbol ''DOT,'' horizontally centered on the label, in letters not less than 0.38 inch (1.0 cm) high.

(2) The term ''FMVSS No. 218,'' horizontally centered beneath the symbol DOT, in letters not less than 0.09 inches (0.23 cm) high.

(3) The word ''CERTIFIED,'' horizontally centered beneath the term ''FMVSS No. 218,'' in letters not less than 0.09 inches (0.23 cm) high.

(4) The precise model designation, horizontally centered above the symbol DOT, in letters and/or numerals not less than 0.09 inch (0.23 cm) high.

(5) The manufacturer's name and/or brand, horizontally centered above the model designation, in letters and/or numerals not less than 0.09 inch (0.23 cm) high.

(6) All symbols, letters and numerals shall be in a color that contrasts with the background of the label.

(b) Other information. No information, other than the information specified in subparagraph (a), shall appear on the label.

(c) Location. The label shall appear on the outer surface of the helmet and be placed so that it is centered laterally with the horizontal centerline of the DOT symbol located a minimum of 1 inch (2.5 cm) and a maximum of 3 inches (7.6 cm) from the bottom edge of the posterior portion of the helmet.

S5.7 *Helmet positioning index.* Each manufacturer of helmets shall establish a positioning index for each helmet he manufactures. This index shall be furnished immediately to any person who requests the information, with respect to a helmet identified by manufacturer, model designation, and size.

S6. *Preliminary test procedures.* Before subjecting a helmet to the testing sequence specified in S7., prepare it according to the procedures in S6.1, S6.2, and S6.3.

S6.1 *Selection of appropriate headform.*

S6.1.1 A helmet with a manufacturer's designated discrete size or size range which does not exceed 6¾ (European size: 54) is tested on the small headform. A helmet with a manufacturer's designated discrete size or size range which exceeds 6¾, but does not exceed 7½ (European size: 60) is tested on the medium headform. A helmet

with a manufacturer's designated discrete size or size range which exceeds 7½ is tested on the large headform.

S6.1.2 A helmet with a manufacturer's designated size range which includes sizes falling into two or all three size ranges described in S6.1.1 is tested on each headform specified for each size range.

S6.2 *Reference marking.*

S6.2.1 Use a reference headform that is firmly seated with the basic and reference planes horizontal. Place the complete helmet to be tested on the appropriate reference headform, as specified in S6.1.1 and S6.1.2.

S6.2.2 Apply a 10-pound (4.5 kg) static vertical load through the helmet's apex. Center the helmet laterally and seat it firmly on the reference headform according to its helmet positioning index.

S6.2.3 Maintaining the load and position described in S6.2.2, draw a line (hereinafter referred to as ''test line'') on the outer surface of the helmet coinciding with portions of the intersection of that service with the following planes, as shown in Figure 2:

(a) A plane 1 inch (2.5 cm) above and parallel to the reference plane in the anterior portion of the reference headform;

(b) A vertical transverse plane 2.5 inches (6.4 cm) behind the point on the anterior surface of the reference headform at the intersection of the mid-sagittal and reference planes;

(c) The reference plane of the reference headform;

(d) A vertical transverse plane 2.5 inches (6.4. cm) behind the center of the external ear opening in a side view; and

(e) A plane 1 inch (2.5 cm) below and parallel to the reference plane in the posterior portion of the reference headform.

S6.3 *Helmet positioning.*

S6.3.1 Before each test, fix the helmet on a test headform in the position that conforms to its helmet positioning index. Secure the helmet so that it does not shift position before impact or before application of force during testing.

S6.3.2 In testing as specified in S7.1 and S7.2, place the retention system in a position such that it does not interfere with free fall, impact or penetration.

S6.4 *Conditioning.*

S6.4.1 Immediately before conducting the testing sequence specified in S7, condition each test helmet in accordance with any one of the following procedures:

(a) *Ambient conditions.* Expose to any temperature from 61 °F to and including 79 °F (from 16 °C to and including 26 °C) and any relative humidity from 30 to and including 70 percent for a minimum of 4 hours.

(b) *Low temperature.* Expose to any temperature from 5 °F to and including 23 °F (from −15 °C to and including −5 °C) for a minimum of 4 hours and no more than 24 hours.

(c) *High temperature.* Expose to any temperature from 113 °F to and including 131 °F (from 45 °C to and including 55 °C) for a minimum of 4 hours and no more than 24 hours.

(d) *Water immersion.* Immerse in water at any temperature from 61 °F to and including 79 °F (from 16 °C to and including 26 °C) for a minimum of 4 hours and no more than 24 hours.

S6.4.2 If during testing, as specified in S7.1.3 and S7.2.3, a helmet is returned to the conditioning environment before the time out of that environment exceeds 4 minutes, the helmet is kept in the environment for a minimum of 3 minutes before resumption of testing with that helmet. If the time out of the environment exceeds 4 minutes, the helmet is returned to the environment for a minimum of 3 minutes for each minute or portion of a minute that the helmet remained out of the environment in excess of 4 minutes or for a maximum of 12 hours, whichever is less, before the resumption of testing with that helmet.

S7. *Test conditions.*

S7.1 *Impact attenuation test.*

S7.1.1 Impact attenuation is measured by determining acceleration imparted to an instrumented test headform on which a complete helmet is mounted as specified in S6.3, when it is dropped in guided free fall upon a fixed hemispherical anvil and a fixed flat steel anvil.

S7.1.2 Each helmet is impacted at four sites with two successive impacts

at each site. Two of these sites are impacted upon a flat steel anvil and two upon a hemispherical steel anvil as specified in S7.1.10 and S7.1.11. The impact sites are at any point on the area above the test line described in paragraph S6.2.3, and separated by a distance not less than one-sixth of the maximum circumference of the helmet in the test area. For each site, the location where the helmet first contacts the anvil on the second impact shall not be greater than 0.75 inch (1.9 cm) from the location where the helmet first contacts the anvil on the first impact.

S7.1.3 Impact testing at each of the four sites, as specified in S7.1.2, shall start at two minutes, and be completed by four minutes, after removal of the helmet from the conditioning environment.

S7.1.4 (a) The guided free fall drop height for the helmet and test headform combination onto the hemispherical anvil shall be such that the impact speed is any speed from 16.4 ft/s to and including 17.7 ft/s (from 5.0 m/s to and including 5.4 m/s).

(b) The guided free fall drop height for the helmet and test headform combination onto the flat anvil shall be such that the impact speed is any speed from 19.0 ft/s to and including 20.3 ft/s (from 5.8 m/s to and including 6.2 m/s).

S7.1.5 Test headforms for impact attenuation testing are constructed of magnesium alloy (K–1A), and exhibit no resonant frequencies below 2,000 Hz.

S7.1.6 The monorail drop test system is used for impact attenuation testing.

S7.1.7 The weight of the drop assembly, as specified in Table 1, is the combined weight of the test headform and the supporting assembly for the drop test. The weight of the supporting assembly is not less than 2.0 lbs. and not more than 2.4 lbs. (0.9 to 1.1 kg). The supporting assembly weight for the monorail system is the drop assembly weight minus the combined weight of the test headform, the headform's clamp down ring, and its tie down screws.

S7.1.8 The center of gravity of the test headform is located at the center of the mounting ball on the supporting assembly and lies within a cone with its axis vertical and forming a 10° included angle with the vertex at the point of impact. The center of gravity of the drop assembly lies within the rectangular volume bounded by x = −0.25 inch (−0.64 cm), x = 0.85 inch (2.16 cm), y = 0.25 inch (0.64 cm), and y = −0.25 inch (−0.64 cm) with the origin located at the center of gravity of the test headform. The rectangular volume has no boundary along the z-axis. The x-y-z axes are mutually perpendicular and have positive or negative designations in accordance with the right-hand rule (See Figure 5). The origin of the coordinate axes also is located at the center of the mounting ball on the supporting assembly (See Figures 6, 7, and 8). The x-y-z axes of the test headform assembly on a monorail drop test equipment are oriented as follows: From the origin, the x-axis is horizontal with its positive direction going toward and passing through the vertical centerline of the monorail. The positive z-axis is downward. The y-axis also is horizontal and its direction can be decided by the z- and x-axes, using the right-hand rule.

S7.1.9 The acceleration transducer is mounted at the center of gravity of the test headform with the sensitive axis aligned to within 5° of vertical when the test headform assembly is in the data impact position. The acceleration data channel complies with the SAE Recommended Practice J211/1, revised March 1995 (incorporated by reference, see §571.5) requirements for channel class 1,000.''

S7.1.10 The flat anvil is constructed of steel with a 5-inch (12.7 cm) minimum diameter impact face, and the hemispherical anvil is constructed of steel with a 1.9 inch (4.8 cm) radius impact face.

S7.1.11 The rigid mount for both of the anvils consists of a solid mass of at least 300 pounds (136.1 kg), the outer surface of which consists of a steel plate with minimum thickness of 1 inch (2.5 cm) and minimum surface area of 1 ft^2 (929 cm^2).

S7.1.12 The drop system restricts side movement during the impact attenuation test so that the sum of the areas bounded by the acceleration-time response curves for both the x- and y-axes (horizontal axes) is less than five

percent of the area bounded by the acceleration-time response curve for the vertical axis.

S7.2 *Penetration test.*

S7.2.1 The penetration test is conducted by dropping the penetration test striker in guided free fall, with its axis aligned vertically, onto the outer surface of the complete helmet, when mounted as specified in S6.3, at any point above the test line, described in S6.2.3, except on a fastener or other rigid projection.

S7.2.2 Two penetration blows are applied at least 3 inches (7.6 cm) apart, and at least 3 inches (7.6 cm) from the centers of any impacts applied during the impact attenuation test.

S7.2.3 The application of the two penetration blows, specified in S7.2.2, starts at two minutes and is completed by four minutes, after removal of the helmet from the conditioning environment.

S7.2.4 The height of the guided free fall is 118.1 ±0.6 in (3 ±0.015 m), as measured from the striker point to the impact point on the outer surface of the test helmet.

S7.2.5 The contactable surface of the penetration test headform is constructed of a metal or metallic alloy having a Brinell hardness number no greater than 55, which will permit ready detection should contact by the striker occur. The surface is refinished if necessary before each penetration test blow to permit detection of contact by the striker.

S7.2.6 The weight of the penetration striker is not less than 6 pounds, 8 ounces and not more than 6 pounds, 12 ounces (2.95 to 3.06 kg).

S7.2.7 The point of the striker has an included angle of 60 ±0.5°, a cone height of 1.5 ±0.015 in. (3.8 ±0.038 cm), a tip radius of 0.02 ±0.004 in. (0.5 ±0.1 mm), and a minimum hardness of 60 Rockwell, C-scale.

S7.2.8 The rigid mount for the penetration test headform is as described in S7.1.11.

S7.3 *Retention system test.*

S7.3.1 The retention system test is conducted by applying a quasi-static tensile load at any rate from 0.4 to and including 1.2 inch/min (from 1.0 to and including 3.0 cm/min) to the retention assembly of a complete helmet, which is mounted, as described in S6.3, on a stationary test headform as shown in Figure 4, and by measuring the movement of the adjustable portion of the retention system test device under tension.

S7.3.2 The retention system test device consists of both an adjustable loading mechanism by which a quasi-static tensile load is applied at any rate from 0.4 to and including 1.2 inch/min (from 1.0 to and including 3.0 cm/min) to the helmet retention assembly and a means for holding the test headform and helmet stationary. The retention assembly is fastened around two freely moving rollers, both of which have a 0.5 inch (1.3 cm) diameter and a 3 inch (7.6 cm) center-to-center separation, and which are mounted on the adjustable portion of the tensile loading device (Figure 4). The helmet is fixed on the test headform as necessary to ensure that it does not move during the application of the test loads to the retention assembly.

S7.3.3 A 50–pound (22.7 kg) preliminary test load is applied to the retention assembly, normal to the basic plane of the test headform and symmetrical with respect to the center of the retention assembly for 30 seconds, and the maximum distance from the extremity of the adjustable portion of the retention system test device to the apex of the helmet is measured.

S7.3.4 An additional 250–pound (113.4 kg) test load is applied to the retention assembly, in the same manner and at the same location as described in S7.3.3, for 120 seconds, and the maximum distance from the extremity of the adjustable portion of the retention system test device to the apex of the helmet is measured.

APPENDIX TO §571.218

TABLE 1—WEIGHT RANGES FOR IMPACT ATTENUATION TEST DROP ASSEMBLY

Test headform size	Weight range [1]—lb kg)
Small	7.6–8.0 (3.4–3.6)
Medium	10.8–11.2 (4.9–5.1)
Large	13.2–13.6 (6.0–6.2)

[1] Combined weight of instrumented test headform and supporting assembly for drop test.

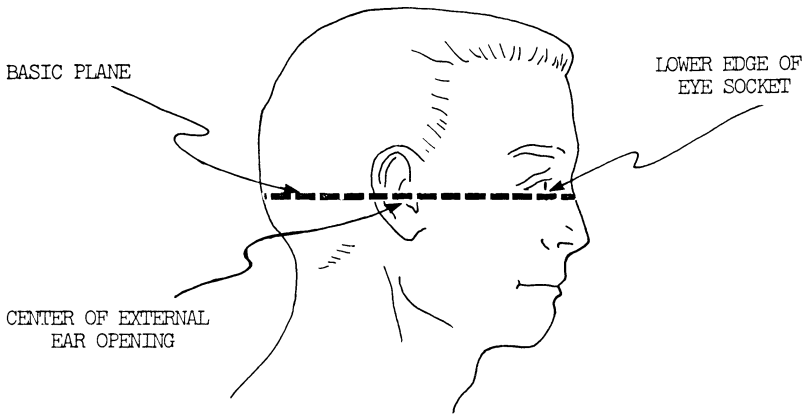
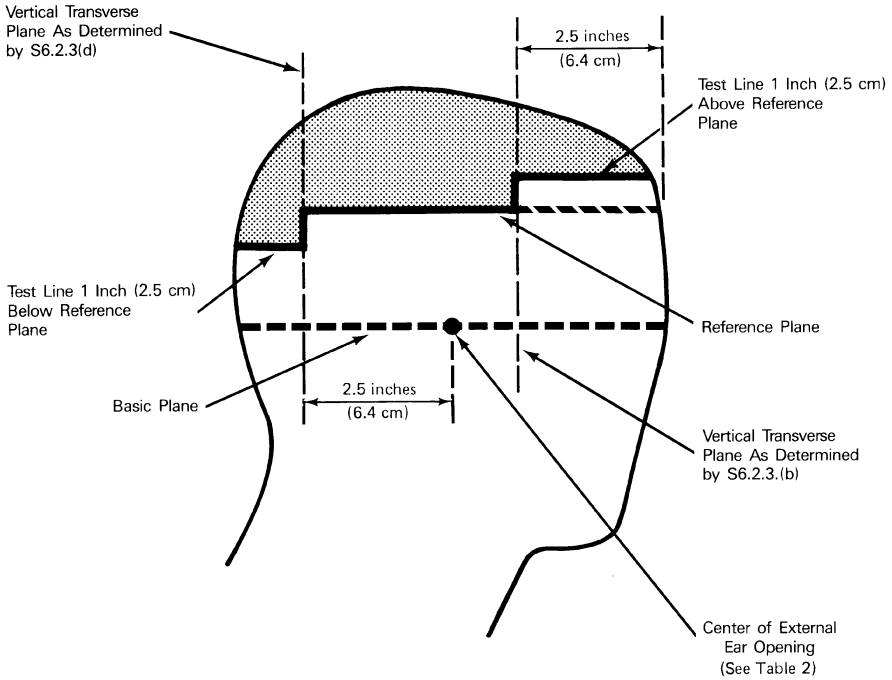

BASIC PLANE
LOWER EDGE OF EYE SOCKET
CENTER OF EXTERNAL EAR OPENING

Figure 1



Note: Solid lines would correspond to the test line on a test helmet.

Figure 2

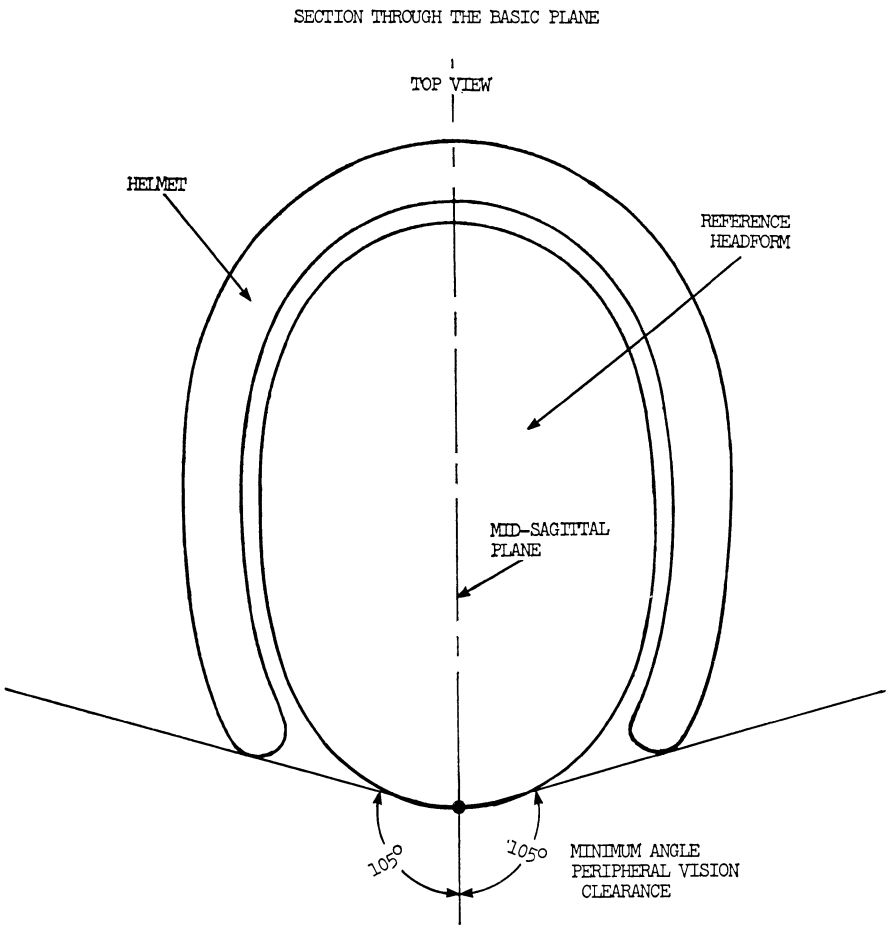
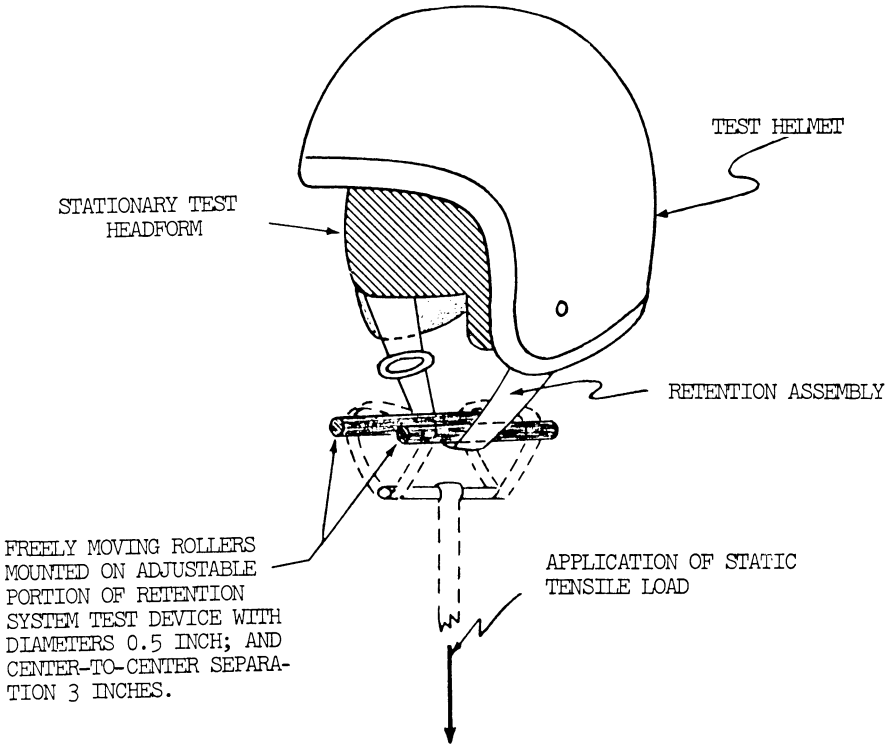

SECTION THROUGH THE BASIC PLANE
TOP VIEW
HELMET
REFERENCE HEADFORM
MID-SAGITTAL PLANE
105°
105°
MINIMUM ANGLE PERIPHERAL VISION CLEARANCE

Figure 3

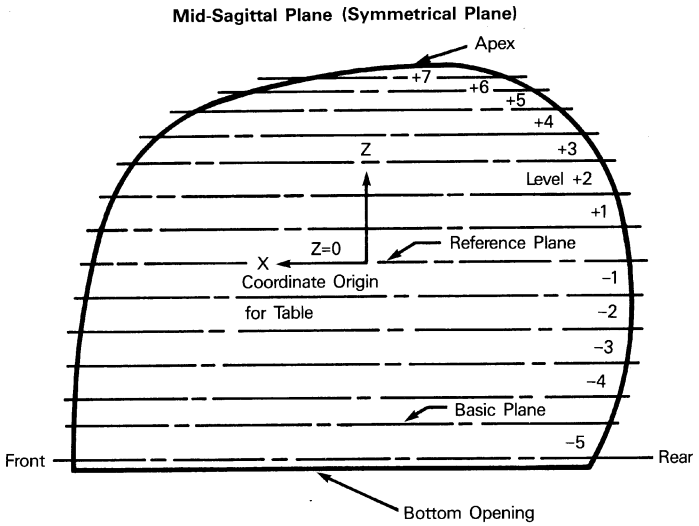


RETENTION SYSTEM TEST DEVICE

Figure 4

Figure 5

HEADFORM SECTIONS



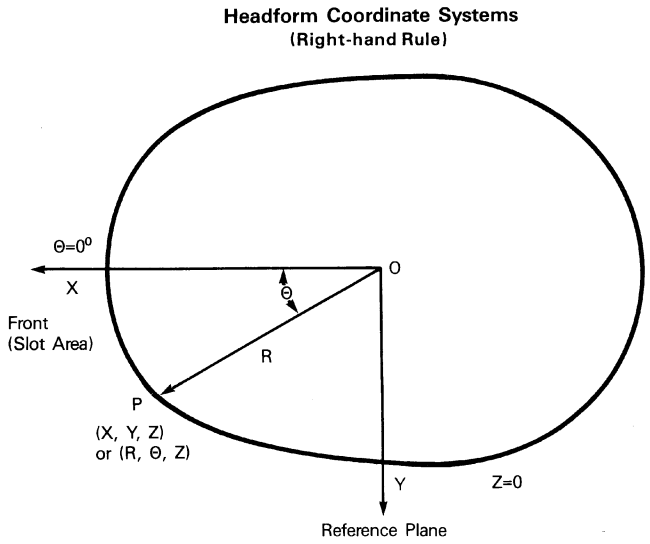


Table 2

Medium Headform — Exterior Dimensions

	Bottom Opening Z= -3.02			Level—5 Z= -2.900		
Θ	R	X	Y	R	X	Y
0	4.292	4.292	0	4.293	4.293	0
10	4.266	4.201	0.741	4.270	4.205	0.742
20	4.159	3.908	1.423	4.172	3.920	1.427
30	3.967	3.436	1.984	3.961	3.430	1.981
40	3.660	2.804	2.353	3.670	2.811	2.359
50	3.332	2.142	2.553	3.352	2.155	2.568
60	3.039	1.520	2.632	3.067	1.534	2.656
70	2.839	0.971	2.668	2.869	0.981	2.696
80	2.720	0.472	2.679	2.772	0.481	2.730
90	2.675	0	2.675	2.709	0	2.709
100	2.703	−0.469	2.662	2.724	−0.473	2.683
110	2.764	−0.945	2.597	2.794	−0.956	2.626
120	2.888	−1.444	2.501	2.917	−1.459	2.526
130	2.985	−1.919	2.287	3.040	−1.954	2.329
140	3.100	−2.375	1.993	3.175	−2.432	2.041
150	3.175	−2.750	1.588	3.232	−2.799	1.616
160	3.186	−2.994	1.090	3.246	−3.050	1.110
170	3.177	−3.129	0.552	3.237	−3.188	0.562
180	3.187	−3.187	0	3.246	−3.246	0

	Basic Plane Z= -2.360			Level—4 Z= -2.000		
Θ	R	X	Y	R	X	Y
0	4.272	4.272	0	4.247	4.247	0
10	4.248	4.184	0.738	4.223	4.159	0.733
20	4.147	3.897	1.418	4.120	3.872	1.409
30	3.961	3.430	1.981	3.940	3.412	1.970
40	3.687	2.824	2.370	3.683	2.821	2.367
50	3.384	2.175	2.592	3.392	2.180	2.598
60	3.111	1.556	2.694	3.132	1.566	2.712
70	2.927	1.001	2.751	2.960	1.012	2.782
80	2.815	0.489	2.772	2.860	0.497	2.817
90	2.779	0	2.779	2.838	0	2.838
100	2.802	−0.487	2.759	2.861	−0.497	2.818
110	2.887	−0.987	2.713	2.958	−1.012	2.780
120	3.019	−1.510	2.615	3.098	−1.549	2.683
130	3.180	−2.044	2.436	3.260	−2.096	2.497
140	3.306	−2.533	2.125	3.405	−2.608	2.189
150	3.398	−2.943	1.699	3.516	−3.045	1.758
160	3.458	−3.250	1.183	3.585	−3.369	1.226
170	3.475	−3.422	0.603	3.612	−3.557	0.627
180	3.472	−3.472	0	3.609	−3.609	0

Table 2

Medium Headform—Exterior Dimensions (Continued)

	Level—3 Z= −1.500			Level—2 Z= −1.000		
Θ	R	X	Y	R	X	Y
0	4.208	4.208	0	4.148	4.148	0
10	4.179	4.116	0.726	4.112	4.050	0.714
20	4.075	3.829	1.394	4.013	3.771	1.373
30	3.902	3.379	1.951	3.844	3.329	1.922
40	3.654	2.799	2.349	3.609	2.765	2.320
50	3.377	2.171	2.587	3.352	2.155	2.568
60	3.094	1.547	2.680	3.137	1.569	2.717
70	2.982	1.020	2.802	2.989	1.022	2.809
80	2.891	0.502	2.847	2.902	0.504	2.858
90	2.876	0	2.876	2.884	0	2.884
100	2.918	−0.507	2.874	2.943	−0.511	2.898
110	3.021	−1.033	2.839	3.052	−1.044	2.868
120	3.170	−1.585	2.745	3.225	−1.613	2.793
130	3.337	−2.145	2.556	3.397	−2.184	2.602
140	3.483	−2.668	2.239	3.536	−2.709	2.273
150	3.604	−3.121	1.802	3.657	−3.167	1.829
160	3.682	−3.460	1.259	3.751	−3.525	1.283
170	3.725	−3.668	0.647	3.807	−3.749	0.661
180	3.741	−3.741	0	3.822	−3.822	0

	Level—1 Z= −0.500			Reference Plane Z=0.0		
Θ	R	X	Y	R	X	Y
0	4.067	4.067	0	3.971	3.971	0
10	4.033	3.972	0.700	3.935	3.875	0.683
20	3.944	3.706	1.349	3.853	3.621	1.318
30	3.777	3.271	1.889	3.701	3.205	1.851
40	3.552	2.721	2.283	3.491	2.674	2.244
50	3.323	2.136	2.546	3.279	2.108	2.512
60	3.126	1.563	2.707	3.101	1.551	2.686
70	2.987	1.022	2.807	2.979	1.019	2.799
80	2.912	0.506	2.868	2.910	0.505	2.866
90	2.893	0	2.893	2.890	0	2.890
100	2.895	−0.503	2.851	2.945	−0.511	2.900
110	3.064	−1.048	2.879	3.062	−1.047	2.877
120	3.231	−1.616	2.798	3.228	−1.614	2.796
130	3.411	−2.193	2.613	3.413	−2.194	2.615
140	3.560	−2.727	2.288	3.563	−2.729	2.290
150	3.682	−3.189	1.841	3.681	−3.188	1.841
160	3.783	−3.555	1.294	3.773	−3.546	1.290
170	3.885	−3.826	0.675	3.832	−3.774	0.665
180	3.857	−3.857	0	3.844	−3.844	0

Table 2

Medium Headform — Exterior Dimensions (Continued)

	Level+1 Z=0.500			Level +2 Z=1.000		
Θ	R	X	Y	R	X	Y
0	3.830	3.830	0	3.665	3.665	0
10	3.801	3.743	0.660	3.613	3.558	0.627
20	3.725	3.500	1.274	3.554	3.340	1.216
30	3.587	3.106	1.794	3.436	2.976	1.718
40	3.399	2.604	2.185	3.271	2.506	2.103
50	3.205	2.060	2.455	3.102	1.994	2.376
60	3.044	1.522	2.636	2.959	1.480	2.563
70	2.927	1.001	2.751	2.854	0.976	2.682
80	2.861	0.497	2.818	2.792	0.485	2.750
90	2.855	0	2.855	2.783	0	2.783
100	2.897	−0.503	2.853	2.832	−0.492	2.789
110	3.007	−1.029	2.826	2.938	−1.005	2.761
120	3.176	−1.588	2.751	3.102	−1.551	2.686
130	3.372	−2.168	2.583	3.294	−2.117	2.523
140	3.520	−2.697	2.263	3.450	−2.643	2.218
150	3.643	−3.155	1.822	3.564	−3.087	1.782
160	3.728	−3.503	1.275	3.637	−3.418	1.244
170	3.777	−3.720	0.656	3.675	−3.619	0.638
180	3.782	−3.782	0	3.670	−3.670	0

	Level +3 Z=1.450			Level +4 Z=1.860		
Θ	R	X	Y	R	X	Y
0	3.419	3.419	0	3.061	3.061	0
10	3.382	3.331	0.587	3.035	2.989	0.527
20	3.299	3.100	1.128	2.966	2.787	1.014
30	3.197	2.769	1.599	2.872	2.487	1.436
40	3.052	2.338	1.962	2.754	2.110	1.770
50	2.911	1.871	2.230	2.642	1.698	2.024
60	2.786	1.393	2.413	2.522	1.261	2.184
70	2.700	0.924	2.537	2.477	0.847	2.328
80	2.647	0.460	2.607	2.442	0.424	2.405
90	2.636	0	2.636	2.442	0	2.442
100	2.691	−0.467	2.650	2.492	−0.433	2.454
110	2.796	−0.956	2.627	2.599	−0.889	2.442
120	2.961	−1.481	2.564	2.758	−1.379	2.389
130	3.147	−2.023	2.411	2.936	−1.887	2.249
140	3.301	−2.529	2.122	3.081	−2.360	1.980
150	3.408	−2.951	1.704	3.176	−2.751	1.588
160	3.479	−3.269	1.190	3.230	−3.035	1.105
170	3.514	−3.461	0.610	3.270	−3.220	0.568
180	3.502	−3.502	0	3.271	−3.271	0

Table 2

Medium Headform — Exterior Dimensions (Continued)

	Level +5 Z=2.250			Level +6 Z=2.560		
Θ	R	X	Y	R	X	Y
0	2.526	2.526	0	1.798	1.798	0
10	2.521	2.483	0.483	1.798	1.771	0.312
20	2.464	2.315	0.843	1.757	1.651	0.601
30	2.387	2.067	1.194	1.719	1.489	0.860
40	2.305	1.766	1.482	1.678	1.285	1.079
50	2.232	1.435	1.710	1.652	1.062	1.266
60	2.174	1.087	1.883	1.641	0.821	1.421
70	2.144	0.733	2.015	1.645	0.563	1.546
80	2.132	0.370	2.100	1.673	0.291	1.648
90	2.147	0	2.147	1.712	0	1.712
100	2.213	−0.384	2.179	1.809	−0.314	1.782
110	2.316	−0.792	2.176	1.925	−0.658	1.809
120	2.463	−1.232	2.133	2.066	−1.033	1.789
130	2.624	−1.687	2.010	2.213	−1.423	1.695
140	2.763	−2.117	1.776	2.358	−1.806	1.516
150	2.863	−2.479	1.432	2.469	−2.138	1.235
160	2.919	−2.743	0.988	2.536	−2.383	0.867
170	2.954	−2.909	0.513	2.561	−2.522	0.445
180	2.958	−2.958	0	2.556	−2.556	0

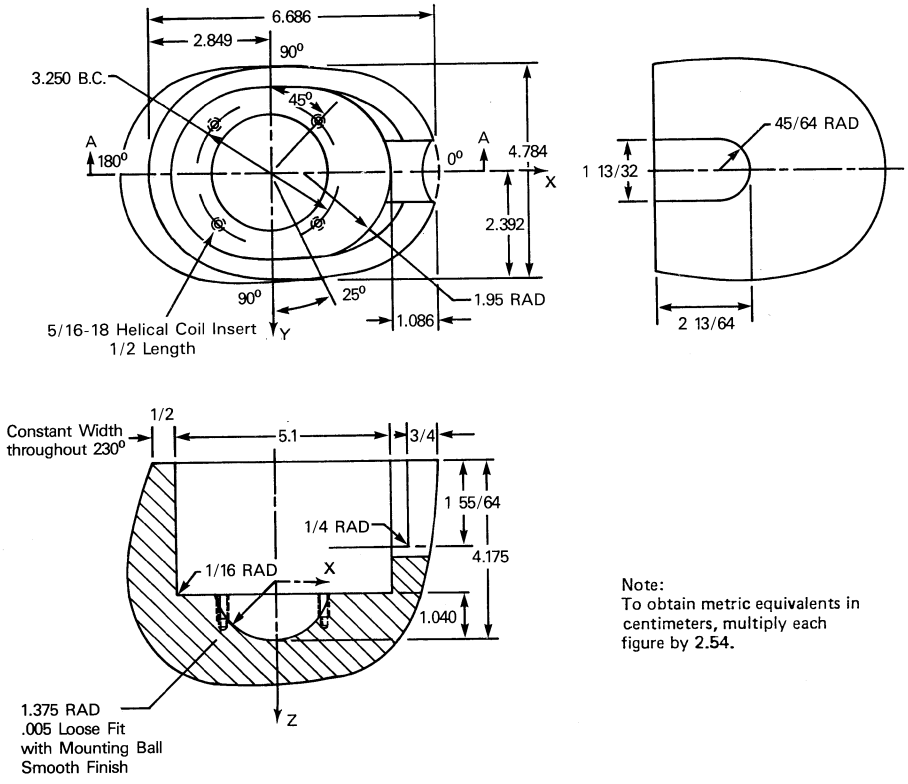
	Level +7 Z=2.750		
Θ	R	X	Y
0	1.081	1.081	0
10	1.088	1.072	0.189
20	1.055	0.991	0.361
30	1.039	0.900	0.520
40	1.039	0.796	0.668
50	1.052	0.676	0.806
60	1.068	0.534	0.925
70	1.106	0.378	1.039
80	1.171	0.203	1.153
90	1.242	0	1.242
100	1.422	−0.247	1.400
110	1.489	−0.509	1.399
120	1.683	−0.842	1.458
130	1.801	−1.158	1.380
140	1.954	−1.497	1.256
150	2.083	−1.804	1.042
160	2.138	−2.009	0.731
170	2.175	−2.142	0.378
180	2.175	−2.175	0

Notes:

1. Apex is located at (-0.75, 0, 3.02) for (X,Y,Z) or (0.75, 180, 3.02) for (R, Θ, Z).
2. Center of ear opening is located at (0.40, 2.78, -2.36) for (X,Y,Z) or (2.80, 81.8, -2.36) for (R,Θ,Z).
3. Scale all dimensions by 0.8941 for small headform.
4. Scale all dimensions by 1.069 for large headform.
5. Headform is symmetrical about the mid-sagittal plane.
6. Units:
   R,X,Y,Z – inches.
   Θ – degrees.
7. To obtain metric equivalents in centimeters, multiply each figure by 2.54.

Figure 6

Small Headform — Interior Design



Section A-A

Note:
To obtain metric equivalents in centimeters, multiply each figure by 2.54.

Figure 7

Medium Headform – Interior Design

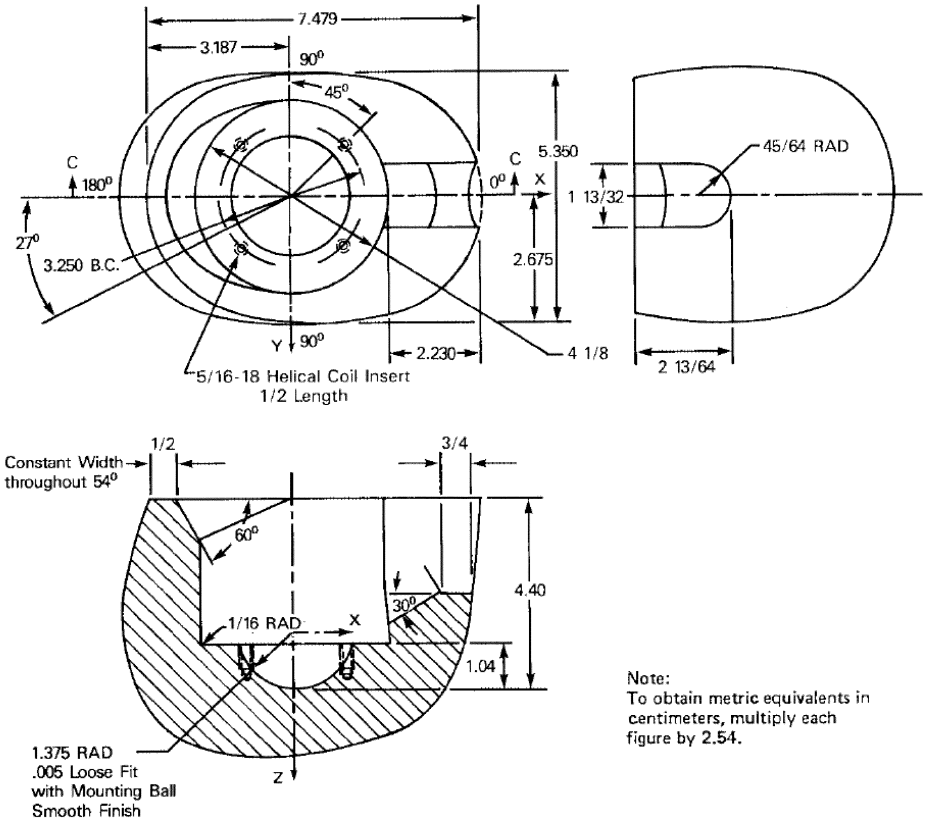
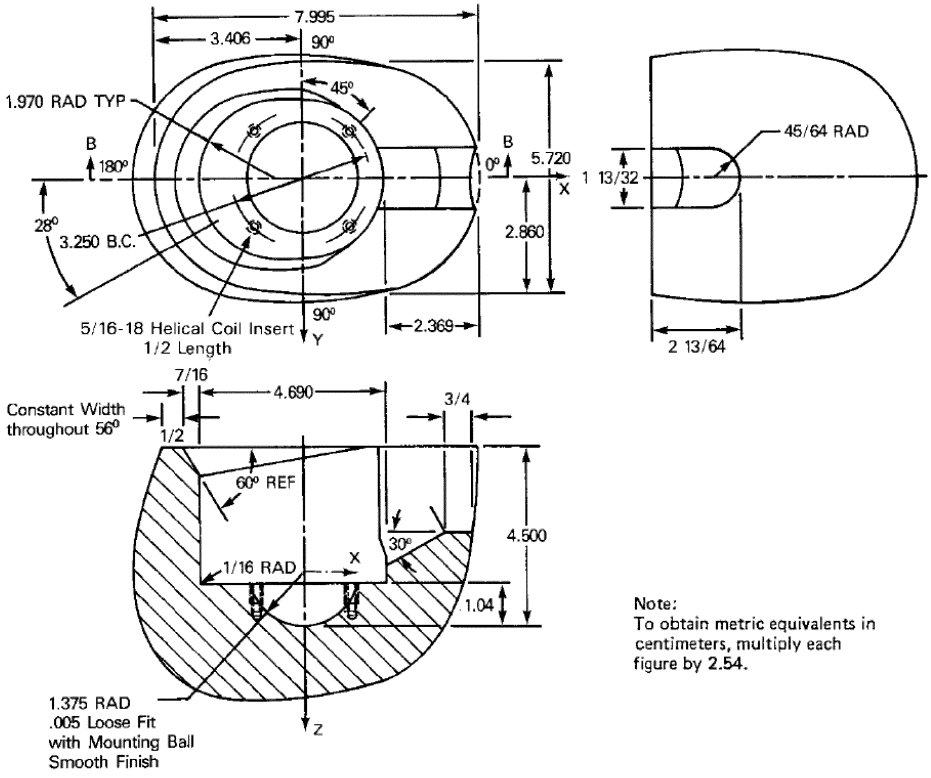


Figure 8

Large Headform – Interior Design



[38 FR 22391, Aug. 20, 1973, as amended at 39 FR 3554, Jan. 28, 1974; 45 FR 15181, Mar. 10, 1980; 53 FR 11288, Apr. 6, 1988; 53 FR 12529, Apr. 15, 1988; 76 FR 28160, May 13, 2011; 77 FR 768, Jan. 6, 2012]

§571.219 Standard No. 219; Windshield zone intrusion.

S1. *Scope.* This standard specifies limits for the displacement into the windshield area of motor vehicle components during a crash.

S2. *Purpose.* The purpose of this standard is to reduce crash injuries and fatalities that result from occupants contacting vehicle components displaced near or through the windshield.

S3. *Application.* This standard applies to passenger cars and to multipurpose passenger vehicles, trucks designed to carry at least one person, and buses of 4,536 kilograms or less gross vehicle weight rating. However, it does not apply to forward control vehicles, walk-in van-type vehicles, or to open-body-type vehicles with fold-down or removable windshields.

S4. *Definitions. Daylight Opening* (DLO) means the maximum unobstructed opening through the glazing surface, including reveal or garnish moldings adjoining the surface, as measured parallel to the outer surface of the glazing material.

S5. *Requirement.* When the vehicle travelling longitudinally forward at any speed up to and including 48 km/h impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, under the conditions of S7, no part of the vehicle outside the occupant compartment, except windshield molding and other components designed to be normally in contact with the windshield, shall penetrate the protected zone template, affixed according to S6, to a depth of more than 6 mm, and no such part of a vehicle shall penetrate the inner surface of that portion of the windshield, within the DLO, below the protected zone defined in S6.

S6. *Protected zone template.*

S6.1 The lower edge of the protected zone is determined by the following procedure (See Figure 1).

(a) Place a 165 mm diameter rigid sphere, with a mass of 6.8 kg in a position such that it simultaneously contacts the inner surface of the windshield glazing and the surface of the instrument panel, including padding. If any accessories or equipment such as the steering control system obstruct positioning of the sphere, remove them for the purposes of this procedure.

(b) Draw the locus of points on the inner surface of the windshield contactable by the sphere across the width of the instrument panel. From the outermost contactable points, extend the locus line horizontally to the edges of the glazing material.

(c) Draw a line on the inner surface of the windshield below and 13 mm distant from the locus line.

(d) The lower edge of the protected zone is the longitudinal projection onto the outer surface of the windshield of the line determined in S6.1(c).

S6.2 The protected zone is the space enclosed by the following surfaces, as shown in Figure 1:

(a) The outer surface of the windshield in its precrash configuration.

(b) The locus of points 76 mm outward along perpendiculars drawn to each point on the outer surface of the windshield.

(c) The locus of lines forming a 45° angle with the outer surface of the windshield at each point along the top and side edges of the outer surface of the windshield and the lower edge of the protected zone determined in S6.1, in the plane perpendicular to the edge at that point.

S6.3 A template is cut or formed from Styrofoam, type DB, cut cell, to the dimensions of the zone as determined in S6.2. The template is affixed to the windshield so that it delineates the protected zone and remains affixed throughout the crash test.

S7. *Test conditions.* The requirement of S5. shall be met under the following conditions:

S7.1 The protected zone template is affixed to the windshield in the manner described in S6.

S7.2 The hood, hood latches, and any other hood retention components are engaged prior to the barrier crash.

S7.3 Adjustable cowl tops or other adjustable panels in front of the windshield are in the position used under normal operating conditions when windshield wiping systems are not in use.

S7.4 The parking brake is disengaged and the transmission is in neutral.

S7.5 Tires are inflated to the vehicle manufacturer's specifications.

S7.6 The fuel tank is filled to any level from 90 to 95 per cent of capacity.

S7.7 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) Except as specified in S7.6, a passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus a 50th-percentile test dummy as specified in part 572 of this chapter at each front outboard designated seating position and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208. Each dummy is restrained only by means that are installed for protection at its seating position.

(b) Except as specified in S7.6, a multipurpose passenger vehicle, truck or bus is loaded to its unloaded vehicle

weight, plus 136 kg or its rated cargo and luggage capacity, whichever is less, secured to the vehicle, plus a 50th-percentile test dummy as specified in part 572 of this chapter at each front outboard designated seating postion and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208. Each dummy is restrained only by means that are installed for protection at its seating position. The load is distributed so that the mass on each axle as measured at the tire-ground interface is in proportion to its GAWR. If the mass on any axle when the vehicle is loaded to its unloaded vehicle weight plus dummy mass exceeds the axle's proportional share of the test mass, the remaining mass is placed so that the mass on that axle remains the same. For the purposes of this section, unloaded vehicle weight does not include the mass of work-performing accessories. Vehicles are tested to a maximum unloaded vehicle weight of 2,495 kg.

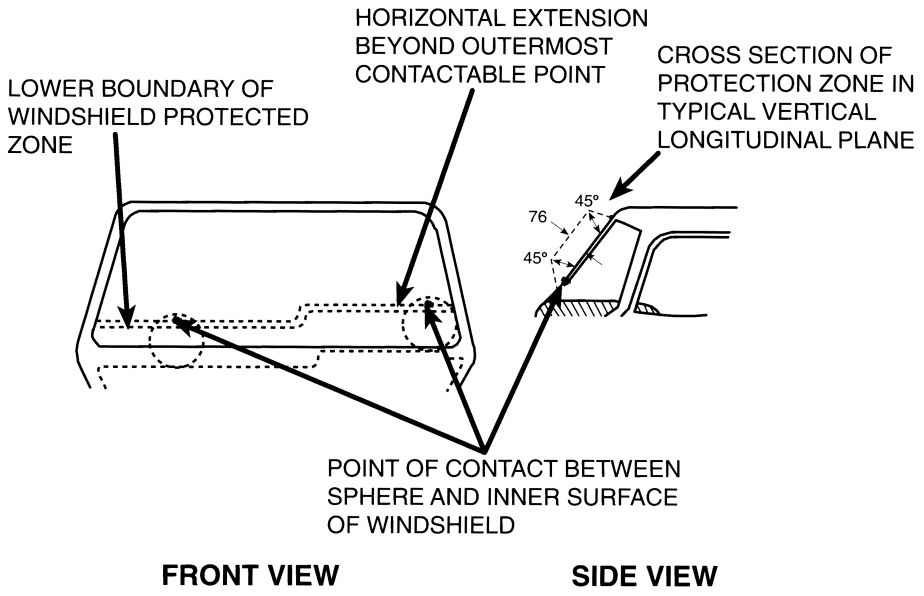


Figure 1.—WINDSHIELD PROTECTION ZONE
All dimensions in millimeters (mm)

[40 FR 25462, June 16, 1975, as amended at 40 FR 53033, Nov. 14, 1975; 41 FR 54946, Dec. 16, 1976; 45 FR 22046, Apr. 3, 1980; 63 FR 28946, May 27, 1998; 87 FR 18599, Mar. 30, 2022]

§ 571.220 Standard No. 220; School bus rollover protection.

S1. *Scope.* This standard establishes performance requirements for school bus rollover protection.

S2. *Purpose.* The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from failure of the school bus body structure to withstand forces encountered in rollover crashes.

S3. *Applicability.* This standard applies to school buses.

S4. *Requirements.* When a force in Newtons equal to 1½ times the unloaded vehicle weight in kilograms

multiplied by 9.8 m/sec^2 is applied to the roof of the vehicle's body structure through a force application plate as specified in S5, Test procedures—

(a) The downward vertical movement at any point on the application plate shall not exceed 130 mm and

(b) Each emergency exit of the vehicle provided in accordance with Standard No. 217 (§ 571.217) shall be capable of opening as specified in that standard during the full application of the force and after release of the force, except that an emergency exit located in the roof of the vehicle is not required to be capable of being opened during the application of the force. A particular vehicle (i.e., test specimen) need not meet the emergency exit opening requirement after release of force if it is subjected to the emergency exit opening requirements during the full application of the force.

S5. *Test procedures.* Each vehicle shall be capable of meeting the requirements of S4. when tested in accordance with the procedures set forth below.

S5.1 With any non-rigid chassis-to-body mounts replaced with equivalent rigid mounts, place the vehicle on a rigid horizontal surface so that the vehicle is entirely supported by means of the vehicle frame. If the vehicle is constructed without a frame, place the vehicle on its body sills. Remove any components which extend upward from the vehicle roof.

S5.2 Use a flat, rigid, rectangular force application plate that is measured with respect to the vehicle roof longitudinal and lateral centerlines,

(a) In the case of a vehicle with a GVWR of more than 4,536 kg, 305 mm shorter than the vehicle roof and 914 mm wide; and

(b) In the case of a vehicle with a GVWR of 4,536 kg or less, 127 mm longer and 127 mm wider than the vehicle roof. For purposes of these measurements, the vehicle roof is that structure, seen in the top projected view, that coincides with the passenger and driver compartment of the vehicle.

S5.3 Position the force application plate on the vehicle roof so that its rigid surface is perpendicular to a vertical longitudinal plane and it contacts the roof at not less than two points, and so that, in the top projected view, its longitudinal centerline coincides with the longitudinal centerline of the vehicle, and its front and rear edges are an equal distance inside the front and rear edges of the vehicle roof at the centerline.

S5.4 Apply an evenly-distributed vertical force in the downward direction to the force application plate at any rate not more than 13 mm per second, until a force of 2,224 N has been applied.

S5.5 Apply additional vertical force in the downward direction to the force application plate at a rate of not more than 13 mm per second until the force specified in S4. has been applied, and maintain this application of force.

S5.6 Measure the downward movement of any point on the force application plate which occurred during the application of force in accordance with S5.5.

S5.7 To test the capability of the vehicle's emergency exits to open in accordance with S4.(b)—

(a) In the case of testing under the full application of force, open the emergency exits as specified in S4.(b) while maintaining the force applied in accordance with S5.4 and S5.5; and

(b) In the case of testing after the release of all force, release all downward force applied to the force application plate and open the emergency exits as specified in S4.(b).

S6. *Test conditions.* The following conditions apply to the requirements specified in S4.

S6.1 *Temperature.* The ambient temperature is any level between 0 °C and 32 °C.

S6.2 *Windows and doors.* Vehicle windows, doors, and emergency exits are in the fully-closed position, and latched but not locked.

[41 FR 3875, Jan. 27, 1976, as amended at 41 FR 36026, 36027, Aug. 26, 1976; 63 FR 28948, May 27, 1998]

§ 571.221 Standard No. 221; School bus body joint strength.

S1. *Scope.* This standard establishes requirements for the strength of the body panel joints in school bus bodies.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries resulting from the structural collapse of school bus bodies during crashes.

S3. Application. This standard applies to school buses.

S4. *Definitions. Body component* means a part of a bus body made from a single piece of homogeneous material or from a single piece of composite material such as plywood.

Body panel means a body component used on the exterior or interior surface to enclose the bus' occupant space.

Body panel joint means the area of contact or close proximity between the edges of a body panel and another body component, including but not limited to floor panels, and body panels made of composite materials such as plastic or plywood, excluding trim and decorative parts which do not contribute to the strength of the bus body, members such as rub rails which are entirely outside of body panels, ventilation panels, components provided for functional purposes, and engine access covers.

Bus body means that portion of a bus that encloses the bus occupant space, including the floor, but excluding the bumpers and chassis frame and any structure forward of the passenger compartment.

Maintenance access panel means a body panel which must be moved or removed to provide access to one or more serviceable component(s).

Passenger compartment means space within the school bus interior that is between a vertical transverse plane located 762 mm in front of the forwardmost passenger seating reference point and including a vertical transverse plane tangent to the rear interior wall of the bus at the vehicle centerline.

Serviceable component means any part of the bus, of either a mechanical or electrical nature, which is explicitly identified by the bus chassis and/or body manufacturer in the owner's manual or factory service manual as requiring routine maintenance actions at intervals of one year or less. Tubing, wires and harnesses are considered to be serviceable components only at their attachments.

S5 Requirements.

S5.1 Except as provided in S5.2, each body panel joint, including small, curved, and complex joints, when tested in accordance with the procedure of S6, shall hold the body panel to the member to which it is joined when subjected to a force of 60 percent of the tensile strength of the weakest joined body panel determined pursuant to S6.2.

S5.1.1 Body panels attached to each other shall have no unattached segment at the joint longer than 203 mm.

S5.2 Exclusions

S5.2.1 The requirements of S5.1 do not apply to—

(a) Any interior maintenance access panel or joint which lies forward of the passenger compartment.

(b) Any interior maintenance access panel within the passenger compartment that does not exceed 305 mm when measured across any two points diametrically on opposite sides of the opening.

(c) Trim and decorative parts which do not contribute to the strength of the joint, support members such as rub rails which are entirely outside of body panels, doors and windows, ventilation panels, and engine access covers.

S6 Procedure

S6.1 Preparation of the test specimen.

S6.1.1 If a body panel joint is 203 mm or longer, cut a test specimen that consists of any 203 mm segment of the joint, together with a portion of the bus body whose dimensions are those specified in Figure 1, so that the specimen's centerline is perpendicular to the joint at the midpoint of the joint segment. Where the body panel joint is not fastened continuously, select the segment so that it does not bisect a spot weld or a discrete fastener. Support members which contribute to the strength of a body panel joint, such as rub rails on the outside of body panels or underlying structure attached to joint members, shall remain attached to the test specimen, except that material may be removed from the support members as necessary to clear the gripping areas of the joint members being tested.

S6.1.2 If a joint is less than 203 mm long, cut a test specimen with enough of the adjacent material to permit it to

be held in the tension testing machine specified in S6.3.

S6.1.3 Prepare the test specimen in accordance with the preparation procedures specified in ASTM E8–89 (incorporated by reference, see § 571.5).

S6.2 *Determination of minimum allowable strength.* For purposes of determining the minimum allowable joint strength, determine the tensile strengths of the joined body components as follows:

(a) If the mechanical properties of a joint component material are specified in ASTM E8–89 (incorporated by reference, see § 571.5), the lowest value of that material's thickness and tensile strength per unit of area shown in that source shall be used.

(b) If the mechanical properties of a material are not specified in ASTM E8–89 (incorporated by reference, see § 571.5), determine its tensile strength by cutting a sheet specimen from outside the joint region of the bus body in accordance with Figure 1 of ASTM E8–89, and by testing it in accordance with S6.3.

(c) The cross sectional area of material removed to facilitate the installation of fasteners shall be subtracted from the cross-sectional area of the panel in the determination of the tensile strength of the weakest joined body panel.

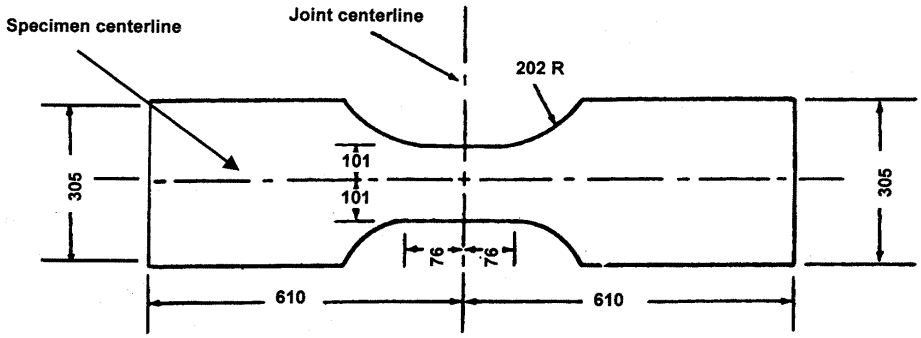
S6.3 Strength Test.

S6.3.1 The joint specimen is gripped on opposite sides of the joint in a tension testing machine in accordance with ASTM E8–89 (incorporated by reference, see § 571.5).

S6.3.2 Adjust the testing machine grips so that the applied force on the joint is at 90 degrees plus or minus 3 degrees from the joint centerline, as shown in Figure 1.

S6.3.3 A tensile force is applied to the specimen by separating the heads of the testing machine at any uniform rate not less than 3 mm and not more than 10 mm per minute until the specimen separates.

FIGURE 1



All dimensions in millimeters

[41 FR 3872, Jan. 27, 1976, as amended at 41 FR 36027, Aug. 26, 1976; 67 FR 64366, 64367, Dec. 13, 2002; 68 FR 6360, Feb. 7, 2003; 77 FR 768, Jan. 6, 2012]

§ 571.222 Standard No. 222; School bus passenger seating and crash protection.

S1. *Scope*. This standard establishes occupant protection requirements for school bus passenger seating and restraining barriers.

S2. *Purpose*. The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from the impact of school bus occupants against structures within the vehicle during crashes and sudden driving maneuvers.

S3. *Application*. This standard applies to school buses.

S4. *Definitions*. Contactable surface means any surface within the zone specified in S5.3.1.1 that is contactable from any direction by the test device described in S6.6, except any surface on the front of a seat back or restraining barrier 76 mm or more below the top of the seat back or restraining barrier.

Fixed occupancy seat means a bench seat equipped with Type 2 seat belts that has a permanent configuration regarding the number of seating positions on the seat. The number of seating positions on the bench seat cannot be increased or decreased.

Flexible occupancy seat means a bench seat equipped with Type 2 seat belts that can be reconfigured so that the number of seating positions on the seat can change. The seat has a minimum occupancy configuration and maximum occupancy configuration, and the number of passengers capable of being carried in the minimum occupancy configuration must differ from the number of passengers capable of being carried in the maximum occupancy configuration.

Maximum occupancy configuration means, on a bench seat equipped with Type 2 seat belts, an arrangement whereby the lap belt portion of the Type 2 seat belts is such that the maximum number of occupants can be belted.

Minimum occupancy configuration means, on a bench seat equipped with Type 2 seat belts, an arrangement whereby the lap belt portion of the Type 2 seat belts is such that the minimum number of occupants can be belted.

School bus passenger seat means a seat in a school bus, other than the driver's seat.

Seat bench width means the maximum transverse width of the bench seat cushion.

Small occupant seating position means the center seating position on a flexible occupancy seat in a maximum occupancy configuration, if the torso belt portion of the Type 2 seat belt is intended to restrain occupants whose dimensions range from those of a 50th percentile 6 year-old child only to those of a 50th percentile 10 year-old child and the torso belt anchor point cannot achieve a minimum height of 520 mm above the seating reference point, as specified by S4.1.3.2(a) of 49 CFR 571.210.

Wheelchair means a wheeled seat frame for the support and conveyance of a physically disabled person, comprised of at least a frame, seat, and wheels.

Wheelchair occupant restraint anchorage means the provision for transferring wheelchair occupant restraint system loads to the vehicle structure.

Wheelchair securement anchorage means the provision for transferring wheelchair securement device loads to the vehicle structure.

Wheelchair securement device means a strap, webbing or other device used for securing a wheelchair to the school bus, including all necessary buckles and other fasteners.

S4.1 *Determination of the number of seating positions and seat belt positions*

(a) The number of seating positions considered to be in a bench seat for vehicles manufactured before October 21, 2011 is expressed by the symbol W, and calculated as the seat bench width in millimeters divided by 381 and rounded to the nearest whole number.

(b) The number of seating positions and the number of Type 1 seat belt positions considered to be in a bench seat for vehicles manufactured on or after October 21, 2011 is expressed by the symbol W, and calculated as the seat bench width in millimeters divided by 380 and rounded to the nearest whole number.

(c) Except as provided in S4.1(d), the number of Type 2 seat belt positions on

a flexible occupancy seat in a minimum occupancy configuration or a fixed occupancy seat for vehicles manufactured on or after October 21, 2011 is expressed by the symbol Y, and calculated as the seat bench width in millimeters divided by 380 and rounded to the next lowest whole number. The minimum seat bench width for a seat equipped with a Type 2 seat belt is 380 mm. See Table 1 for an illustration.

(d) A flexible occupancy seat meeting the requirements of S4.1(c) may also have a maximum occupancy configuration with Y + 1 Type 2 seat belt positions, if the minimum seat bench width for this configuration is Y + 1 times 330 mm. See Table 1 for an illustration.

(e) A flexible occupancy seat equipped with Type 2 seat belts in a maximum occupancy configuration may have up to one single small occupant seating position.

TABLE 1—NUMBER OF SEATING POSITIONS AS A FUNCTION OF SEAT BENCH WIDTH

Seating configuration	Seat bench width (mm)				
	380–659	660–759	760–989	990–1139	1140–1319
Minimum or Fixed Occupancy	1	1	2	2	3
Maximum Occupancy	1	2	2	3	3

S5. *Requirements.*

(a) *Large school buses.*

(1) Each school bus manufactured before October 21, 2011 with a gross vehicle weight rating of more than 4,536 kg (10,000 pounds) shall be capable of meeting any of the requirements set forth under this heading when tested under the conditions of S6. However, a particular school bus passenger seat (i.e., a test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or having been subjected to either S5.1.3, S5.1.4, or S5.3.

(2) Each school bus manufactured on or after October 21, 2011 with a gross vehicle weight rating of more than 4,536 kg (10,000 pounds) shall be capable of meeting any of the requirements set forth under this heading when tested under the conditions of S6 of this standard or § 571.210. However, a particular school bus passenger seat (i.e., a test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or having been subjected to either S5.1.3, S5.1.4, S5.1.6 (if applicable), or S5.3. If S5.1.6.5.5(b) is applicable, a particular test specimen need only meet S5.1.6.5.5(b)(1) or (2) as part of meeting S5.1.6 in its entirety. Each vehicle with voluntarily installed Type 1 seat belts and seat belt anchorages at W seating positions in a bench seat, voluntarily installed Type 2 seat belts and seat belt anchorages at Y seat belt positions in a fixed occupancy seat, or voluntarily installed Type 2 seat belts and seat belt anchorages at Y and Y + 1 seat belt positions in a flexible occupancy seat, shall also meet the requirements of:

(i) S4.4.3.2 of Standard No. 208 (49 CFR 571.208);

(ii) Standard No. 209 (49 CFR 571.209), as they apply to school buses; and,

(iii) Standard No. 210 (49 CFR 571.210) as it applies to school buses with a gross vehicle weight rating greater than 10,000 pounds.

(b) *Small school buses.* Each vehicle with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or less shall be capable of meeting the following requirements at all seating positions:

(1)(i) In the case of vehicles manufactured before September 1, 1991, the requirements of §§ 571.208, 571.209, and 571.210 as they apply to multipurpose passenger vehicles;

(ii) [Reserved]

(iii) In the case of vehicles manufactured on or after October 21, 2011 the requirements of S4.4.3.2 of § 571.208 and the requirements of §§ 571.207, 571.209 and 571.210 as they apply to school buses with a gross vehicle weight rating of 4,536 kg or less; and,

(2) The requirements of S5.1.2, S5.1.3, S5.1.4, S5.1.5, S5.1.6, S5.1.7, S5.3, S5.4 and S5.5 of this standard. However, the requirements of §§ 571.208 and 571.210 shall be met at Y seat belt positions in a fixed occupancy seat, and at Y and Y

+ 1 seat belt positions for a flexible occupancy seat. A particular school bus passenger seat (i.e. a test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or after having been subjected to either S5.1.3, S5.1.4, S5.1.6, or S5.3 of this standard or §571.207, §571.210 or §571.225.

S5.1 *Seating requirements.* School bus passenger seats shall be forward facing.

S5.1.1 [Reserved]

S5.1.2 *Seat back height, position, and surface area.*

(a) For school buses manufactured before October 21, 2009, each school bus passenger seat must be equipped with a seat back that has a vertical height of at least 508 mm (20 inches) above the seating reference point. Each school bus passenger seat must be equipped with a seat back that, in the front projected view, has front surface area above the horizontal plane that passes through the seating reference point, and below the horizontal plane 508 mm (20 inches) above the seating reference point, of not less than 90 percent of the seat bench width in millimeters multiplied by 508.

(b) For school buses manufactured on or after October 21, 2009, each school bus passenger seat must be equipped with a seat back that has a vertical height of at least 610 mm (24 inches) above the seating reference point. The minimum total width of the seat back at 610 mm (24 inches) above the seating reference point shall be 75 percent of the maximum width of the seat bench. Each school bus passenger seat must be equipped with a seat back that, in the front projected view, has front surface area above the horizontal plane that passes through the seating reference point, and below the horizontal plane 610 mm (24 inches) above the seating reference point, of not less than 90 percent of the seat bench width in millimeters multiplied by 610.

S5.1.3 *Seat performance forward.* When a school bus passenger seat that has another seat behind it is subjected to the application of force as specified in S5.1.3.1 and S5.1.3.2, and subsequently, the application of additional force to the seat back as specified in S5.1.3.3 and S5.1.3.4:

(a) The seat back force/deflection curve shall fall within the zone specified in Figure 1;

(b) Seat back deflection shall not exceed 356 mm; (for determination of (a) and (b) the force/deflection curve describes only the force applied through the upper loading bar, and only the forward travel of the pivot attachment point of the upper loading bar, measured from the point at which the initial application of 44 N of force is attained.)

(c) The seat shall not deflect by an amount such that any part of the seat moves to within 102 mm of any part of another school bus passenger seat or restraining barrier in its originally installed position;

(d) The seat shall not separate from the vehicle at any attachment point; and

(e) Seat components shall not separate at any attachment point.

S5.1.3.1 Position the loading bar specified in S6.5 so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in any horizontal plane between 102 mm above and 102 mm below the seating reference point of the school bus passenger seat behind the test specimen.

S5.1.3.2 Apply a force of 3,114W newtons horizontally in the forward direction through the loading bar at the pivot attachment point. Reach the specified load in not less than 5 nor more than 30 seconds.

S5.1.3.3 No sooner than 1.0 second after attaining the required force, reduce that force to 1,557W newtons and, while maintaining the pivot point position of the first loading bar at the position where the 1,557W newtons is attained, position a second loading bar described in S6.5 so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 406 mm above the seating reference point of the school bus passenger seat behind the test specimen, and move the bar forward against the seat back until a force of 44 N has been applied.

S5.1.3.4 Apply additional force horizontally in the forward direction through the upper bar until 452W joules

of energy have been absorbed in deflecting the seat back (or restraining barrier). Apply the additional load in not less than 5 seconds nor more than 30 seconds. Maintain the pivot attachment point in the maximum forward travel position for not less than 5 seconds nor more than 10 seconds and release the load in not less than 5 nor more than 30 seconds. (For the determination of S5.1.3.4 the force/deflection curve describes only the force applied through the upper loading bar, and the forward and rearward travel distance of the upper loading bar pivot attachment point measured from the position at which the initial application of 44 N of force is attained.)

S5.1.4 *Seat performance rearward.* When a school bus passenger seat that has another seat behind it is subjected to the application of force as specified in S5.1.4.1 and S5.1.4.2:

(a) Seat back force shall not exceed 9,786 N;

(b) Seat back deflection shall not exceed 254 mm; (for determination of (a) and (b) the force/deflection curve describes only the force applied through the loading bar, and only the rearward travel of the pivot attachment point of the loading bar, measured from the point at which the initial application of 222 N is attained.

(c) The seat shall not deflect by an amount such that any part of the seat moves to within 102 mm of any part of another passenger seat in its originally installed position;

(d) The seat shall not separate from the vehicle at any attachment point; and

(e) Seat components shall not separate at any attachment point.

S5.1.4.1 Position the loading bar described in S6.5 so that it is laterally centered forward of the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 343 mm above the seating reference point of the test specimen, and move the loading bar rearward against the seat back until a force of 222 N has been applied.

S5.1.4.2 Apply additional force horizontally rearward through the loading bar until 316W joules (J) of energy has been absorbed in deflecting the seat back. Apply the additional load in not less than 5 seconds nor more than 30 seconds. Maintain the pivot attachment point in the maximum rearward travel position for not less than 5 seconds nor more than 10 seconds and release the load in not less than 5 seconds nor more than 30 seconds. (For determination of S5.1.4.2 the force deflection curve describes the force applied through the loading bar and the rearward and forward travel distance of the loading bar pivot attachment point measured from the position at which the initial application of 222 N of force is attained.)

S5.1.5 *Seat cushion latching and retention.*

(a) School bus passenger seat cushions equipped with attachment devices that allow for the seat cushion to be removable without tools or to flip up must have a self-latching mechanism that latches when subjected to the conditions specified in S5.1.5.1. The seat cushion shall not separate from the seat at any attachment point when subjected to the conditions specified in S5.1.5.2 after being subjected to the conditions of S5.1.5.1.

(b) School bus passenger seat cushions that are removable only with the use of tools shall not separate from the seat at any attachment point when subjected to the conditions of S5.1.5.2.

S5.1.5.1 Release the seat cushion self-latching mechanism. Lift the seat cushion then place the seat cushion back in the down position without activating the self-latching mechanism, if possible. Apply a downward force of 216 N (48.4 pounds) to the center of the seat cushion. The downward force shall be applied in any period of not less than 1 and not more than 5 seconds, and maintained for 5 seconds.

S5.1.5.2 Apply an upward force of 5 times the weight of the seat cushion to the center of the bottom of the seat cushion. The upward force shall be applied in any period of not less than 1 and not more than 5 seconds, and maintained for 5 seconds.

S5.1.6 *Quasi-static test of compartmentalization and Type 2 seat belt performance.* This section applies to school buses manufactured on or after October 21, 2011 with a gross vehicle weight rating expressed in the first column of Tables 2 through 4, and that are

equipped with Type 2 seat belt assemblies.

(a) Except as provided in S5.1.6(b), when tested under the conditions of S5.1.6.5.1 through S5.1.6.5.6, the criteria specified in S5.1.6.1 and S5.1.6.2 must be met.

(b) A school bus passenger seat that does not have another seat behind it is not loaded with the upper and lower loading bars as specified in S5.1.6.5.2, S5.1.6.5.3, and S5.1.6.5.7 and is excluded from the requirements of S5.1.6.1(b).

S5.1.6.1 *Displacement limits.* In Tables 2 and 3, AH is the height in millimeters of the school bus torso belt anchor point specified by S4.1.3.2(a) of Standard No. 210 (49 CFR 571.210) and Φ is the angle of the posterior surface of the seat back defined in S5.1.6.3 of this standard.

(a) Any school bus torso belt anchor point, as defined in S3 of Standard No. 210, must not displace horizontally forward from its initial position (when Φ was determined) more than the value in millimeters calculated from the following expression in the second column of Table 2:

TABLE 2—TORSO BELT ANCHOR POINT DISPLACEMENT LIMIT

Gross vehicle weight rating	Displacement limit in millimeters
More than 4,536 kg (10,000 pounds).	(AH + 100) (tanΦ + 0.242/cosΦ)
Less than or equal to 4,536 kg (10,000 pounds).	(AH + 100) (tanΦ + 0.356/cosΦ)

(b) A point directly rearward of any school bus torso belt anchor point, as defined in S3 of Standard No. 210 (49 CFR 571.210) on the rear facing surface of the seat back, must not displace horizontally forward from its initial position (when Φ was determined) more than the value in millimeters calculated from the following expression in the second column of Table 3:

TABLE 3—SEAT BACK POINT DISPLACEMENT LIMIT

Gross vehicle weight rating	Displacement limit in millimeters
More than 4,536 kg (10,000 pounds).	(AH + 100) (tanΦ + 0.174/cosΦ)
Less than or equal to 4,536 kg (10,000 pounds).	(AH + 100) (tanΦ + 0.259/cosΦ)

S5.1.6.2 *Slippage of device used to achieve torso belt adjusted height.* If the torso belt adjusted height, as defined in S3 of Standard No. 210 (49 CFR 571.210), is achieved without the use of an adjustable torso belt anchorage, the adjustment device must not slip more than 25 mm (1.0 inches) along the webbing or guide material upon which it moves for the purpose of adjusting the torso belt height.

S5.1.6.3 *Angle of the posterior surface of a seat back.* If the seat back inclination is adjustable, the seat back is placed in the manufacturer's normal design riding position. If such a position is not specified, the seat back is positioned so it is in the most upright position. Position the loading bar specified in S6.5 of this standard so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle in a horizontal plane within ±6 mm (0.25 inches) of the horizontal plane passing through the seating reference point and move the bar forward against the seat back until a force of 44 N (10 pounds) has been applied. Position a second loading bar as described in S6.5 of this standard so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 406 ±6 mm (16 ±0.25 inches) above the seating reference point, and move the bar forward against the seat back until a force of 44 N (10 pounds) has been applied. Determine the angle from vertical of a line in the longitudinal vehicle plane that passes through the geometric center of the cross-section of each cylinder, as shown in Figure 8. That angle is the angle of the posterior surface of the seat back.

S5.1.6.4 The seat back must absorb 452W joules of energy when subjected to the force specified in S5.1.6.5.7.

S5.1.6.5 *Quasi-static test procedure.*

S5.1.6.5.1 Adjust the seat back as specified in S5.1.6.3. Place all torso anchor points in their highest position of adjustment. If the torso belt adjusted height, as defined in S3 of FMVSS No. 210, is achieved by a method other than an adjustable anchor point, initially place the torso belt adjusted height at its highest position. Then move the adjustment device 38 mm (1.5 inches)

downward with respect to its webbing or guide material.

S5.1.6.5.2 Position the lower loading bar specified in S6.5 of this standard so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in any horizontal plane between 102 mm (4 inches) above and 102 mm (4 inches) below the seating reference point of the school bus passenger seat behind the test specimen. Position the upper loading bar described in S6.5 so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 406 mm (16 inches) above the seating reference point of the school bus passenger seat behind the test specimen.

S5.1.6.5.3 Apply a force of 3,114W N (700W pounds) horizontally in the forward direction through the lower loading bar specified at S6.5 at the pivot attachment point. Reach the specified load in not less than 5 and not more than 30 seconds. No sooner than 1.0 second after attaining the required force, reduce that force to 1,557W N (350W pounds) and maintain the pivot point position of the loading bar at the position where the 1,557W N (350W pounds) is attained until the completion of S5.1.6.5.7 of this standard.

S5.1.6.5.4 Position the body block specified in Figure 3 of FMVSS No. 210 (49 CFR 571.210) under each torso belt (between the torso belt and the seat back) in the passenger seat and apply a preload force of 600 ±50 N (135 ±11 pounds) on each body block in a forward direction parallel to the longitudinal centerline of the vehicle pursuant to the specifications of Standard No. 210 (49 CFR 571.210). After preload application is complete, the origin of the 203 mm body block radius at any point across the 102 mm body block thickness shall lie within the zone defined by S5.1.6.5.4(a) and S5.1.6.5.4(b) as shown in Figure 9:

(a) At or rearward of a transverse vertical plane of the vehicle located 100 mm longitudinally forward of the seating reference point.

(b) Within 75 mm of the horizontal plane located midway between the horizontal plane passing through the school bus torso belt adjusted height, specified in S3 of Standard No. 210 (49 CFR 571.210), and the horizontal plane 100 mm below the seating reference point.

S5.1.6.5.5 *Load application.*

(a) *Fixed Occupancy Seat.* For school buses with the gross vehicle weight rating listed in the first column of Table 4, if the expression in the second column is true, simultaneously apply the force listed in the third column to each body block.

TABLE 4—TORSO BODY BLOCK FORCES FOR FIXED OCCUPANCY SEATS

Gross vehicle weight rating	True expression	Applied force
More than 4,536 kg (10,000 pounds)	((seat bench width in mm)—(380Y)) ≤25 mm (1 inch).	3,300 N (742 pounds).
More than 4,536 kg (10,000 pounds)	((seat bench width in mm)—(380Y)) >25 mm (1 inch).	5,000 N (1,124 pounds).
Less than or equal to 4,536 kg (10,000 pounds).	((seat bench width in mm)—(380Y)) ≤25 mm (1 inch).	5,000 N (1,124 pounds).
Less than or equal to 4,536 kg (10,000 pounds).	((seat bench width in mm)—(380Y)) >25 mm (1 inch).	7,500 N (1,686 pounds).

(b) *Flexible Occupancy Seat.*

(1) For school buses with the gross vehicle weight rating listed in the first column of Table 5 and a bench seat in the maximum occupancy configuration for a flexible occupancy seat of Y + 1 seat belt positions as specified in S4.1(d), simultaneously apply the force listed in the second column of Table 5 to each body block.

TABLE 5—TORSO BODY BLOCK FORCES IN MAXIMUM OCCUPANCY CONFIGURATION

Gross vehicle weight rating	Applied force
More than 4,536 kg (10,000 pounds)	3,300 N (742 pounds).
Less than or equal to 4,536 kg (10,000 pounds).	5,000 N (1,124 pounds).

(2) For a flexible occupancy seat in the minimum occupant configuration,

apply the forces to each body block as specified in S5.1.6.5.5(a).

S5.1.6.5.6 Reach the specified load in not less than 5 and not more than 30 seconds. While maintaining the load, measure the school bus torso belt anchor point and seat back point horizontal displacement and then remove the body block.

S5.1.6.5.7 Move the upper bar forward against the seat back until a force of 44 N has been applied. Apply an additional force horizontally in the forward direction through the upper bar until 452W joules of energy have been absorbed in deflecting the seat back. The maximum travel of the pivot attachment point for the upper loading bar shall not exceed 356 mm as measured from the position at which the initial application of 44 N of force is attained and the maximum load must stay below the upper boundary of the force/deflection zone in Figure 1. Apply the additional load in not less than 5 seconds and not more than 30 seconds. Maintain the pivot attachment point at the maximum forward travel position for not less than 5 seconds, and not more than 10 seconds and release the load in not less than 5 seconds and not more than 30 seconds. (For the determination of S5.1.6.5.7, the energy calculation describes only the force applied through the upper loading bar, and the forward and rearward travel distance of the upper loading bar pivot attachment point measured from the position at which the application in this section of 44 N of force is attained.)

S5.1.7 *Buckle side length limit.* This section applies to rear passenger seats on school buses manufactured on or after October 21, 2011 that are equipped with Type 1 or Type 2 seat belt assemblies. All portions of the buckle/latchplate assembly must remain rearward of the limit plane defined in S5.1.7.1 when tested under the conditions of S5.1.7.2.

S5.1.7.1 *Buckle/latchplate limit plane.* Establish a transverse limit plane 65 mm from the SgRP that is perpendicular to a transverse plane that passes through the SgRP at an angle of 50 degrees to the horizontal.

S5.1.7.2 *Load application.* Insert the seat belt latchplate into the seat belt buckle. Apply a 20 N load to the buckle/latchplate assembly whose vector is in a vertical longitudinal plane. Apply the load along the centerline of the webbing attached to the latchplate at least 100mm from the nearest point on the latchplate. The load may be applied at any angle in the range of 30 to 75 degrees from horizontal.

S5.2 *Restraining barrier requirements.* Each vehicle shall be equipped with a restraining barrier forward of any designated seating position that does not have the rear surface of another school bus passenger seat within 610 mm of its seating reference point, measured along a horizontal longitudinal line through the seating reference point in the forward direction.

S5.2.1 *Barrier-seat separation.* The horizontal distance between the restraining barrier's rear surface and the seating reference point of the seat in front of which the barrier is required shall not be more than 610 mm measured along a horizontal longitudinal line through the seating reference point in the forward direction.

S5.2.2 *Barrier height, position, and rear surface area.* The position and rear surface area of the restraining barrier shall be such that, in a front projected view of the bus, each point of the barrier's perimeter coincides with or lies outside of the perimeter of the minimum seat back area required by S5.1.2 for the seat immediately rearward of the restraining barrier.

S5.2.3 *Barrier performance forward.* When force is applied to the restraining barrier in the same manner as specified in S5.1.3.1 through S5.1.3.4 for seating performance tests:

(a) The restraining barrier force/deflection curve shall fall within the zone specified in Figure 1;

(b) Restraining barrier deflection shall not exceed 356 mm; (for computation of (a) and (b) the force/deflection curve describes only the force applied through the upper loading bar, and only the forward travel of the pivot attachment point of the loading bar, measured from the point at which the initial application of 44 N of force is attained.)

(c) Restraining barrier deflection shall not interfere with normal door operation;

(d) The restraining barrier shall not separate from the vehicle at any attachment point; and

(e) Restraining barrier components shall not separate at any attachment point.

S5.3 *Impact zone requirements.*

S5.3.1 *Head protection zone.* Any contactable surface of the vehicle within any zone specified in S5.3.1.1 shall meet the requirements of S5.3.1.2 and S5.3.1.3. However, a surface area that has been contacted pursuant to an impact test need not meet further requirements contained in S5.3.

S5.3.1.1 The head protection zones in each vehicle are the spaces in front of each school bus passenger seat which are not occupied by bus sidewall, window, or door structure and which, in relation to that seat and its seating reference point, are enclosed by the following planes;

(a) Horizontal planes 305 mm and 1016 mm above the seating reference point;

(b) A vertical longitudinal plane tangent to the inboard (aisle side) edge of the seat; and

(c) A vertical longitudinal plane 83 mm inboard of the outboard edge of the seat;

(d) Vertical transverse planes through and 762 mm forward of the reference point.

S5.3.1.2 *Head form impact requirement.* When any contactable surface of the vehicle within the zones specified in S5.3.1.1 is impacted from any direction at 6.7 m/s by the head form described in S6.6, the axial acceleration at the center of gravity of the head form shall be such that the expression

$$\left[\frac{1}{t1-t2}\int_{t1}^{t2} a\,dt\right]^{2.5}(t1-t2)$$

shall not exceed 1,000 where ''a'' is the axial acceleration expressed as a multiple of ''*g*'' (the acceleration due to gravity), and ''t_1'' and ''t_2'' are any two points in time during the impact.

S5.3.1.3 *Head form force distribution.* When any contactable surface of the vehicle within the zones specified in S5.3.1.1 is impacted from any direction at 6.7 m/s by the head form described in S6.6, the energy necessary to deflect the impacted material shall be not less than 4.5 joules before the force level on the head form exceeds 667 N. When any contactable surface within such zones is impacted by the head form from any direction at 1.5 m/s the contact area on the head form surface shall be not less than 1,935 mm^2.

S5.3.2 *Leg protection zone.* Any part of the seat backs or restraining barriers in the vehicle within any zone specified in S5.3.2.1 shall meet the requirements of S5.3.2.2.

S5.3.2.1 The leg protection zones of each vehicle are those parts of the school bus passenger seat backs and restraining barriers bounded by horizontal planes 305 mm above and 102 mm below the seating reference point of the school bus passenger seat immediately behind the seat back or restraining barrier.

S5.3.2.2 When any point on the rear surface of that part of a seat back or restraining barrier within any zone specified in S5.3.2.1 is impacted from any direction at 4.9 m/s by the knee form specified in S6.7, the resisting force of the impacted material shall not exceed 2,669 N and the contact area on the knee form surface shall not be less than 1,935 mm^2.

S5.4 Each school bus having one or more locations designed for carrying a person seated in a wheelchair shall comply with S5.4.1 through S5.4.4 at each such wheelchair location.

S5.4.1 *Wheelchair securement anchorages.* Each wheelchair location shall have not less than four wheelchair securement anchorages complying with S5.4.1.1 through S5.4.1.3.

S5.4.1.1 Each wheelchair securement anchorage shall have a wheelchair securement device complying with S5.4.2 attached to it.

S5.4.1.2 The wheelchair securement anchorages at each wheelchair location shall be situated so that—

(a) A wheelchair can be secured in a forward-facing position.

(b) The wheelchair can be secured by wheelchair securement devices at two locations in the front and two locations in the rear.

(c) The front wheel of a three-wheeled wheelchair can be secured.

S5.4.1.3 Each wheelchair securement anchorage shall be capable of withstanding a force of 13,344 Newtons applied as specified in paragraphs (a) through (d) of this section. When more than one securement device share a common anchorage, the anchorage shall be capable of withstanding a force of 13,344 Newtons multiplied by the number of securement devices sharing that anchorage.

(a) The initial application force shall be applied at an angle of not less than 30 degrees, but not more than 60 degrees, measured from the horizontal. (See Figure 4.)

(b) The horizontal projection of the force direction shall be within a horizontal arc of ±45 degrees relative to a longitudinal line which has its origin at the anchorage location and projects rearward for an anchorage whose wheelchair securement device is intended to secure the front of the wheelchair and forward for an anchorage whose wheelchair securement device is intended to secure the rear of the wheelchair. (See Figure 4.)

(c) The force shall be applied at the onset rate of not more than 133,440 Newtons per second.

(d) The 13,344 Newton force shall be attained in not more than 30 seconds, and shall be maintained for 10 seconds.

S5.4.2 *Wheelchair securement devices.* Each wheelchair securement device shall—

(a) If incorporating webbing or a strap—

(1) Comply with the requirements for Type 1 safety belt systems in S4.2, S4.3, and S4.4(a) of FMVSS No. 209, *Seat Belt Assemblies*; and

(2) Provide a means of adjustment to remove slack from the device.

(b) If not incorporating webbing or a strap, limit movement of the wheelchair through either the equipment design or a means of adjustment.

S5.4.3 *Wheelchair occupant restraint anchorages.*

S5.4.3.1 Each wheelchair location shall have:

(a) Not less than one anchorage for the upper end of the upper torso restraint; and

(b) Not less than two floor anchorages for wheelchair occupant pelvic and upper torso restraint.

S5.4.3.2 Each wheelchair occupant restraint floor anchorage shall be capable of withstanding a force of 13,344 Newtons applied as specified in paragraphs (a) through (d). When more than one wheelchair occupant restraint share a common anchorage, the anchorage shall be capable of withstanding a force of 13,344 Newtons multiplied by the number of occupant restraints sharing that anchorage.

(a) The initial application force shall be applied at an angle of not less than 45 degrees, but not more than 80 degrees, measured from the horizontal. (See Figure 5.)

(b) The horizontal projection of the force direction shall be within a horizontal arc of ±45 degrees relative to a longitudinal line which has its origin at the anchorage and projects forward. (See Figure 5.)

(c) The force shall be applied at an onset rate of not more than 133,440 Newtons per second.

(d) The 13,344 Newton force shall be attained in not more than 30 seconds, and shall be maintained for 10 seconds.

(e) When a wheelchair securement device and an occupant restraint share a common anchorage, including occupant restraint designs that attach the occupant restraint to the securement device or the wheelchair, the loads specified by S5.4.1.3 and S5.4.3.2 shall be applied simultaneously, under the conditions specified in S5.4.3.2 (a) and (b). (See Figure 6.)

S5.4.3.3 Each anchorage for a wheelchair occupant upper torso restraint shall be capable of withstanding a force of 6,672 Newtons applied as specified in paragraphs (a) through (d).

(a) The initial application force shall be applied at a vertical angle of not less than zero degrees, but not more than 40 degrees, below a horizontal plane which passes through the anchorage. (See Figure 7.)

(b) The projection of the force direction onto the horizontal plane shall be within zero degrees and 45 degrees as measured from a longitudinal line with its origin at the anchorage and projecting forward. (See Figure 7.)

(c) The force shall be applied at the onset rate of not more than 66,720 Newtons per second.

(d) The 6,672 Newton force shall be attained in not more than 30 seconds, and shall be maintained for 10 seconds.

S5.4.4 *Wheelchair occupant restraints.*

(a) Each wheelchair location shall have wheelchair occupant pelvic and upper torso restraints attached to the anchorages required by S5.4.3.

(b) Each wheelchair occupant restraint shall comply with the requirements for Type 2 safety belt systems in S4.2, S4.3, and S4.4(b) of FMVSS No. 209, *Seat Belt Assemblies*.

S5.5 *Labeling.* (a) A small occupant seating position must be permanently and legibly marked or labeled with the phrase: ''Do Not Sit In Middle Seat If Over Age 10''. The phrase must be comprised of no more than two lines of text. The label must be placed on the torso belt portion of the Type 2 seat belt. It must be plainly visible and easily readable when the seat belt is in a stored position. The distance from the top edge of the top line of text to the bottom edge of the bottom line of text must be at least 35 mm. If the label is sewn on, it must be stitched around its entire perimeter.

(b) [Reserved]

S6. *Test conditions.* The following conditions apply to the requirements specified in S5.

S6.1 *Test surface.* The bus is at rest on a level surface.

S6.2 *Tires.* Tires are inflated to the pressure specified by the manufacturer for the gross vehicle weight rating.

S6.3 *Temperature.* The ambient temperature is any level between 0 degrees C and 32 degrees C.

S6.4 *Seat back position.* If adjustable, a seat back is adjusted to its most upright position.

S6.5 *Loading bar.* The loading bar is a rigid cylinder with an outside diameter of 152 mm that has hemispherical ends with radii of 76 mm and with a surface roughness that does not exceed 1.6 μm, root mean square. The length of the loading bar is 102 mm less than the width of the seat back in each test. The stroking mechanism applies force through a pivot attachment at the center point of the loading bar which allows the loading bar to rotate in a horizontal plane 30 degrees in either direction from the transverse position.

S6.5.1 A vertical or lateral force of 17,792 N applied externally through the pivot attachment point of the loading bar at any position reached during a test specified in this standard shall not deflect that point more than 25 mm.

S6.6 *Head form.* The head form for the measurement of acceleration is a rigid surface comprised of two hemispherical shapes, with total equivalent mass of 5.2 kg. The first of the two hemispherical shapes has a diameter of 166 mm. The second of the two hemispherical shapes has a 50 mm diameter and is centered as shown in Figure 3 to protrude from the outer surface of the first hemispherical shape. The surface roughness of the hemispherical shapes does not exceed 1.6 μm, root mean square.

S6.6.1 The direction of travel of the head form is coincidental with the straight line connecting the centerpoints of the two spherical outer surfaces which constitute the head form shape.

S6.6.2 The head form is instrumented with an acceleration sensing device whose output is recorded in a data channel that conforms to the requirements for a 1,000 Hz channel class as specified in SAE Recommended Practice J211a (1971) (incorporated by reference, see § 571.5). The head form exhibits no resonant frequency below three times the frequency of the channel class. The axis of the acceleration sensing device coincides with the straight line connecting the centerpoints of the two hemispherical outer surfaces which constitute the head form shape.

S6.6.3 The head form is guided by a stroking device so that the direction of travel of the head form is not affected by impact with the surface being tested at the levels called for in the standard.

S6.7 *Knee form.* The knee form for measurement of force is a rigid 76 millimeter-diameter cylinder, with an equivalent weight of 44 N that has one hemispherical end with a 38 mm radius forming a contact surface of the knee form. The hemispherical surface roughness does not exceed 1.6 μm, root mean square.

S6.7.1 The direction of travel of the knee form is coincidental with the centerline of the rigid cylinder.

S6.7.2 The knee form is instrumented with an acceleration sensing device whose output is recorded in a data channel that conforms to the requirements of a 600 Hz channel class as specified in SAE Recommended Practice J211a (1971) (incorporated by reference, see §571.5). The knee form exhibits no resonant frequency below three times the frequency of the channel class. The axis of the acceleration sensing device is aligned to measure acceleration along the centerline of the cylindrical knee form.

S6.7.3 The knee form is guided by a stroking device so that the direction of travel of the knee form is not affected by impact with the surface being tested at the levels called for in the standard.

S6.8 The head form, knee form, and contactable surfaces are clean and dry during impact testing.

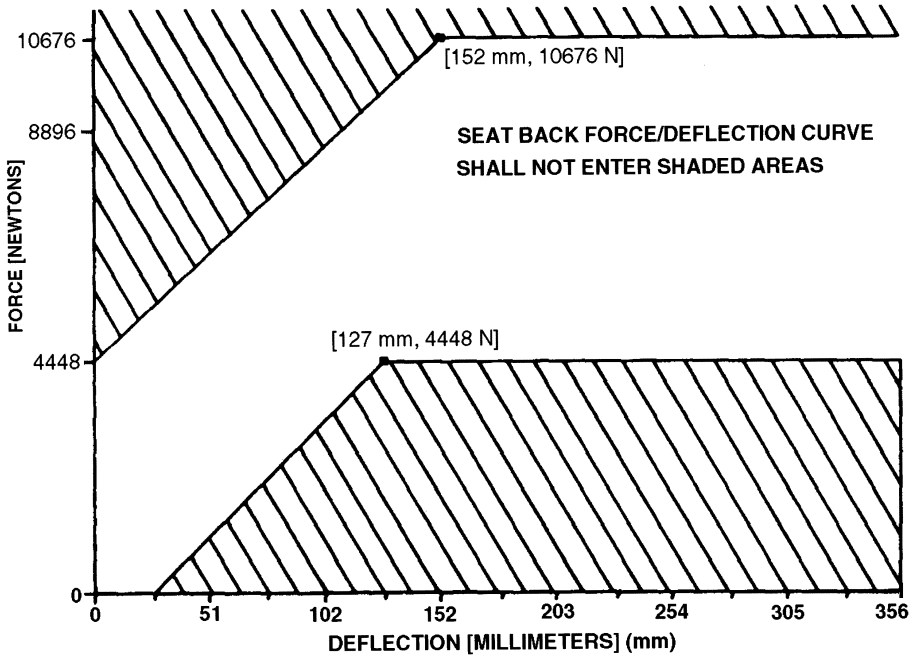


Figure 1.—Force/Deflection Zone

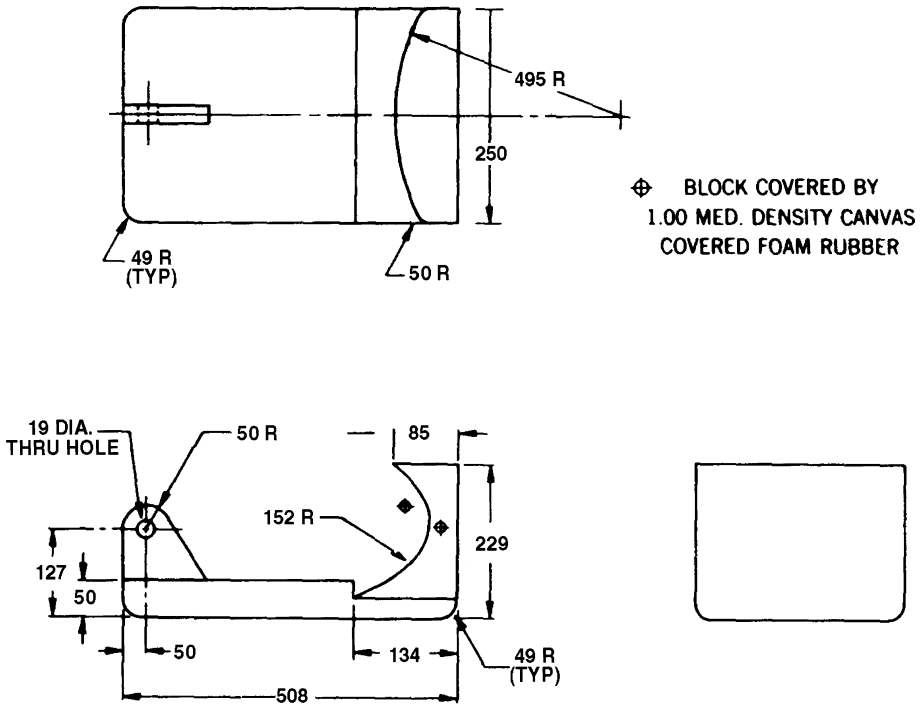


Figure 2.—Body Block for Lap Belt
All Dimensions in Millimeters (mm)

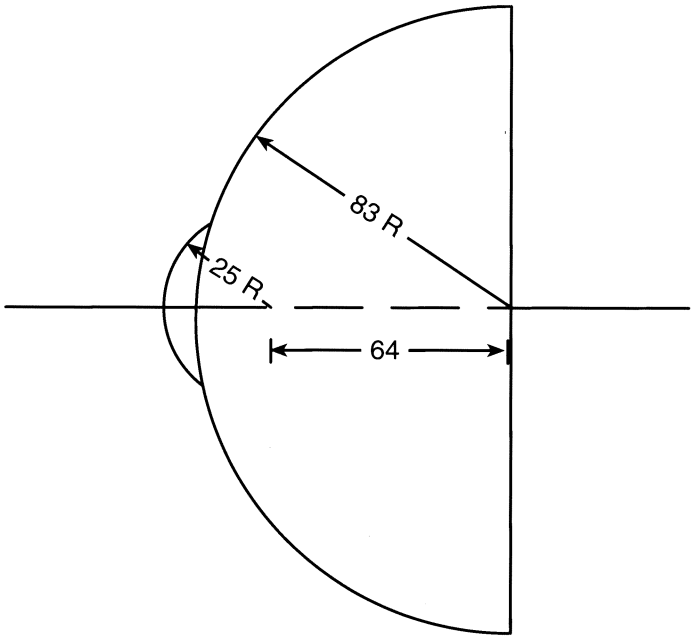


Figure 3
All dimensions in millimeters (mm)

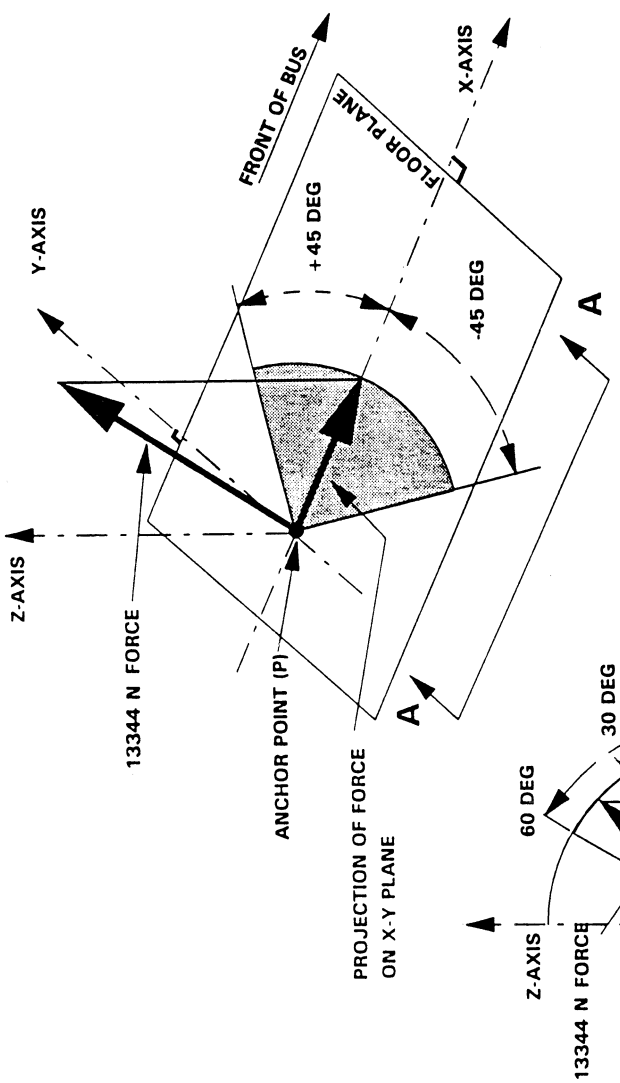


Figure 4. Wheelchair Securement Anchorage Loading Direction (Rear Anchorage Shown)

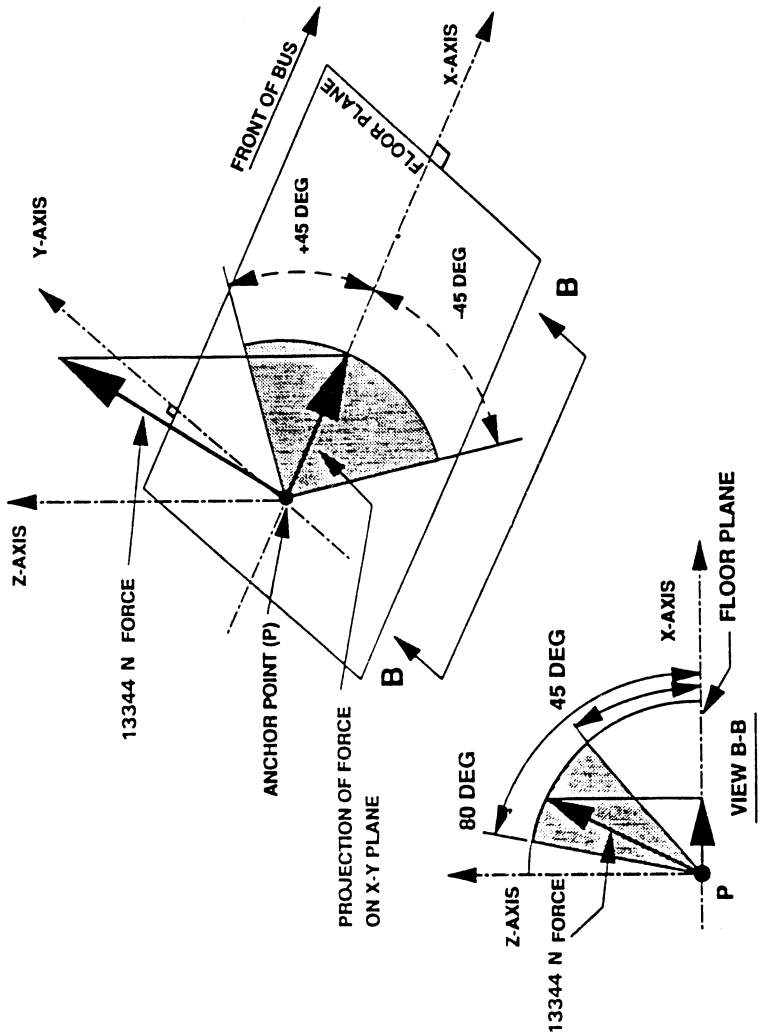


Figure 5. Pelvic Restraint Anchorage Loading Direction

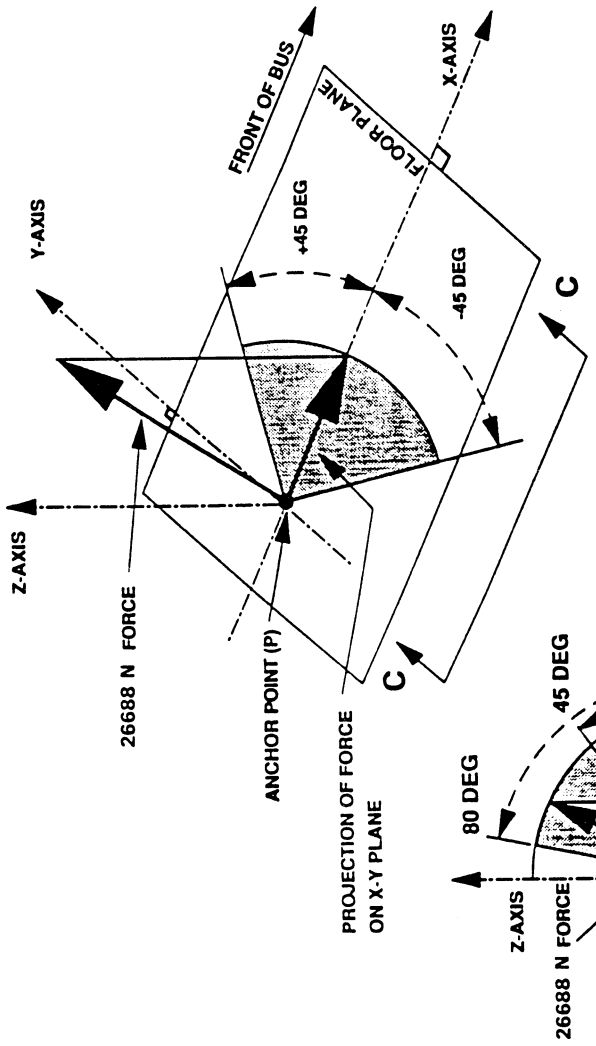


Figure 6. Pelvic Restraint and Wheelchair Securement Common Anchorage Loading Direction (Rear Direction Only)

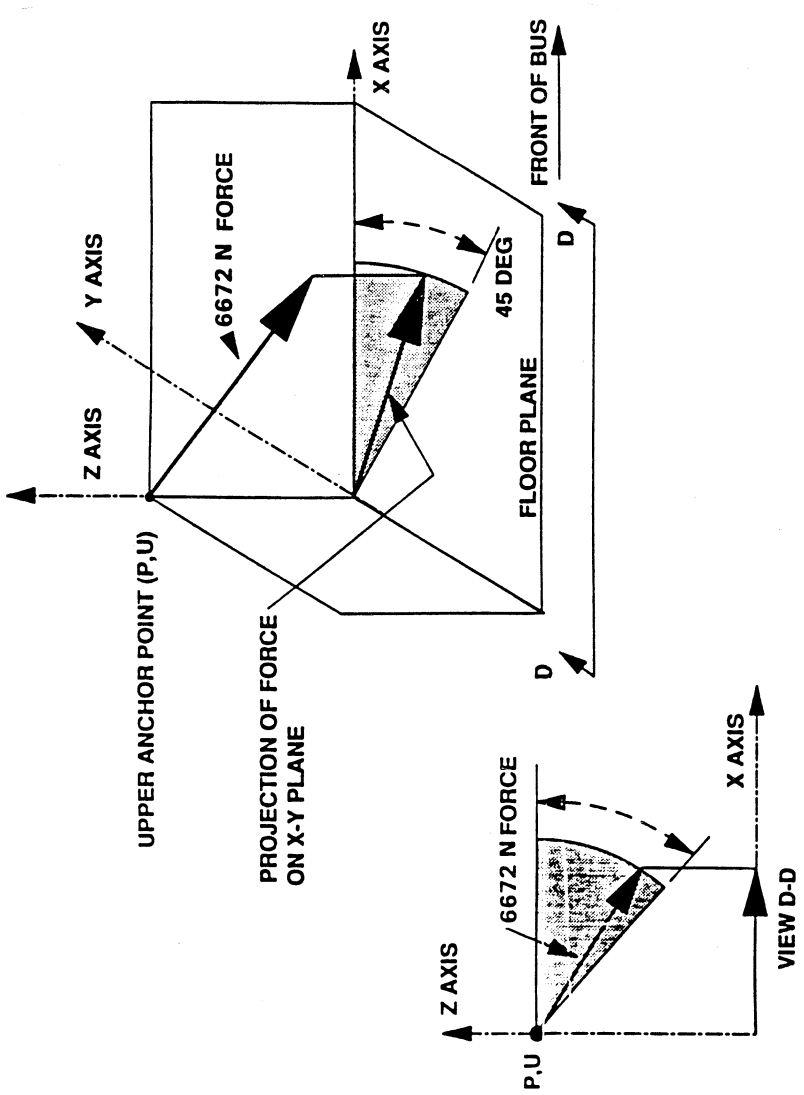


Figure 7. Upper Torso Restraint and Torso Harness Anchorage Loading Location

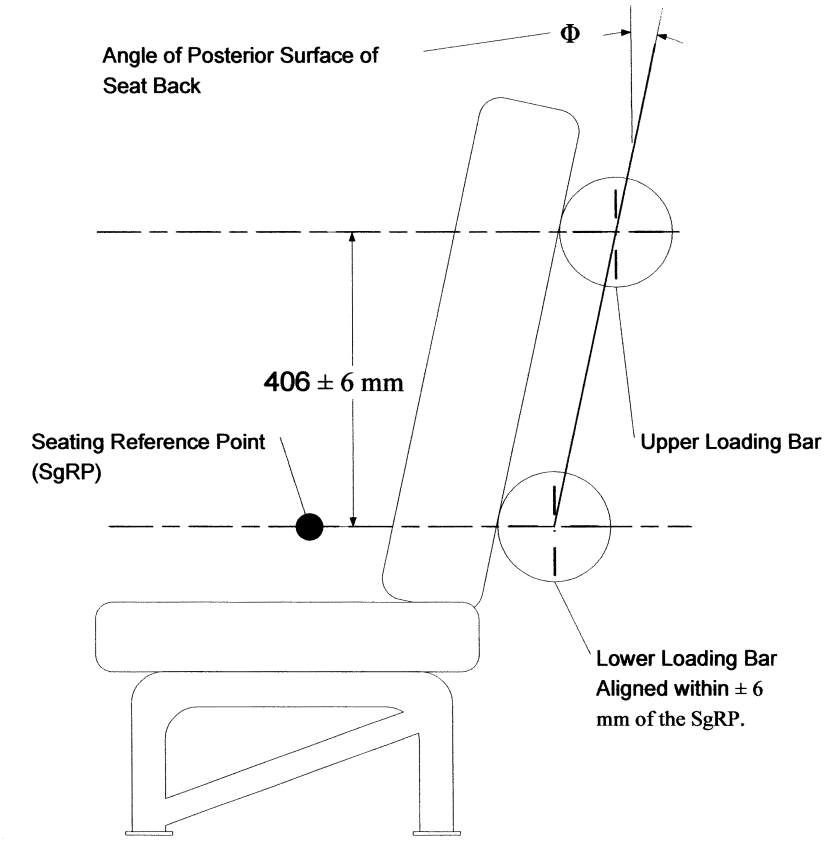


Figure 8 – Definition of initial angle of compartmentalizing seat back surface

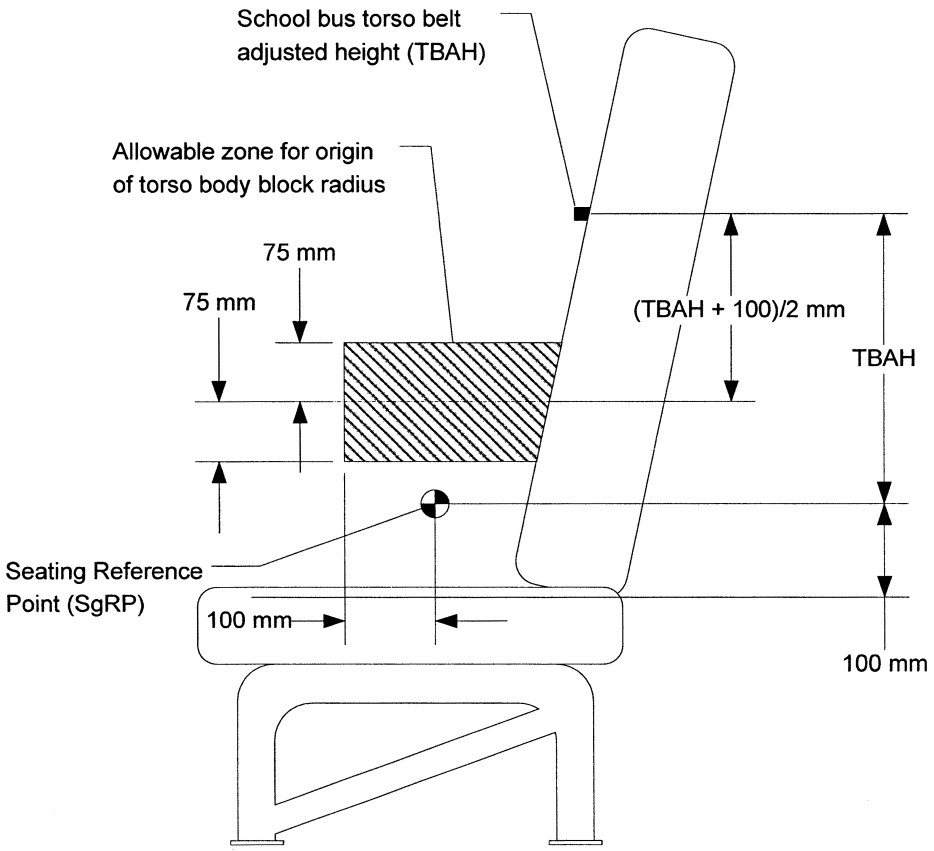


Figure 9 – Torso Block Zone

[41 FR 4018, Jan. 28, 1976]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §571.222, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§571.223 Standard No. 223; Rear impact guards.

S1. *Scope.* This standard specifies requirements for rear impact guards for trailers and semitrailers.

S2. *Purpose.* The purpose of this standard is to reduce the number of deaths and serious injuries that occur when light duty vehicles collide with the rear end of trailers and semitrailers.

S3. *Application.* This standard applies to rear impact guards for trailers and semitrailers subject to Federal Motor Vehicle Safety Standard No. 224, *Rear Impact Protection* (§571.224).

S4. *Definitions.*

In this standard, directional terms such as *bottom*, *center*, *height*, *horizontal*, *longitudinal*, *transverse*, and *rear* refer to directions relative to the vehicle orientation when the guard is oriented as if it were installed on a vehicle according to the installation instructions in S5.5 of this section.

Chassis means the load supporting frame structure of a motor vehicle.

Guard width means the maximum horizontal guard dimension that is perpendicular to the longitudinal vertical plane passing through the longitudinal centerline of the vehicle when the guard is installed on the vehicle according to the installation instructions in S5.5 of this section.

Ground clearance means the vertical distance from the bottom edge of a horizontal member to the ground.

Horizontal member means the structural member of the guard that meets the configuration requirements of S5.1.1 through 5.1.3 of § 571.224, Rear Impact Protection, when the guard is installed on a vehicle according to the guard manufacturer's installation instructions.

Hydraulic guard means a guard designed to use fluid properties to provide resistance force to deformation.

Load path means a route of force transmission between the horizontal member and the chassis.

Rear impact guard means a device installed on or near the rear of a vehicle so that when the vehicle is struck from the rear, the device limits the distance that the striking vehicle's front end slides under the rear end of the impacted vehicle.

Rigid test fixture means a supporting structure on which a rear impact guard can be mounted in the same manner it is mounted to a vehicle. The rigid test fixture is designed to resist the forces applied to the rear impact guard without significant deformation, such that a performance requirement of this standard must be met no matter how small an amount of energy is absorbed by the rigid test fixture.

S5. Requirements.

S5.1 *Projected Vertical Height.* The horizontal member of each guard, when viewed from the rear as it would be installed on a trailer pursuant to the installation instructions or procedures required by S5.5 of this standard, shall have a vertical height of at least 100 mm at each point across the guard width, when projected horizontally on a transverse vertical plane. Those installation instructions or procedures shall specify that the guard is to be mounted so that all portions of the horizontal member necessary to achieve a 100 mm high projected vertical height are located not more than 305 mm forward of the vehicle's rear extremity, as defined in S4 of 49 CFR 571.224, Rear Impact Protection. See Figure 1 of this section.

S5.2 *Strength and Energy Absorption.* When tested under the procedures of S6 of this section, each guard shall comply with the strength requirements of S5.2.1 of this section at each test location and the energy absorption requirements of S5.2.2 of this section when a distributed load is applied uniformly across the horizontal member, as specified in S6.8 of this section. However, a particular guard (*i.e.*, test specimen) need not be tested at more than one location.

S5.2.1 *Guard Strength.* The guard must resist the force levels specified in S5.2.1(a) through (c) of this section without deflecting by more than 125 mm and without eliminating any load path that existed before the test was initiated.

(a) A force of 50,000 N applied in accordance with S6.6 of this section at test location P1 on either the left or the right side of the guard as defined in S6.4(a) of this section.

(b) A force of 50,000 N applied in accordance with S6.6 of this section at test location P2 as defined in S6.4(b) of this section.

(c) A uniform distributed force of at least 350,000 N applied across the horizontal member, as specified in S6.8 of this section and in accordance with S6.6 of this section.

S5.2.2 *Guard Energy Absorption.*

(a) A guard, other than a hydraulic guard or one installed on a tanker trailer, when subjected to a uniform distributed load applied in accordance with S6.6(c) of this section:

(1) Shall absorb by plastic deformation at least 20,000 J of energy within the first 125 mm of deflection without eliminating any load path that existed before the test was initiated; and

(2) Have a ground clearance not exceeding 560 mm, measured at each support to which the horizontal member is attached, as shown in Figure 4 of this section, after completion of the load application.

(b) A guard, other than a hydraulic guard or one installed on a tanker trailer, that demonstrates resistance to a uniform distributed load greater than 700,000 N applied in accordance with S6.6(b) of this section, need not meet the energy absorption requirements of S5.2.2(a) of this section but must have a ground clearance not exceeding 560 mm at each vertical support to which the horizontal member is attached after completion of the 700,000 N load application.

S5.3 *Labeling.* Each guard shall be permanently labeled with the information specified in S5.3 (a) through (c) of this section. The information shall be in English and in letters that are at least 2.5 mm high. The label shall be placed on the forward or rearward facing surface of the horizontal member of the guard, provided that the label does not interfere with the retroreflective sheeting required by S5.7.1.4.1(c) of FMVSS No. 108 (49 CFR 571.108), and is readily accessible for visual inspection.

(a) The guard manufacturer's name and address.

(b) The statement: ''Manufactured in _____'' (inserting the month and year of guard manufacture).

(c) The letters ''DOT'', constituting a certification by the guard manufacturer that the guard conforms to all requirements of this standard.

S5.4 *Guard Attachment Hardware.* Each guard, other than a guard that is to be installed on a vehicle manufactured by the manufacturer of the guard, shall be accompanied by all attachment hardware necessary for installation of the guard on the chassis of the motor vehicle for which it is intended.

S5.5 *Installation Instructions.* The manufacturer of rear impact guards for sale to vehicle manufacturers shall include with each guard printed instructions in English for installing the guard, as well as a diagram or schematic depicting proper guard installation. The manufacturer of a rear impact guard for one of its own vehicles shall prepare and keep a copy of installation procedures applicable to each vehicle/guard combination for a period of one year from the date of vehicle manufacture and provide them to NHTSA on request. The instructions or procedures shall specify:

(a) Vehicles on which the guard can be installed. Vehicles may be designated by listing the make and model of the vehicles for which the guard is suitable, or by specifying the design elements that would make any vehicle an appropriate host for the particular guard (e.g., vehicles with frame rails of certain spacing and gauge of steel).

(b) A description of the chassis surface to which the guard will be attached, including frame design types with dimensions, material thickness, and tire track width. This description shall be detailed enough to permit the agency to locate and duplicate the chassis surface during compliance testing.

(c) An explanation of the method of attaching the guard to the chassis of each vehicle make and model listed or to the design elements specified in the instructions or procedures. The principal aspects of vehicle chassis configuration that are necessary to the proper functioning of the guard shall be specified including the maximum allowable vertical distance between the bottom edge of the horizontal member of the guard and the ground to ensure post-test ground clearance requirements are met. If the chassis strength is inadequate for the guard design, the instructions or procedures shall specify methods for adequately reinforcing the vehicle chassis. Procedures for properly installing any guard attachment hardware shall be provided.

S6. *Guard Test Procedures.* The procedures for determining compliance with S5.2 of this section are specified in S6.1 through S6.9 of this section.

S6.1 *Preparation of Hydraulic Guards.* For hydraulic guards, the horizontal member of the guard is deflected in a forward direction until the hydraulic unit(s) have reached the full extent of their designed travel or 610 mm, whichever occurs first. The hydraulic units are compressed before the application of force to the guard in accordance with S6.6 of this section and maintained in this condition throughout the testing under S6.6 of this section.

S6.2 *Guard Installation for Strength and Energy Absorption Tests.*

(a) The rear impact guard is attached to a test device.

(b) The test device for the compliance test will be whichever of the following devices, if either was used, the manufacturer used as a basis for its certification of the guard in S5.3(c) of this section. If the manufacturer did not use one of these devices or does not specify a device when asked by the agency, the agency may choose either of the following devices—

(1) A rigid test fixture. In the case of testing on a rigid test fixture NHTSA will consult the installation instructions or procedures to determine the surface or structure that the guard is supposed to be mounted to and mount it to the rigid test fixture in the same way.

(2) A complete trailer for which installation of the guard is suitable, as provided in the manufacturer's installation instructions or procedures required by S5.5 of this section. The trailer chassis is secured so that it behaves essentially as a fixed object during the test, such that the test must be passed no matter how little it moves during the test.

(c) The guard is attached in accordance with the instructions or procedures for guard attachment provided by the guard manufacturer for that guard as required by S5.5 of this section.

S6.3 *Point Load Force Application Device.* The force application device employed in S6.6 of this section consists of a rectangular solid made of rigid steel. The steel solid is 203 mm in height, 203 mm in width, and 25 mm in thickness. The 203 mm by 203 mm face of the block is used as the contact surface for application of the forces specified in S5.2.1(a) and (b) of this section. Each edge of the contact surface of the block has a radius of curvature of 5 mm plus or minus 1 mm.

S6.4 *Point Load Test Locations.* With the guard mounted to the rigid test fixture or to a complete trailer, determine the test locations P1 and P2 in accordance with the procedure set forth in S6.4(a) and (b) of this section. See Figure 1 of this section.

(a) Point Load Test location P1 is the point on the rearmost surface of the horizontal member of the guard that:

(1) Is located at a distance of ⅜ of the guard width from the vertical longitudinal plane passing through center of the guard;

(2) Lies on either side of the center of the guard's horizontal member; and

(3) Is 50 mm above the bottom of the guard.

(b) Point Load Test location P2 is the point on the rearmost surface of the horizontal member of the guard that:

(1) Lies in the longitudinal vertical plane passing through the center of the guard's horizontal member; and

(2) Is 50 mm above the bottom of the guard.

S6.5 *Positioning of Force Application Device.* Before applying any force to the guard, locate the force application device specified in S6.3 of this section for the point load test location and that specified in S6.7 of this section for the uniform distributed load test location, such that:

(a) The center point of the contact surface of the force application device is aligned with and touching the guard test location, as defined by the specifications of S6.4 of this section for the point load test locations, and S6.8 of this section for the uniform distributed load test location.

(b) The longitudinal axis of the force application device passes through the test location and is perpendicular to the transverse vertical plane that is tangent to the rearmost surface of the guard's horizontal member.

(c) If the guard is tested on a rigid test fixture, the vertical distance from the bottom edge of the horizontal member to the ground at the location of each support to which the horizontal member is attached, shall be measured.

S6.6 *Force Application.* After the force application device has been positioned according to S6.5 of this section, at the point load test locations specified in S6.4 of this section or the uniform distributed load test location specified in S6.8 of this section, apply the loads specified in S5.2 of this section. Load application procedures are specified in S6.6(a) through (d) of this section.

(a) Using the force application device, apply force to the guard in a forward direction such that the displacement rate of the force application device is the rate, plus or minus 10 percent, designated by the guard manufacturer within the range of 2.0 cm per minute to 9.0 cm per minute. If the guard manufacturer does not designate a rate, any rate within that range may be chosen.

(b) If conducting a strength test to satisfy the requirement of S5.2.1 or S5.2.2(b) of this section, the force is applied until the forces specified in S5.2.1 or S5.2.2(b) of this section have been exceeded, or until the displacement of the force application device has reached at least 125 mm whichever occurs first.

(c) If conducting a test to be used for the calculation of energy absorption levels to satisfy the requirement of S5.2.2(a) of this section, apply a uniform distributed force to the guard until displacement of the force application device, specified in S6.7 of this section, has reached 125 mm. For calculation of guard energy absorption, the value of force is recorded at least ten times per 25 mm of displacement of the contact surface of the loading device. Reduce the force until the guard no longer offers resistance to the force application device. Produce a force vs. deflection diagram of the type shown in Figure 2 of this section using this information. Determine the energy absorbed by the guard by calculating the shaded area bounded by the curve in the force vs. deflection diagram and the abscissa (X-axis).

(d) During each force application, the force application device is guided so that it does not rotate. At all times during the application of force, the location of the longitudinal axis of the force application device remains constant.

S6.7 *Uniform Distributed Load Force Application Device.* The force application device to be employed in applying the uniform distributed load is to be unyielding, have a height of 203 mm, and have a width that exceeds the distance between the outside edges of the outermost supports to which the tested portion of the horizontal member is attached, as shown in Figure 3 of this section.

S6.8 *Uniform Distributed Load Test Location.* With the guard mounted to the rigid test fixture or to a complete trailer, determine the test location in accordance with the following procedure. See Figure 3 of this section. Distributed Force Test location is the plane on the rearmost surface of the horizontal member of the guard that:

(a) Is centered in the longitudinal vertical plane passing through the center of the guard's horizontal member; and

(b) Is centered 50 mm above the bottom of the guard.

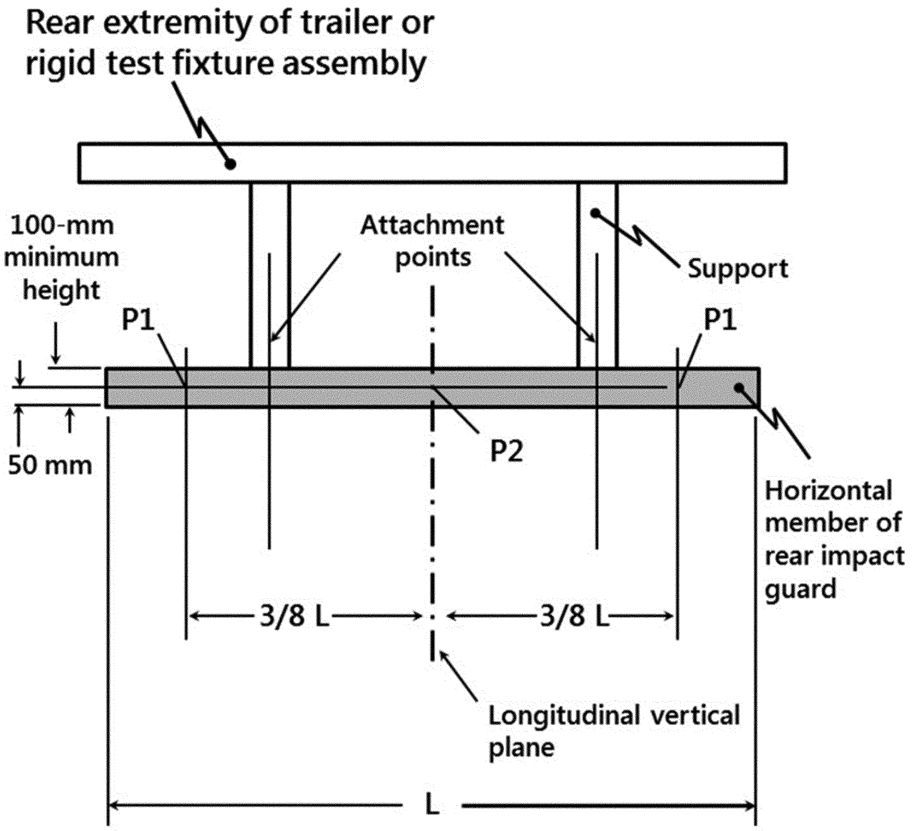
S6.9 *Ground Clearance Measurement.*

(a) For the test device attached to a complete trailer as specified in S6.2 of this section, the ground clearance of the guard at the vertical supports to which the horizontal member is attached shall be measured after completion of the uniform distributed load test in accordance with S6.6(b) or S6.6(c) of this section.

(b) For the test device attached to a rigid test fixture as specified in S6.2 of this section, the vertical distance from the ground to the bottom edge of the horizontal member at the vertical supports to which the horizontal member is attached shall be measured after completion of the uniform distributed load test in accordance with S6.6(b) or S6.6(c) of this section and subtracted from the corresponding ground clearance measured before the load application in accordance with S6.5(c) of this section. The difference in ground clearance before and after the load application is added to the allowable maximum vertical distance between the bottom edge of the horizontal member of the guard and the ground as specified in S5.5(c) of this section, to obtain the ground clearance after completion of the uniform distributed load test.

FIGURES TO § 571.223

FIGURE 1: REAR VIEW OF THE REAR IMPACT GUARD



Notes:
1. L means width of the horizontal member.
2. Drawing not to scale

(Note: Drawing is not to scale)

FIGURE 2: TYPICAL FORCE DEFLECTION DIAGRAM

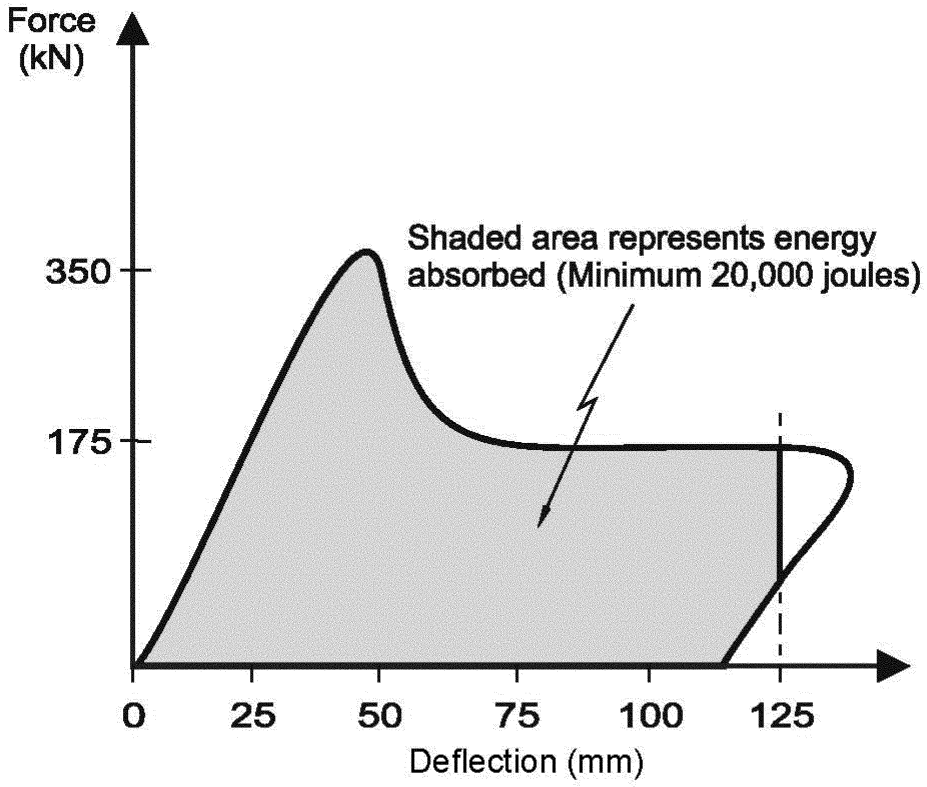
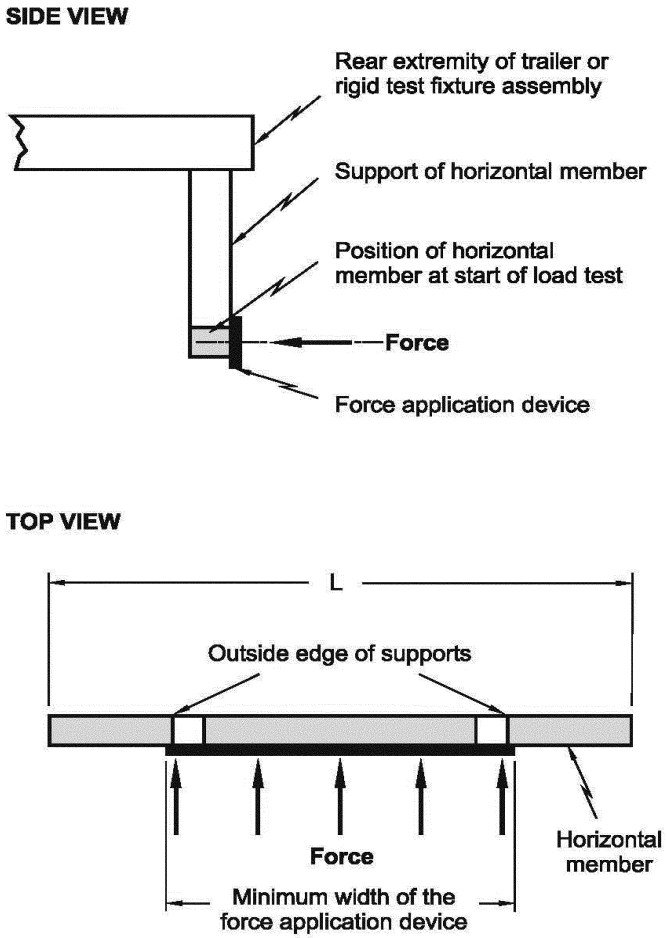


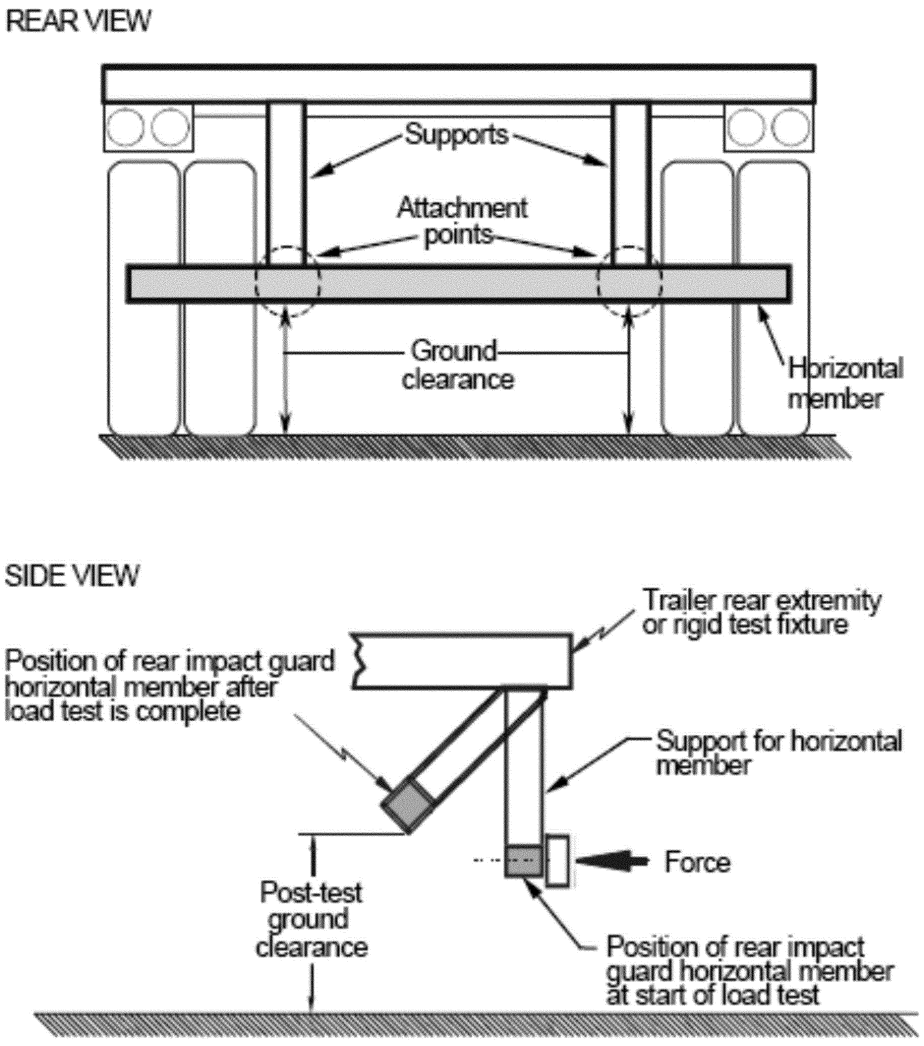
FIGURE 3: UNIFORM DISTRIBUTED LOAD APPLICATION TEST



Notes:
1. L means width of the horizontal member.
2. Drawings not to scale

(Note: Drawings are not to scale)

FIGURE 4: POST-TEST GROUND CLEARANCE MEASUREMENT



(Note: Drawings are not to scale)

[61 FR 2030, Jan. 24, 1996, as amended at 63 FR 3662, Jan. 26, 1998; 69 FR 67662, Nov. 19, 2004; 87 FR 42366, July 15, 2022]

§ 571.224 Standard No. 224; Rear impact protection.

S1. *Scope.* This standard establishes requirements for the installation of rear impact guards on trailers and semitrailers with a gross vehicle weight rating (GVWR) of 4,536 kg or more.

S2. *Purpose.* The purpose of this standard is to reduce the number of deaths and serious injuries occurring when light duty vehicles impact the rear of trailers and semitrailers with a GVWR of 4,536 kg or more.

S3. Application. This standard applies to trailers and semitrailers with a GVWR of 4,356 kg or more. The standard does not apply to pole trailers, pulpwood trailers, low chassis vehicles, road construction controlled horizontal discharge trailers, special purpose vehicles, wheels back vehicles, or temporary living quarters as defined in 49 CFR 523.2. If a cargo tank motor vehicle, as defined in 49 CFR 171.8, is certified to carry hazardous materials and has a rear bumper or rear end protection device conforming with 49 CFR part 178 located in the area of the horizontal member of the rear underride guard required by this standard, the guard need not comply with the energy absorption requirement (S5.2.2) of 49 CFR 571.223.

S4. *Definitions.*

Chassis means the load supporting frame structure of a motor vehicle.

Horizontal member means the structural member of the guard that meets the configuration requirements of S5.1 of this section when the guard is installed on the vehicle according to the installation instructions or procedures required by S5.5 of § 571.223, Rear Impact Guards.

Low chassis vehicle means a trailer or semitrailer having a chassis that extends behind the rearmost point of the rearmost tires and a lower rear surface that meets the configuration requirements of S5.1.1 through 5.1.3 of this section.

Outer or *Outboard* means away from the trailer centerline and toward the side extremities of the trailer.

Pulpwood trailer means a trailer that is designed exclusively for harvesting logs or pulpwood and constructed with a skeletal frame with no means for attachment of a solid bed, body, or container.

Rear extremity means the rearmost point on a trailer that is above a horizontal plane located above the ground clearance and below a horizontal plane located 1,900 mm above the ground when the trailer is configured as specified in S5.1 of this section and when the trailer's cargo doors, tailgate and other permanent structures are positioned as they normally are when the trailer is in motion, with non-structural protrusions excluded from the determination of the rearmost point, such as:

(1) Tail lamps;

(2) Rubber bumpers;

(3) Hinges and latches; and

(4) Flexible aerodynamic devices capable of being folded to within 305 mm from the transverse vertical plane tangent to the rear most surface of the horizontal member for vertical heights below 1,740 mm above ground and, when positioned as they normally are when the trailer is in motion, are located forward of the transverse plane that is tangent to the rear bottom edge of the horizontal member and intersecting a point located 1,210 mm rearward of the horizontal member and 1,740 mm above the ground.

Road construction controlled horizontal discharge trailer means a trailer or semitrailer that is equipped with a mechanical drive and a conveyor to deliver asphalt and other road building materials, in a controlled horizontal manner, into a lay down machine or paving equipment for road construction and paving operations.

Rounded corner means a guard's outermost end that curves upward or forward toward the front of the vehicle, or both.

Side extremity means the outermost point on a vehicle's side that is located above a horizontal plane 560 mm above the ground, below a horizontal plane located 190 cm above the ground, and between a transverse vertical plane tangent to the rear extremity of the vehicle and a transverse vertical plane located 305 mm forward of that plane when the vehicle is configured as specified in S5.1 of this section. Non-structural protrusions such as taillights, hinges, rubber bumpers, and latches

are excluded from the determination of the outermost point.

Special purpose vehicle means a trailer or semitrailer that:

(1) Has work performing equipment that, while the vehicle is in transit, resides in or moves through any portion of the space bounded:

(i) Vertically from the ground to a horizontal plane 660 mm above the ground;

(ii) Laterally the full width of the trailer, determined by the trailer's side extremities as defined in S4 of this section; and

(iii) From the rear extremity of the trailer as defined in S4 of this section to a transverse vertical plane 305 mm forward of the rear extremity of the trailer; or

(2) Is equipped with a loading platform that, while the vehicle is in transit, is completely stowed in the space bounded by a plane tangent to the underside of the vehicle, the ground, the rear extremity of the vehicle, and the rearmost axle, and that, when operated, deploys from its stowed position to the rear of the vehicle through any portion of the space described above.

Wheels back vehicle means a trailer or semitrailer whose rearmost axle is permanently fixed and is located such that the rearmost surface of tires of the size recommended by the vehicle manufacturer for the vehicle on that axle is not more than 305 mm forward of the transverse vertical plane tangent to the rear extremity of the vehicle.

S5. *Requirements.*

S5.1 *Installation; vehicle configuration.* Each vehicle shall be equipped with a rear impact guard certified as meeting Federal Motor Vehicle Safety Standard No. 223, *Rear Impact Guards* (§571.223). When the vehicle to which the guard is attached is resting on level ground, unloaded, with its full capacity of fuel, and with its tires inflated and air suspension, if so equipped, pressurized in accordance with the manufacturer's recommendations, the guard shall comply with the requirements of S5.1.1 through S5.1.3 of this section. See Figure 1 of this section.

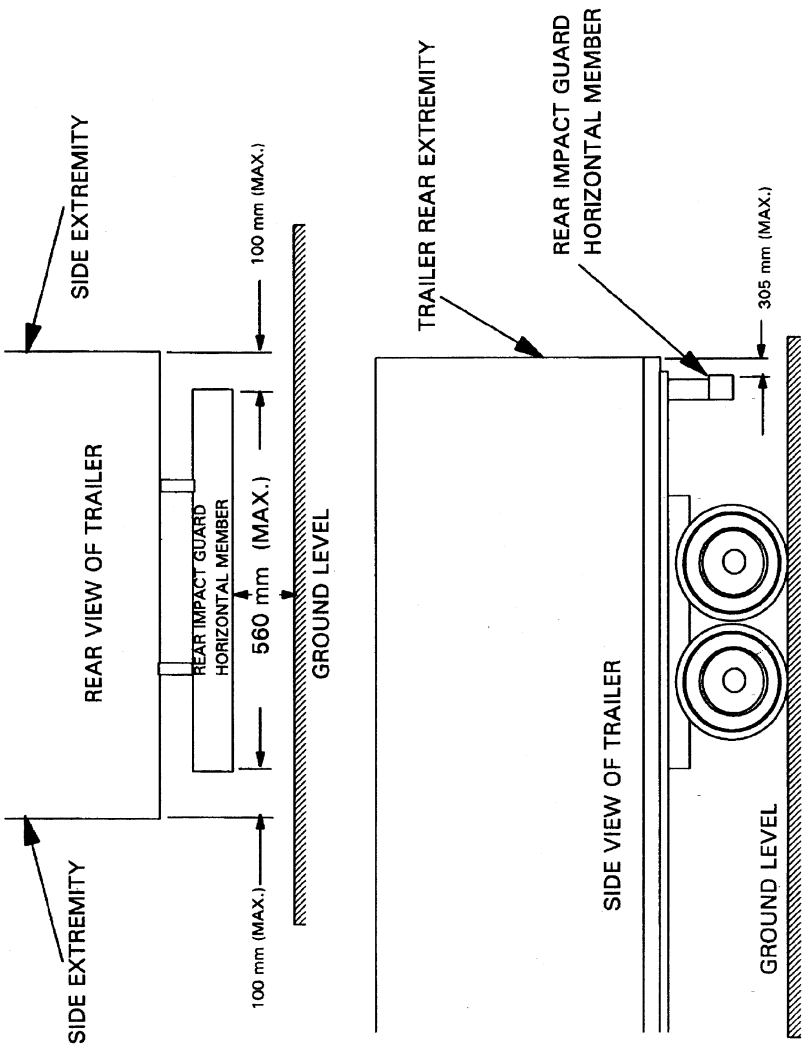
S5.1.1 *Guard width.* The outermost surfaces of the horizontal member of the guard shall extend outboard to within 100 mm of the longitudinal vertical planes that are tangent to the side extremities of the vehicle, but shall not extend outboard of those planes. See Figure 1 of this section.

S5.1.2 *Guard height.* The vertical distance between the bottom edge of the horizontal member of the guard and the ground shall not exceed 560 mm at any point across the full width of the member. Notwithstanding this requirement, guards with rounded corners may curve upward within 255 mm of the longitudinal vertical planes that are tangent to the side extremities of the vehicle. See Figure 1 of this section.

S5.1.3 *Guard rear surface.* At any height 560 mm or more above the ground, the rearmost surface of the horizontal member of the guard shall be located as close as practical to a transverse vertical plane tangent to the rear extremity of the vehicle, but no more than 305 mm forward of that plane. Notwithstanding this requirement, the horizontal member may extend rearward of the plane, and guards with rounded corners may curve forward within 255 mm of the longitudinal vertical planes that are tangent to the side extremities of the vehicle.

S5.2 *Installation Requirements.* Guards shall be attached to the vehicle's chassis by the vehicle manufacturer in accordance with the installation instructions or procedures provided pursuant to S5.5 of Standard No. 223, *Rear Impact Guards* (§571.223). The vehicle must be of a type identified in the installation instructions as appropriate for the guard.

FIGURE 1. CONFIGURATION REQUIREMENTS



[61 FR 2035, Jan. 24, 1996, as amended at 63 FR 3662, Jan. 26, 1998; 69 FR 64500, Nov. 5, 2004; 69 FR 67668, Nov. 19, 2004; 71 FR 9277, Feb. 23, 2006; 87 FR 42372, July 15, 2022]

§ 571.225 Standard No. 225; Child restraint anchorage systems.

S1. *Purpose and scope.* This standard establishes requirements for child restraint anchorage systems to ensure their proper location and strength for the effective securing of child restraints, to reduce the likelihood of the anchorage systems' failure, and to increase the likelihood that child restraints are properly secured and thus more fully achieve their potential effectiveness in motor vehicles.

S2. *Application.* This standard applies to passenger cars; to trucks and multipurpose passenger vehicles with a gross vehicle weight rating (GVWR) of 3,855 kilograms (8,500 pounds) or less; and to

buses (including school buses) with a GVWR of 4,536 kg (10,000 lb) or less. This standard does not apply to walk-in van-type vehicles, vehicles manufactured to be sold exclusively to the U.S. Postal Service, shuttle buses, and funeral coaches.

S3. *Definitions.*

Child restraint anchorage means any vehicle component, other than Type I or Type II seat belts, that is involved in transferring loads generated by a child restraint system to the vehicle structure.

Child restraint anchorage system means a vehicle system that is designed for attaching a child restraint system to a vehicle at a particular designated seating position, consisting of:

(a) Two lower anchorages meeting the requirements of S9; and

(b) A tether anchorage meeting the requirements of S6.

Child restraint fixture (CRF) means the fixture depicted in Figures 1 and 2 of this standard that simulates the dimensions of a child restraint system, and that is used to determine the space required by the child restraint system and the location and accessibility of the lower anchorages.

Funeral coach means a vehicle that contains only a front row of occupant seats, is designed exclusively for transporting a body and casket and that is equipped with features to secure a casket in place during operation of the vehicle.

Rear designated seating position means any designated seating position (as that term is defined at §571.3) that is rearward of the front seats(s).

Seat bight means the area close to and including the intersection of the surfaces of the vehicle seat cushion and the seat back.

SFAD 1 means Static Force Application Device 1 shown in Figures 12 to 16 of this standard.

SFAD 2 means Static Force Application Device 2 shown in Figures 17 and 18 of this standard.

Shuttle bus means a bus with only one row of forward-facing seating positions rearward of the driver's seat or, for a vehicle without manually operated controls, means a bus with only one row of forward-facing seating positions rearward of all front row passenger seats.

Tether anchorage means a user-ready, permanently installed vehicle system that transfers loads from a tether strap through the tether hook to the vehicle structure and that accepts a tether hook.

Tether strap means a strap that is secured to the rigid structure of the seat back of a child restraint system, and is connected to a tether hook that transfers the load from that system to the tether anchorage.

Tether hook means a device, illustrated in Figure 11 of Standard No. 213 (§571.213), used to attach a tether strap to a tether anchorage.

S4. *General vehicle requirements.*

S4.1 Each tether anchorage and each child restraint anchorage system installed, either voluntarily or pursuant to this standard, in any new vehicle manufactured on or after September 1, 1999, shall comply with the configuration, location, marking and strength requirements of this standard. The vehicle shall be delivered with written information, in English, on how to appropriately use those anchorages and systems.

S4.2 Vehicles shall be equipped as specified in paragraphs S4.2(a) through (c), except as provided in S5 of this standard.

(a) Each vehicle with three or more forward-facing rear designated seating positions shall be equipped as specified in S4.2(a)(1) and (2).

(1) Each vehicle shall be equipped with a child restraint anchorage system conforming to the requirements of S6 and S9 of this standard at not fewer than two forward-facing rear designated seating positions. At least one of the child restraint anchorage systems shall be installed at a forward-facing seating position in the second row in each vehicle that has three or more rows, if such a forward-facing seating position is available in that row.

(2) Each vehicle shall be equipped with a tether anchorage conforming to the requirements of S6 of this standard at a third forward-facing rear designated seating position. The tether anchorage of a child restraint anchorage system may count towards the

third required tether anchorage. In each vehicle with a forward-facing rear designated seating position other than an outboard designated seating position, at least one tether anchorage (with or without the lower anchorages of a child restraint anchorage system) shall be at such a designated seating position.

(b) Each vehicle with not more than two forward-facing rear designated seating positions shall be equipped with a child restraint anchorage system conforming to the requirements of S6 and S9 of this standard at each forward-facing rear designated seating position.

(c) Each vehicle without any forward-facing rear designated seating position shall be equipped with a tether anchorage conforming to the requirements of S6 of this standard at each forward-facing front passenger designated seating position.

S4.3 *Movable seats.* (a) A vehicle that is equipped with a forward-facing rear designated seating position that can be moved such that it is capable of being used at either an outboard or non-outboard forward-facing designated seating position shall be considered as having a forward-facing non-outboard designated seating position. Such a movable seat must be equipped with a tether anchorage that meets the requirements of S6 of this standard or a child restraint anchorage system that meets the requirements of S6 and S9 of this standard, if the vehicle does not have another forward-facing non-outboard designated seating position that is so equipped.

(b) Tether and lower anchorages shall be available for use at all times, except when the seating position for which it is installed is not available for use because the vehicle seat has been removed or converted to an alternate use such as allowing for the carrying of cargo.

S5 *General exceptions.* Vehicles manufactured before September 1, 2031, must meet the requirements of S5.1. Vehicles manufactured on or after September 1, 2031, must meet the requirements of S5.2.

S5.1 *Vehicles manufactured before September 1, 2031.* (a) Convertibles and school buses are excluded from the requirements to be equipped with tether anchorages.

(b) A vehicle may be equipped with a built-in child restraint system conforming to the requirements of Standard No. 213 (§ 571.213) or Standard No. 213b (§ 571.213b) as applicable, instead of one of the required tether anchorages or child restraint anchorage systems.

(c) Vehicles with no air bag in front passenger designated position:

(1) Each vehicle that does not have a rear designated seating position and does not have an air bag installed at front passenger designated seating positions pursuant to a temporary exemption granted by NHTSA under 49 CFR part 555, must have a child restraint anchorage system installed at a front passenger designated seating position. In the case of convertibles, the front designated passenger seating position need have only the two lower anchorages meeting the requirements of S9 of this standard.

(2) Each vehicle that has a rear designated seating position and meets the conditions in S4.5.4.1(b) of Standard No. 208 (§ 571.208), and does not have an air bag installed at front passenger designated seating positions pursuant to a temporary exemption granted by NHTSA under 49 CFR part 555, must have a child restraint anchorage system installed at a front passenger designated seating position in place of one of the child restraint anchorage systems that is required for the rear seat. In the case of convertibles, the front designated passenger seating position need have only the two lower anchorages meeting the requirements of S9 of this standard.

(d) A vehicle that does not have an air bag on-off switch meeting the requirements of S4.5.4 of Standard No. 208 (§ 571.208) shall not have any child restraint anchorage system installed at a front designated seating position.

(e) A vehicle with a rear designated seating position for which interference with transmission and/or suspension components prevents the location of the lower bars of a child restraint anchorage system anywhere within the zone described by S9.2 of this standard is excluded from the requirement to provide a child restraint anchorage

system at that position. However, except as provided elsewhere in this S5, such a vehicle must have a tether anchorage at a front passenger designated seating position.

S5.2 *Vehicles manufactured on or after September 1, 2031.* (a) School buses are excluded from the requirements to be equipped with tether anchorages.

(b) A vehicle may be equipped with a built-in child restraint system conforming to the requirements of Standard No. 213b (§571.213b) instead of one of the required tether anchorages or child restraint anchorage systems.

(c) Vehicles with no air bag in front passenger designated position:

(1) Each vehicle that does not have a rear designated seating position and does not have an air bag installed at front passenger designated seating positions pursuant to a temporary exemption granted by NHTSA under 49 CFR part 555 must have a child restraint anchorage system installed at a front passenger designated seating position.

(2) Each vehicle that has a rear designated seating position and meets the conditions in S4.5.4.1(b) of Standard No. 208 (§571.208), and does not have an air bag installed at front passenger designated seating positions pursuant to a temporary exemption granted by NHTSA under 49 CFR part 555, must have a child restraint anchorage system installed at a front passenger designated seating position in place of one of the child restraint anchorage systems that is required for the rear seat.

(d) A vehicle that does not have an air bag on-off switch meeting the requirements of S4.5.4 of Standard No. 208 (§571.208), shall not have any child restraint anchorage system installed at a front designated seating position.

S6. *Requirements for tether anchorages.* Vehicles subject to Standard No. 225 (this section) shall meet the tether anchorage requirements specified in S6.1, S6.2, and S6.4 according to the phase-in schedule specified in S13 of this standard.

S6.1 *Configuration of the tether anchorage.*

S6.1.1 Each tether anchorage shall:

(a) Permit the attachment of a tether hook of a child restraint system meeting the configuration and geometry specified in figure 11 of Standard No. 213 (figure 11 to §571.213);

(b) Be accessible without the need for any tools other than a screwdriver or coin;

(c) Once accessed, be ready for use without the need for any tools; and

(d) Be sealed to prevent the entry of exhaust fumes into the passenger compartment.

S6.1.2 Each tether anchorage shall:

(a) Consist of a rigid bar of any cross-section shape that permits the attachment of a tether hook (of a child restraint system) meeting the configuration and geometry specified in figure 11 of Standard No. 213 (figure 11 to §571.213), except in buses with a GVWR less than or equal to 10,000 pounds and vehicles that use a routing device per S6.2.1.2;

(b) Be accessible without the need for any tools and without folding the seat back (other than the head restraint) or removing carpet or other vehicle components (other than cargo covers) to access the anchorages. Individual tether anchorages may be covered with a cap, flap, or cover, provided that any cap, flap, or, cover is specifically designed to be opened, moved aside, or to otherwise give unobstructed access to the anchorage and is labeled with the symbol shown in figure 25 to this section;

(c) Once accessed, be ready for use without the need for any tools; and

(d) Be sealed to prevent the entry of exhaust fumes into the passenger compartment.

S6.2 *Location of the tether anchorage.*

S6.2.1 Subject to S6.2.1.2, the part of each tether anchorage that attaches to a tether hook must be located within the shaded zone shown in figures 3 through 7 to this section of the designated seating position for which it is installed. The zone is defined with reference to the seating reference point (*see* §571.3). (For purposes of the figures, ''H Point'' is defined to mean seating reference point.) A tether anchorage may be recessed in the seat back, provided that it is not in the strap wrap-around area at the top of the vehicle seat back. For the area under the vehicle seat, the forwardmost edge of the shaded zone is

defined by the torso line reference plane.

S6.2.1.1 [Reserved]

S6.2.1.2 In the case of a vehicle that—

(a) Has a user-ready tether anchorage for which no part of the shaded zone shown in Figures 3 to 7 of this standard of the designated seating position for which the anchorage is installed is accessible without removing a seating component of the vehicle; and

(b) Has a tether strap routing device that is—

(1) Not less than 65 mm behind the torso line for that seating position, in the case of a flexible routing device or a deployable routing device, measured horizontally and in a vertical longitudinal plane; or

(2) Not less than 100 mm behind the torso line for that seating position, in the case of a fixed rigid routing device, measured horizontally and in a vertical longitudinal plane, the part of that anchorage that attaches to a tether hook may, at the manufacturer's option (with said option selected prior to, or at the time of, certification of the vehicle) be located outside that zone.

(c) The measurement of the location of the flexible or deployable routing device described in S6.2.1.2(b)(1) is made with SFAD 2 properly attached to the lower anchorages. A 40 mm wide nylon tether strap is routed through the routing device and attached to the tether anchorage in accordance with the written instructions required by S12 of this standard. The forwardmost contact point between the strap and the routing device must be within the stated limit when the tether strap is flat against the top surface of the SFAD and tensioned to 55 to 65 N. In seating positions without lower anchorages of a child restraint anchorage system, the SFAD 2 is held with its central lateral plane in the central vertical longitudinal plane of the seating position. The adjustable anchor attaching bars of the SFAD 2 are replaced by spacers that end flush with the back surface of the SFAD.

S6.2.2 Subject to S6.2.2.2, the part of each tether anchorage to which a tether hook attaches must be located within the shaded zone shown in figures 3 through 7 to this section of the designated seating position for which it is installed. The zone is defined with reference to the seating reference point (*see* § 571.3). (For purposes of the figures, ''H Point'' means seating reference point.) A tether anchorage may be recessed in the seat back, provided that it is not in the strap wrap-around area at the top of the vehicle seat back. For the area under the vehicle seat, the forwardmost edge of the shaded zone is defined by a vertical plane 120 mm rearward of the ''H Point,'' as shown in figure 3 to this section.

S6.2.2.1 Subject to S6.2.2.2, for vehicles with adjustable or removable head restraints or no head restraints, the tether anchorage to which a tether hook attaches must be located outside the zone created by a 325 mm radius sphere with its center on the R-point and truncated horizontally at 230 mm below the sphere's center as shown in figures 8 and 9 to this section.

S6.2.2.2 In the case of a vehicle that—

(a) Has a user-ready tether anchorage for which no part of the shaded zone shown in figures 4 through 7 and 10 to this section of the designated seating position for which the anchorage is installed is accessible without the need for folding the seatback (other than the head restraint) or removing a seating component of the vehicle; and

(b) Has a tether strap routing device that is—

(1) Not less than 65 mm behind the torso line for that seating position, in the case of a flexible routing device or a deployable routing device, measured horizontally and in a vertical longitudinal plane; or

(2) Not less than 100 mm behind the torso line for that seating position, in the case of a fixed rigid routing device, measured horizontally and in a vertical longitudinal plane, the part of that anchorage that attaches to a tether hook may, at the manufacturer's option (with said option selected prior to, or at the time of, certification of the vehicle) be located outside that zone.

(c) The measurement of the location of the flexible or deployable routing device described in S6.2.2.2(b)(1) is made with SFAD 2 properly attached to the lower anchorages. A 40 mm wide nylon

tether strap is routed through the routing device and attached to the tether anchorage in accordance with the written instructions required by S12 of this standard. The forwardmost contact point between the strap and the routing device must be within the stated limit when the tether strap is flat against the top surface of the SFAD and tensioned to 55 to 65 N. In seating positions without lower anchorages of a child restraint anchorage system, the SFAD 2 is held with its central lateral plane in the central vertical longitudinal plane of the seating position. The adjustable anchorage attaching bars of the SFAD 2 are replaced by spacers that end flush with the back surface of the SFAD 2.

S6.3 *Strength requirements for tether anchorages.* (a) When tested in accordance with S8, the tether anchorage must not separate completely from the vehicle seat or seat anchorage or the structure of the vehicle.

(b) Provisions for simultaneous and sequential testing:

(1) In the case of vehicle seat assemblies equipped with more than one tether anchorage, the force referred to in this S6.3 may, at the agency's option, be applied simultaneously to each of those tether anchorages. However, that force may not be applied simultaneously to tether anchorages for any two adjacent seating positions whose midpoints are less than 400 mm apart, as measured in accordance with S6.3(b)(i) and (ii) and figure 20 to this section.

(i) The midpoint of the seating position lies in the vertical longitudinal plane that is equidistant from vertical longitudinal planes through the geometric center of each of the two lower anchorages at the seating position. For those seating positions that do not provide lower anchorages, the midpoint of the seating position lies in the vertical longitudinal plane that passes through the SgRP of the seating position.

(ii) Measure the distance between the vertical longitudinal planes passing through the midpoints of the adjacent seating positions, as measured along a line perpendicular to the planes.

(2) A tether anchorage of a particular child restraint anchorage system will not be tested with the lower anchorages of that anchorage system if one or both of those lower anchorages have been previously tested under this standard.

S6.4 *Marking and conspicuity requirements for tether anchorages.* Vehicles subject to Standard No. 225 (this section) shall meet S6.4 according to the phase-in schedule specified in S13 of this standard.

(a) For each tether anchorage installed pursuant to S4 of this standard, there shall be a permanent marking that:

(1) Consists of one of the pictograms shown in figure 25 to this section that is not less than 20 mm in height;

(2) Except for vehicles that use a routing device per S6.2.2.2, the center of the pictogram in the longitudinal direction must be in the vertical longitudinal plane that passes through the center of the tether anchorage bar (± half of the tether anchorage length), as shown in figure 26 (Left) to this section; or the center of the pictogram in the lateral direction must be in the horizontal lateral plane that passes through the center of the tether anchorage bar (± half of the pictogram height), as shown in figure 26 (right) to this section.

(3) The nearest edge of the marking shall be located not more than 100 mm away from the tether anchorage bar as shown in figure 27 to this section. No other attachment feature to secure occupant items (*i.e.*, cargo hooks or similar) shall be nearer to the marking than the distance from the marking to the tether anchorage. Vehicles with routing devices per S6.2.2.2 may use tags attached to the routing device.

(b) The tether anchorage bar may be covered by a cap or cover that is removable without the use of any tool, provided that the cap or cover is permanently labeled with a marking meeting the requirements of S6.4(a)(1). If the cap or cover is permanently attached to the vehicle, the tether anchorage is not required to be separately marked. If the cap or cover is not permanently attached to the vehicle, the tether anchorage must also be marked with the symbol meeting S6.4(a)(1) through (3).

(c) For vehicles that have a cargo cover that needs to be moved or removed to access the tether anchorages, the cargo cover must be permanently marked with the symbol meeting S6.4.1(a)(1) of this standard for each tether anchorage that is accessible under the cargo cover. Tether anchorages under the cargo cover must also be marked per S6.4(a).

S7. *Test conditions for testing tether anchorages.*

The test conditions described in paragraphs (a) and (b) of S7 apply to the test procedures in S8.

(a) Vehicle seats are adjusted to their full rearward and full downward position and the seat back is placed in its most upright position. When SFAD 2 is used in testing and cannot be attached to the lower anchorages with the seat back in this position, adjust the seat back as recommended by the manufacturer in its instructions for attaching child restraints. If no instructions are provided, adjust the seat back to the position that enables SFAD 2 to attach to the lower anchorages that is the closest to the most upright position.

(b) Head restraints are adjusted in accordance with the manufacturer's instructions, provided pursuant to S12, as to how the head restraints should be adjusted when using the child restraint anchorage system. If instructions with regard to head restraint adjustment are not provided pursuant to S12, the head restraints are adjusted to any position.

S8 *Test procedures.* Each vehicle shall meet the requirements of S6.3 when tested according to the following procedures. Where a range of values is specified, the vehicle shall be able to meet the requirements at all points within the range. For the testing specified in these procedures, the SFAD used in the test has a tether strap consisting of webbing material with an elongation limit of 4 percent at a tensile load of 65,000 N (14,612 lb). Pretension the tether strap with 53.5 N to 67 N of preload prior to the test. The strap is fitted at one end with a high strength steel tether hook for attachment to the tether anchorage. The tether hook meets the specifications in Standard No. 213 (49 CFR § 571.213) as to the configuration and geometry of tether hooks required by the standard. A steel cable is connected to the X point through which the test force is applied.

S8.1 Apply the force specified in S6.3 as follows—

(a) Use the following specified test device, as appropriate:

(1) SFAD 1, to test a tether anchorage at a designated seating position that does not have a child restraint anchorage system; or,

(2) SFAD 2, to test a tether anchorage at a designated seating position that has a child restraint anchorage system.

(b) Attach the SFAD 1 to the vehicle seat using the vehicle belts or the SFAD 2 to the lower anchorages of the child restraint anchorage system, as appropriate, and attach the test device to the tether anchorage, in accordance with the manufacturer's instructions provided pursuant to S12 of this standard. For the testing specified in this procedure, if SFAD 1 cannot be attached using the vehicle belts because of the location of the vehicle belt buckle, the test device is attached by material whose breaking strength is equal to or greater than the breaking strength of the webbing for the seat belt assembly installed as original equipment at that seating position. The geometry of the attachment duplicates the geometry, at the pre-load point, of the attachment of the originally installed seat belt assembly. All belt systems (including the tether) used to attach the test device are tightened to a tension of not less than 53.5 N and not more than 67 N on the webbing portion of the belt. For SFAD 1, apply a rearward force of 135 N ±15 N, in a horizontal plane through point ''X'' of SFAD 1. While maintaining the force, tighten the vehicle seat belt to a tension of not less than 53.5 N and not more than 67 N measured at the lap portion of the seat belt and maintain the tension during the preload, lock the seat belt retractor, and tighten the tether belt strap to remove all slack. A rearward force of 135 N ±15 N is applied to the center of the lower front crossmember of SFAD 2 to press the device against the seat back as the fore-aft position of the rearward extensions of

the SFAD is adjusted to remove any slack or tension.

(c) Apply the force—

(1) Initially, in a forward direction in a vertical longitudinal plane and through the Point X on the test device; and

(2) Initially, along a line through the X point and at an angle of 10 ±5 degrees above the horizontal. Apply a preload force of 500 N to measure the angle; and then

(3) Increase the pull force as linearly as practicable to a full force application of 15,000 N in not less than 24 seconds and not more than 30 seconds, and maintain at a 15,000 N level for 1 second.

S8.2 [Reserved]

S9. *Requirements for the lower anchorages of the child restraint anchorage system.* Vehicles subject to Standard No. 225 (this section) shall meet the lower anchorage requirements specified in S9.2 and S9.5 according to the phase-in schedule specified in S13 of this standard.

S9.1 *Configuration of the lower anchorages*

S9.1.1 The lower anchorages shall consist of two bars that—

(a) Are 6 mm ±.1 mm in diameter;

(b) Are straight, horizontal and transverse;

(c) As shown in Figure 21, are:

(i) Not less than 25 mm in length, and

(ii) Are not more than 60 mm in length between the anchor bar supports or other structural members of the vehicle that restrict lateral movement of the components of a child restraint that are designed to attach to the bars, measured in a vertical plane 7 mm rearward of the vertical plane that is tangent of the rearward face of the anchor bar.

(d) The bars must not be capable of being stowable or foldable.

(e) [Reserved]

(f) Are part of the vehicle, such that they can only be removed by use of a tool, such as a screwdriver or wrench; and

(g) Are rigidly attached to the vehicle such that they will not deform more than 5 mm when subjected to a 100 N force in any direction.

S9.2 *Location of the lower anchorages.*

S9.2.1 The anchorage bars are located at the vehicle seating position by using the CRF rearward extensions, with the CRF placed against or near the vehicle seat back. With the CRF attached to the anchorages and resting on the seat cushion, the bottom surface shall have attitude angles within the limits in the following table, angles measured relative to the vehicle horizontal, longitudinal and transverse reference planes.

TABLE TO S9.2.1

Pitch	15° ±10°
Roll	0° ±5°
Yaw	0° ±10°

NOTE: An explanation of the above angles is given in Figure 1.

S9.2.2 With adjustable seats adjusted as described in S9.2.3, each lower anchorage bar shall be located so that a vertical transverse plane tangent to the front surface of the bar is:

(a) Not more than 70 mm behind the corresponding point Z of the CRF, measured parallel to the bottom surface of the CRF and in a vertical longitudinal plane, while the CRF is pressed against the seat back by the rearward application of a horizontal force of 100 N at point A on the CRF; and

(b) Not less than 120 mm behind the vehicle seating reference point, measured horizontally and in a vertical longitudinal plane.

S9.2.3 Adjustable seats are adjusted as follows:

(a) Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer; and

(b) Place adjustable seats in the full rearward and full downward position.

S9.2.4 The lower anchorages shall be located such that the lower anchorage depth tool depicted in Drawing Package, *Anchorage Depth Tool,* dated April 2020 (incorporated by reference; *see* §571.5), measures an anchorage depth of 25 mm or less using the procedure in S11(c) of this standard.

S9.2.5 The lower anchorages shall be located such that the tool depicted in Drawing Package, *Clearance Angle Tool,* dated April 2020 (incorporated by reference; *see* §571.5), measures a clearance angle of at least 54 degrees using

the procedure in S11(b) of this standard.

S9.3 *Adequate fit of the lower anchorages.* Each vehicle and each child restraint anchorage system in that vehicle shall be designed such that the CRF can be placed inside the vehicle and attached to the lower anchorages of each child restraint anchorage system, with adjustable seats adjusted as described in S9.3(a) and (b).

(a) Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer; and

(b) Place adjustable seats in the full rearward and full downward position.

(c) To facilitate installation of the CRF in a vehicle seat, the side, back and top frames of the CRF may be removed for installation in the vehicle, as indicated in Figure 1A of this standard. If necessary, the height of the CRF may be 560 mm.

S9.4 *Strength of the lower anchorages.*

S9.4.1 When tested in accordance with S11, the lower anchorages shall not allow point X on SFAD 2 to be displaced horizontally more than the distances specified below, after preloading the device—

(a) 175 mm, when a force of 11,000 N is applied in a forward direction in a vertical longitudinal plane; and

(b) 150 mm, for lower anchorages when a force of 5,000 N is applied in a lateral direction in a vertical longitudinal plane that is 75 ±5 degrees to either side of a vertical longitudinal plane.

S9.4.1.1 Forces described in S9.4.1(a), forward direction, shall be applied with an initial force application angle of 10 ±5 degrees above the horizontal. Forces described in S9.4.1(b), lateral direction, shall be applied horizontally (0 ±5 degrees).

S9.4.1.2 The amount of displacement is measured relative to an undisturbed point on the vehicle body.

S9.4.2 *Provisions for simultaneous and sequential testing.* (a) In the case of vehicle seat assemblies equipped with more than one child restraint anchorage system, the lower anchorages may, at the agency's option, be tested simultaneously. However, forces may not be applied simultaneously for any two adjacent seating positions whose midpoints are less than 400 mm apart, as measured in accordance with S9.4.2(a)(1) and (2) and Figure 20.

(1) The midpoint of the seating position lies in the vertical longitudinal plane that is equidistant from vertical longitudinal planes through the geometric center of each of the two lower anchorages at the seating position.

(2) Measure the distance between the vertical longitudinal planes passing through the midpoints of the adjacent seating positions, as measured along a line perpendicular to the planes.

(b) The lower anchorages of a particular child restraint anchorage system will not be tested if one or both of the anchorages have been previously tested under this standard.

S9.5 *Marking and conspicuity requirements.*

S9.5.1 *Requirements for lower anchors.* Lower anchorages must meet the requirements in S9.5.1(a) or (b).

(a) For each bar installed pursuant to S4, the vehicle shall be permanently marked with a circle:

(1) That is not less than 13 mm in diameter;

(2) That is either solid or open, with or without words, symbols, or pictograms, provided that if words, symbols or pictograms are used, their meaning is explained to the consumer in writing, such as in the vehicle's owner's manual; and

(3) That is located such that its center is on each seat back between 50 and 100 mm above or on the seat cushion 100 ±25 mm forward of the intersection of the vertical transverse and horizontal longitudinal planes intersecting at the horizontal centerline of each lower anchorage, as illustrated in figure 22 to this section. The center of the circle must be in the vertical longitudinal plane that passes through the center of the bar (±25 mm).

(4) The circle may be on a tag.

(b) The vehicle shall be configured such that the following is visible: Each of the bars installed pursuant to S4, or a permanently attached guide device for each bar. The bar or guide device must be visible without the compression of the seat cushion or seat back, when the bar or device is viewed, in a vertical longitudinal plane passing through the center of the bar or guide

device, along a line making an upward 30-degree angle with a horizontal plane. Seat backs are in the nominal design riding position. The bars may be covered by a removable cap or cover, provided that the cap or cover is permanently marked with words, symbols or pictograms whose meaning is explained to the consumer in written form as part of the owner's manual.

S9.5.2 *Requirements for lower anchors.* Lower anchorages must meet the requirements in S9.5.2(a) and (b), as applicable.

(a) For each bar installed pursuant to S4, the vehicle shall be permanently marked with a symbol that:

(1) Is not less than 13 mm in diameter;

(2) Contains the pictogram shown in figure 24 to this section; and

(3) Is located such that its center is on each seat back between 50 and 100 mm above or on the seat cushion between 100 to −50 mm forward of the intersection of the vertical transverse and horizontal longitudinal planes intersecting at the horizontal centerline of each lower anchorage, as illustrated in figure 19 to this section. The center of the symbol must be in the vertical longitudinal plane that passes through the center of the bar (±25 mm).

(4) The symbol may be on a tag.

(b) The bars may be covered by a removable cap or cover, provided that the cap or cover is permanently marked with the pictogram shown in figure 24 to this section. If the cap or cover is permanently attached to the vehicle, the lower anchorage bars are not required to be separately marked with the pictogram. If the cap or cover is not permanently attached to the vehicle, the lower anchorage bars must also be marked with the symbol meeting S9.5.2(a)(1) through (4).

S10. *Test conditions for testing the lower anchorages.* The test conditions described in this paragraph apply to the test procedures in S11.

(a) Adjust vehicle seats to their full rearward and full downward position and place the seat backs in their most upright position. When SFAD 2 is used in testing and cannot be attached to the lower anchorages with the seat back in this position, adjust the seat back as recommended by the manufacturer in its instructions for attaching child restraints. If no instructions are provided, adjust the seat back to the position closest to the upright position that enables SFAD 2 to attach to the lower anchorages.

(b) Head restraints are adjusted in accordance with the manufacturer's instructions, provided pursuant to S12, as to how the head restraints should be adjusted when using the child restraint anchorage system. If instructions with regard to head restraint adjustment are not provided pursuant to S12, the head restraints are adjusted to any position.

S11. *Test procedures.* Each vehicle shall meet the requirements of this standard when tested according to the following procedures. Where a range of values is specified, the vehicle shall be able to meet the requirements at all points within the range.

(a) *Strength requirements*—(1) *Forward force direction.* Place SFAD 2 in the vehicle seating position and attach it to the two lower anchorages of the child restraint anchorage system. Do not attach the tether anchorage. A rearward horizontal force of 135 ±15 N is applied to the center of the lower front crossbar of SFAD 2 to press the device against the seat back as the fore-aft position of the rearward extensions of the SFAD is adjusted to remove any slack or tension. Apply a preload force of 500 N horizontally and in the vertical centerline of the SFAD 2 at point X. Increase the pull force as linearly as practicable to a full force application of 11,000 N in not less than 24 seconds and not more than 30 seconds and maintain at an 11,000 N level for 1 second.

(2) *Lateral force direction.* Place SFAD 2 in the vehicle seating position and attach it to the two lower anchorages of the child restraint anchorage system. Do not attach the tether anchorage. A rearward force of 135 ±15 N is applied to the center of the lower front crossbar of SFAD 2 to press the device against the seat back as the fore-aft position of the rearward extensions of the SFAD is adjusted to remove any slack or tension. Apply a preload force of 500 N horizontal and perpendicular to the longitudinal centerline of the SFAD 2 at point X of the test device. Increase the

pull force as linearly as practicable to a full force application of 5,000 N in not less than 24 seconds and not more than 30 seconds and maintain at a 5,000 N level for 1 second.

(b) *Clearance angle.* The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle. If the position is not specified, set the seat back at the first detent rearward of 25° from the vertical. Remove or open any lower anchorage cover, if present, to expose the lower anchorage. To measure clearance angle, attach the clearance angle tool to the lower anchorage and apply a vertical force of 67 N (15 lbf) to the tool. Measure the angle (with respect to the horizontal) of the tool while the force is being applied.

(c) *Anchorage depth.* The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle. If the position is not specified, set the seat back at the first detent rearward of 25° from the vertical. To measure the anchorage depth, subtract 30 degrees from the measured seat pan angle to calculate the view angle. With the anchorage depth tool (*see* figure 28 to this section) on a flat surface, adjust the view bar to read the view angle. Slide the zeroing strip along the view bar so that it is barely touching the top of the depth tool hook. Move the view bar forward, so the end of the zeroing strip is aligned with the zero-scribe line. For hidden anchorages, slide the anchorage depth tool so that it reads 0 mm at the rear edge of the slider. For visible anchorages, align the depth gauge to 25 mm so that negative values can be read. Attach the depth tool centered to the lower anchorage. Adjust the depth tool base to be within ±2 degrees of the view angle (30 degrees minus seat pan angle) to set the tool-parallel to the seat pan angle. Move the entire slider bar forward until the zeroing strip contacts the vehicle seat back or any other vehicle part.

S12. *Written instructions.* Vehicles subject to Standard No. 225 (this section) shall meet the written instruction requirements specified in either S12.1 or S12.2 according to the phase-in schedule specified in S13.

S12.1 Written instructions shall:

(a) Indicate which seating positions in the vehicle are equipped with tether anchorages and child restraint anchorage systems;

(b) In the case of vehicles required to be marked as specified in paragraphs S4.1 and S9.5 of this standard, explain the meaning of markings provided to locate the lower anchorages of child restraint anchorage systems; and

(c) Include instructions that provide a step-by-step procedure, including diagrams, for properly attaching a child restraint system's tether strap to the tether anchorages.

S12.2 Written instructions shall:

(a) Indicate which seating positions in the vehicle are equipped with tether anchorages and child restraint anchorage systems;

(b) In the case of vehicles required to be marked as specified in paragraphs S4.1 and S9.5 of this standard, explain the meaning of markings provided to locate the lower anchorages of child restraint anchorage systems and the top tether anchorages;

(c) Include instructions that provide a step-by-step procedure, including diagrams, for properly attaching a child restraint system's tether strap to the tether anchorages;

(d) Include instructions on how to locate and access the tether anchorage and the lower anchorages; and

(e) Use the following terms when referring to the different components of the child restraint anchorage system that are used to connect the child restraint system to the vehicle: ''lower anchor'' means the lower anchorage of the child restraint anchorage system in the vehicle, ''tether anchor'' means the top tether anchorage of the child restraint anchorage system in the vehicle, ''lower anchor attachment'' means the child restraint system or the detachable base's (in the case of a rear-facing child restraint with a detachable base) lower anchorage connector and the lower anchorage strap (for flexible lower anchorage attachments), ''rigid lower anchor attachment'' means the child restraint system or the detachable base's (in the case of a rear-facing child restraint with a detachable base) lower anchorage connector that is rigidly attached to the CRS or detachable base, respectively, and does not have a

lower anchorage strap, and ''tether'' means the child restraints system's tether hook and tether strap.

S13 *Phase-in schedule.* The S13 phase in schedule details when listed requirements become inactive and are replaced by newer requirements. Requirements in Standard No. 225 (this section) not listed in S13 shall be in effect before, during, and after the S13 phase-in.

S13.1 *Vehicle certification information.* At any time during the production years ending August 31, 2029, and August 31, 2030, each manufacturer shall, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles (by make, model and vehicle identification number) that have been certified as complying with the child restraint anchorage usability requirements of this standard. Manufacturers shall specify the number of vehicles meeting each phase-in percentage. The manufacturer's designation of a vehicle as a certified vehicle is irrevocable.

S13.1.1 *Pre phase-in.* Vehicles manufactured before September 1, 2028, are subject to S6.1.1, S6.2.1, S9.2.1, S9.2.2, S9.2.3, S9.5.1, and S12.1 of this standard.

S13.1.2 *Phase-in year 1.* Vehicles manufactured on or after September 1, 2028, and before September 1, 2029. The total number of individual vehicles complying with S6.1.2, S6.2.2, S6.4, S9.2 (except for S9.2.2(a)), S9.5.2, and S12.2 of this standard shall be not less than 20 percent of a vehicle manufacturer's total production for this time period. The remaining 80 percent of a vehicle manufacturer's total production are subject to S6.1.1, S6.2.1, S9.2.1, S9.2.2, S9.2.3, S9.5.1, and S12.1 of this standard.

S13.1.3 *Phase-in year 2.* Vehicles manufactured on or after September 1, 2029, and before September 1, 2030. The total number of individual vehicles complying with S6.1.2, S6.2.2, S6.4, S9.2 (except for S9.2.2(a)), S9.5.2, and S12.2 of this standard shall be not less than 50 percent of a vehicle manufacturer's total production for this time period. The remaining 50 percent of a vehicle manufacturer's total production are subject to S6.1.1, S6.2.1, S9.2.1, S9.2.2, S9.2.3, S9.5.1, and S12.1 of this standard.

S13.1.4 *Phase-in year 3 and beyond.* Vehicles manufactured on or after September 1, 2030. The total number of vehicles complying with S6.1.2, S6.2.2, S6.4, S9.2 (except for S9.2.2(a)), S9.5.2, and S12.2 shall be not less than 100 percent of a vehicle manufacturer's total production.

S13.2 *Vehicles produced by more than one manufacturer.*

S13.2.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S13.1.1 through S13.1.4, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows:

(a) A vehicle which is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer which markets the vehicle.

S13.2.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturers so specified and the manufacturer to which the vehicle would otherwise be attributed under S13.2.1.

FIGURES TO § 571.225

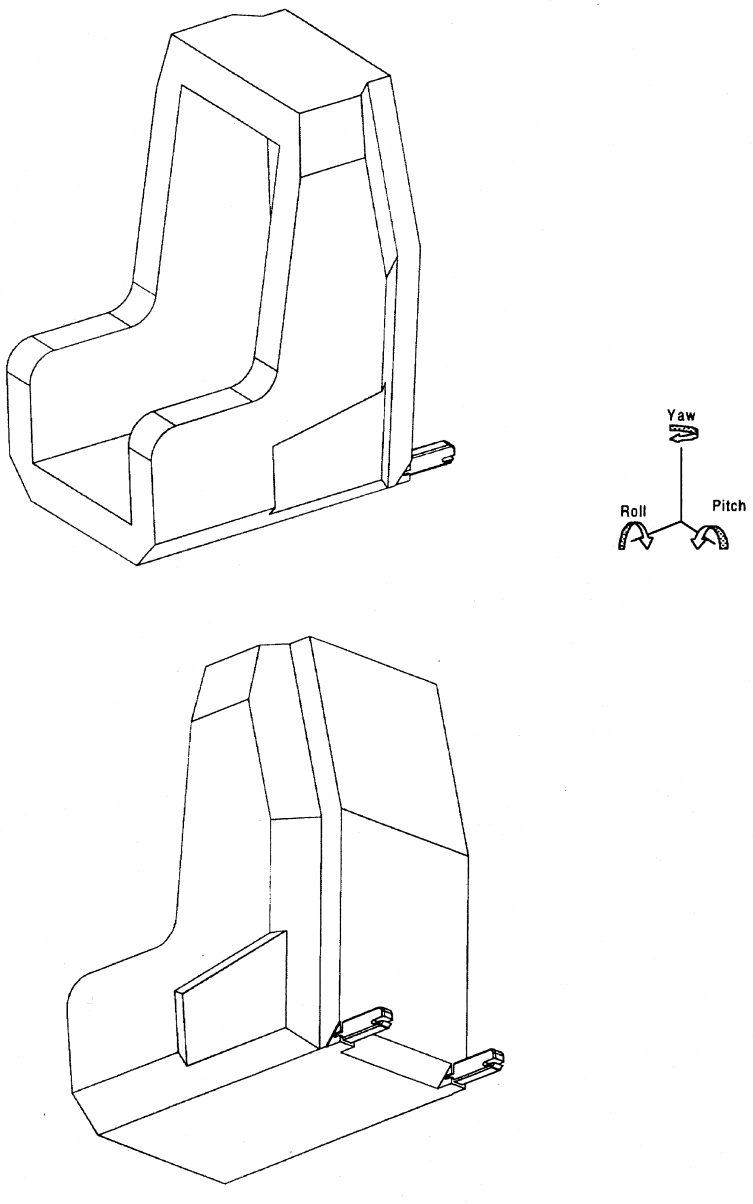


Figure 1 – Child restraint fixture (CRF)

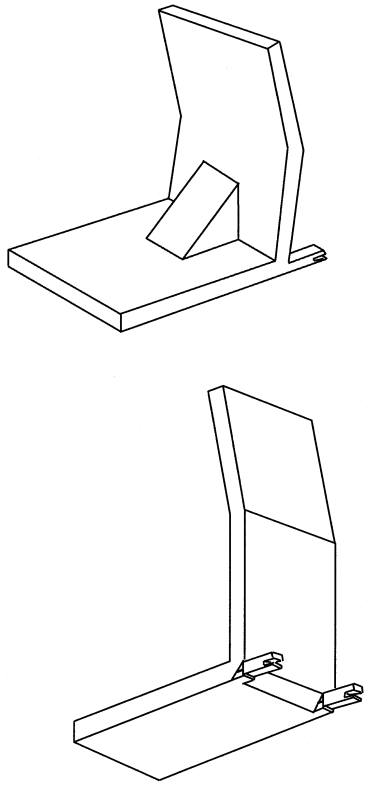
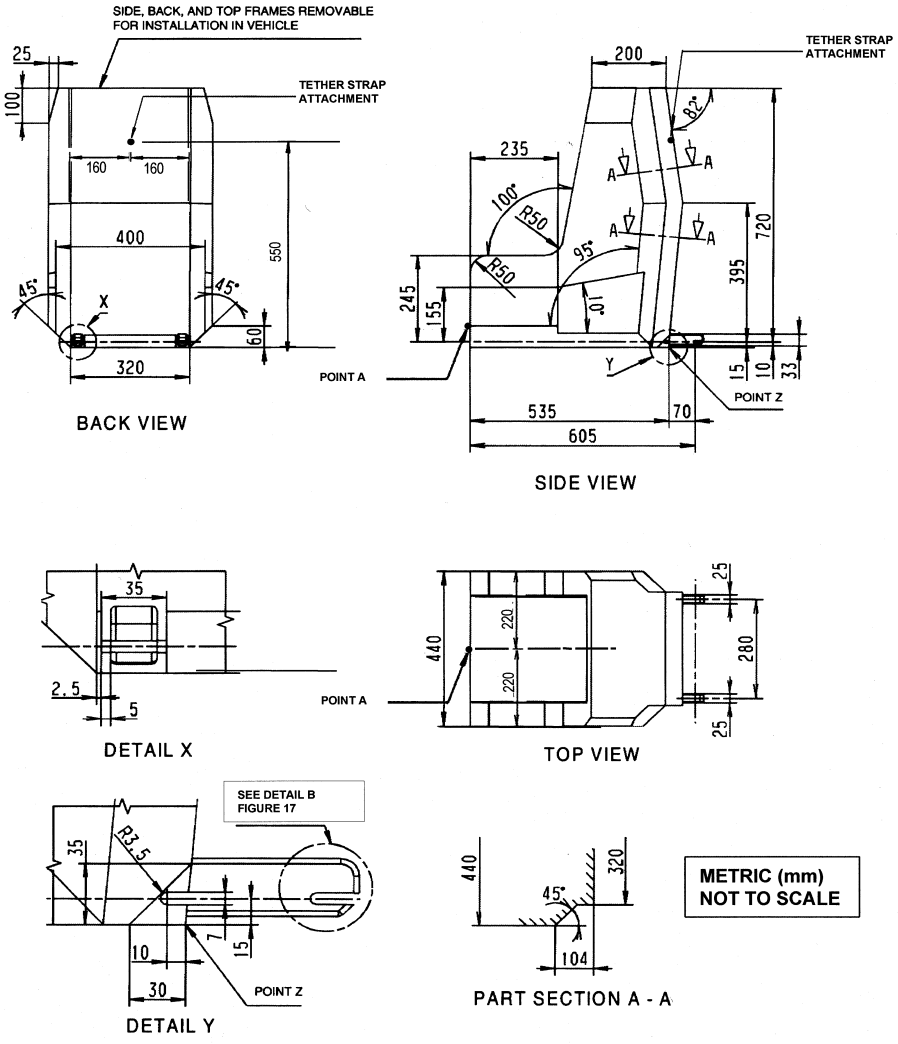
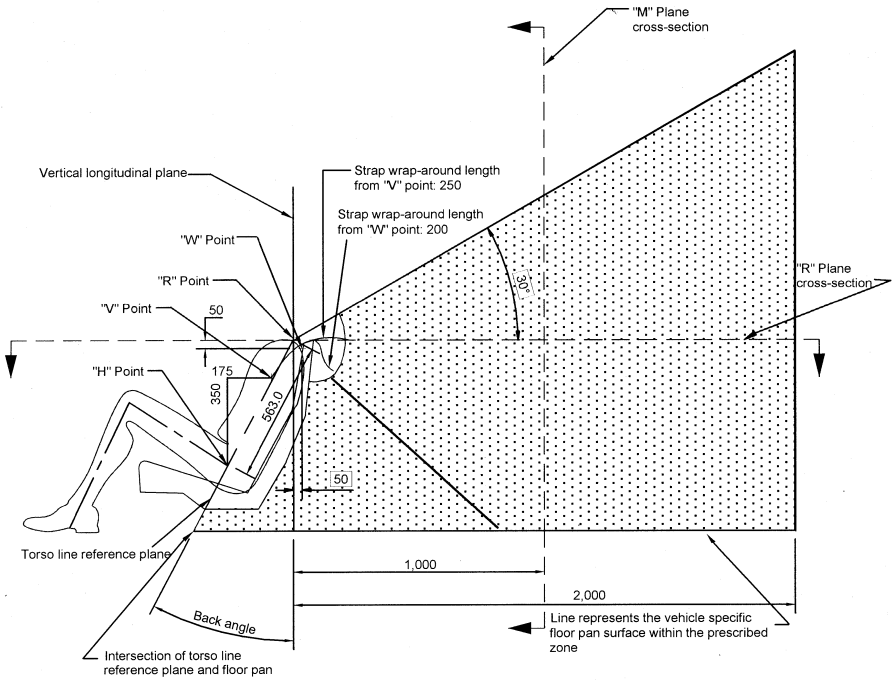


Figure 1A - Child Restraint Fixture (CRF) with Side and Top Frames Removed



Note:
1. Mass of CRF 5 to 8 kg

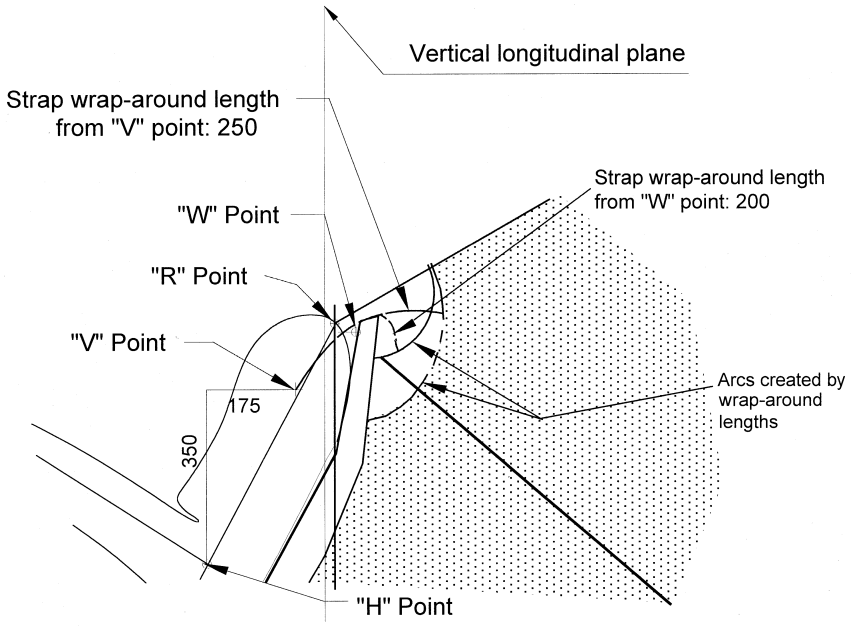
Figure 2 - Child restraint fixture (CRF)



Notes

1. Dimensions in mm, except where otherwise indicated
2. Portion of user-ready tether anchorage that is designed to bind with the tether strap hook to be located within shaded zone
3. Drawing not to scale
4. "R" Point: Shoulder reference point
5. "V" Point: V-reference point, 350 mm vertically above and 175 mm horizontally back from H-point
6. "W" Point: W-reference point, 50 mm vertically below and 50 mm horizontally back from "R" Point
7. "M" Plane: M-reference plane, 1 000 mm horizontally back from "R" Point

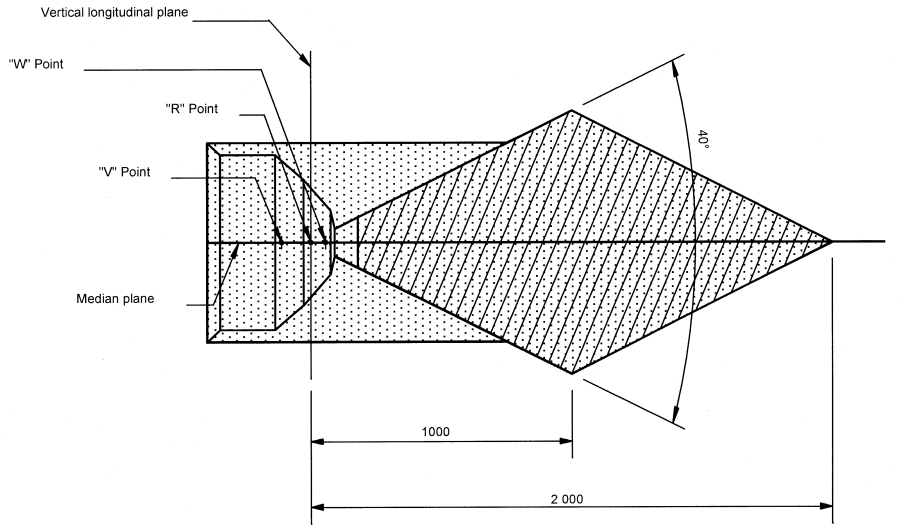
Figure 3 -- Side View, User-ready Tether Anchorage Location



Notes

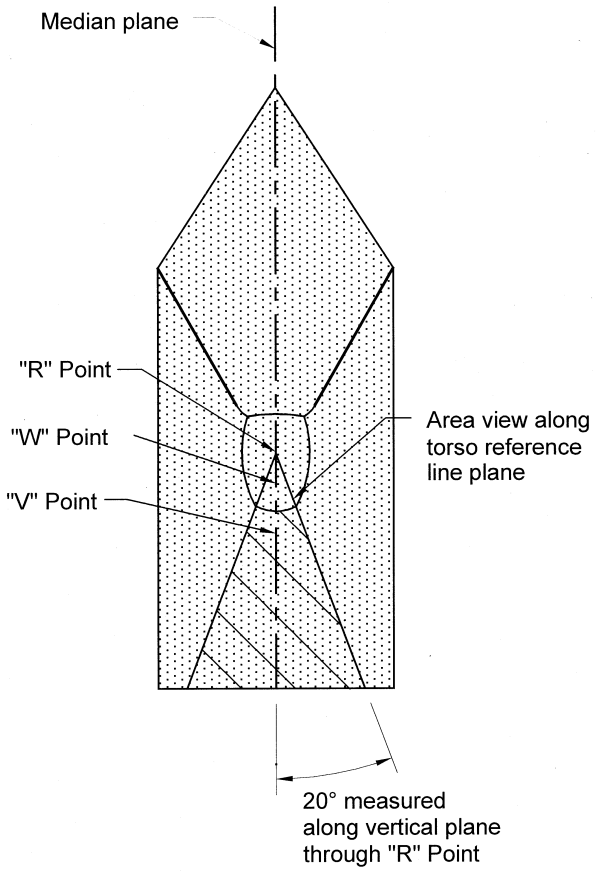
1. Dimensions in mm, except where otherwise indicated
2. Portion of user-ready tether anchorage that is designed to bind with the tether strap hook to be located within shaded zone
3. Drawing not to scale
4. "R" Point: Shoulder reference point
5. "V" Point: V-reference point, 350 mm vertically above and 175 mm horizontally back from H-point
6. "W" Point: W-reference point, 50 mm vertically below and 50 mm horizontally back from "R" Point
7. "M" Plane: M-reference plane, 1 000 mm horizontally back from "R" Point

Figure 4 -- Enlarged Side View of Strap Wrap-around Area, User-ready Tether Anchorage Location



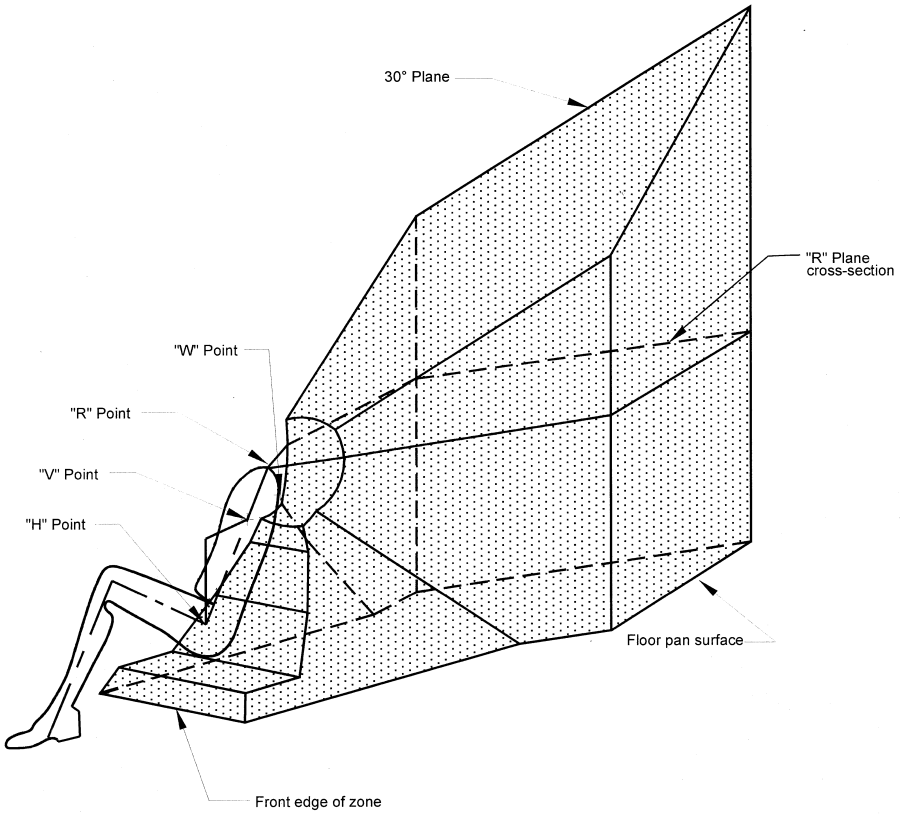
1. Dimensions in mm, except where otherwise indicated
2. Portion of user-ready tether anchorage that is designed to bind with the tether strap hook to be located within shaded zone
3. Drawing not to scale
4. "R" Point: Shoulder reference point
5. "V" Point: V-reference point, 350 mm vertically above and 175 mm horizontally back from H-point.
6. "W" Point: W-reference point, 50 mm vertically below and 50 mm horizontally back from "R" Point

Figure 5. Plan View (R-plane Cross Section), User-ready Tether Anchorage Location



Notes
1. Portion of user-ready tether anchorage that is designed to bind with the tether strap hook to be located within shaded zone
2. Drawing not to scale
3. “R” Point: Shoulder reference point
4. “V” Point: V-reference point, 350 mm vertically above and 175 mm horizontally back from H-point
5. “W” Point: W-reference point, 50 mm vertically below and 50 mm horizontally back from “R” Point

Figure 6 -- Front View, User-ready Tether Anchorage Location



Notes

1. Portion of user-ready tether anchorage that is designed to bind with the tether strap hook to be located within shaded zone
2. Drawing not to scale
3. "R" Point: Shoulder reference point
4. "V" Point: V-reference point, 350 mm vertically above and 175 mm horizontally back from H-point
5. "W" Point: W-reference point, 50 mm vertically below and 50 mm horizontally back from "R" Point

Figure 7 -- Three-dimensional Schematic View of User-ready Tether Anchorage Location

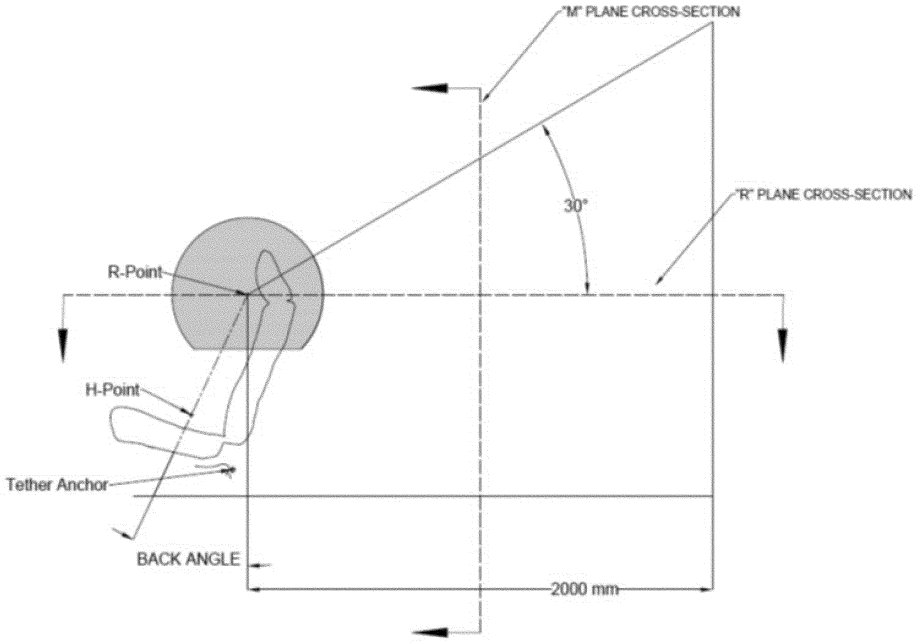


Figure 8 to § 571.225. Side View of 325 mm Radius Sphere Zone From R-Point, Truncated at 230 mm Below the Center

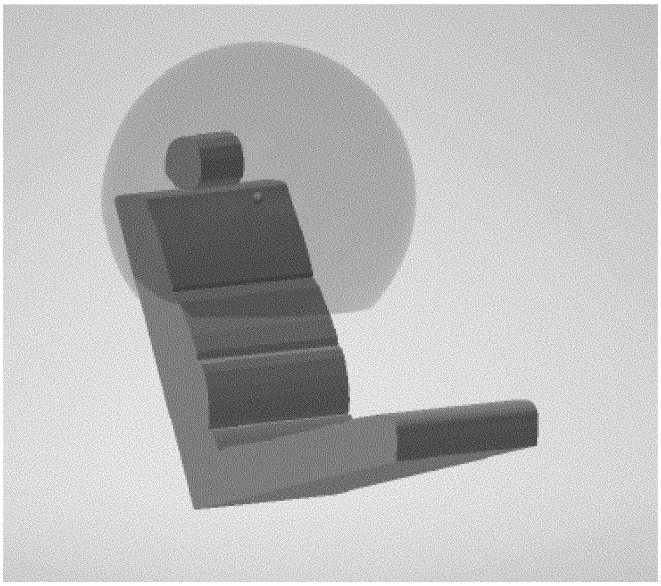
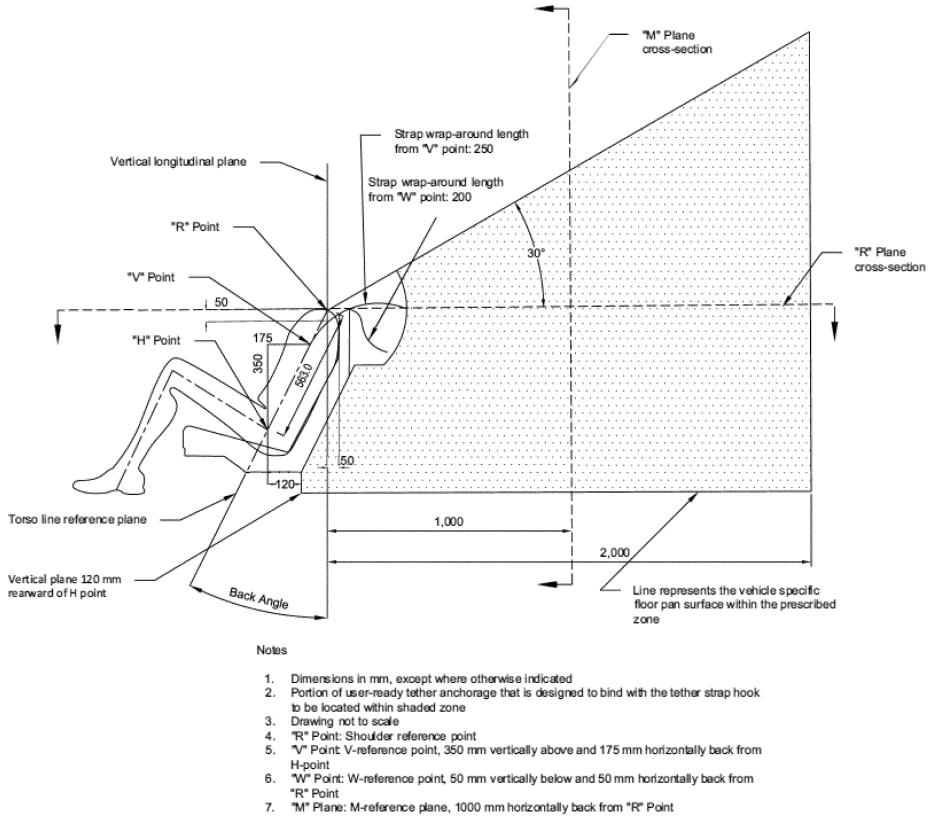


Figure 9 to § 571.225. Three-Dimensional 325 mm Radius Sphere Zone From R-Point, Truncated Along the Lower Edge at 230 mm Below Its Center



Notes

1. Dimensions in mm, except where otherwise indicated
2. Portion of user-ready tether anchorage that is designed to bind with the tether strap hook to be located within shaded zone
3. Drawing not to scale
4. "R" Point: Shoulder reference point
5. "V" Point: V-reference point, 350 mm vertically above and 175 mm horizontally back from H-point
6. "W" Point: W-reference point, 50 mm vertically below and 50 mm horizontally back from "R" Point
7. "M" Plane: M-reference plane, 1000 mm horizontally back from "R" Point

Figure 10 to §571.225—Side View. User Ready Tether Anchorage Location

FIGURE 11 TO §571.225 [RESERVED]

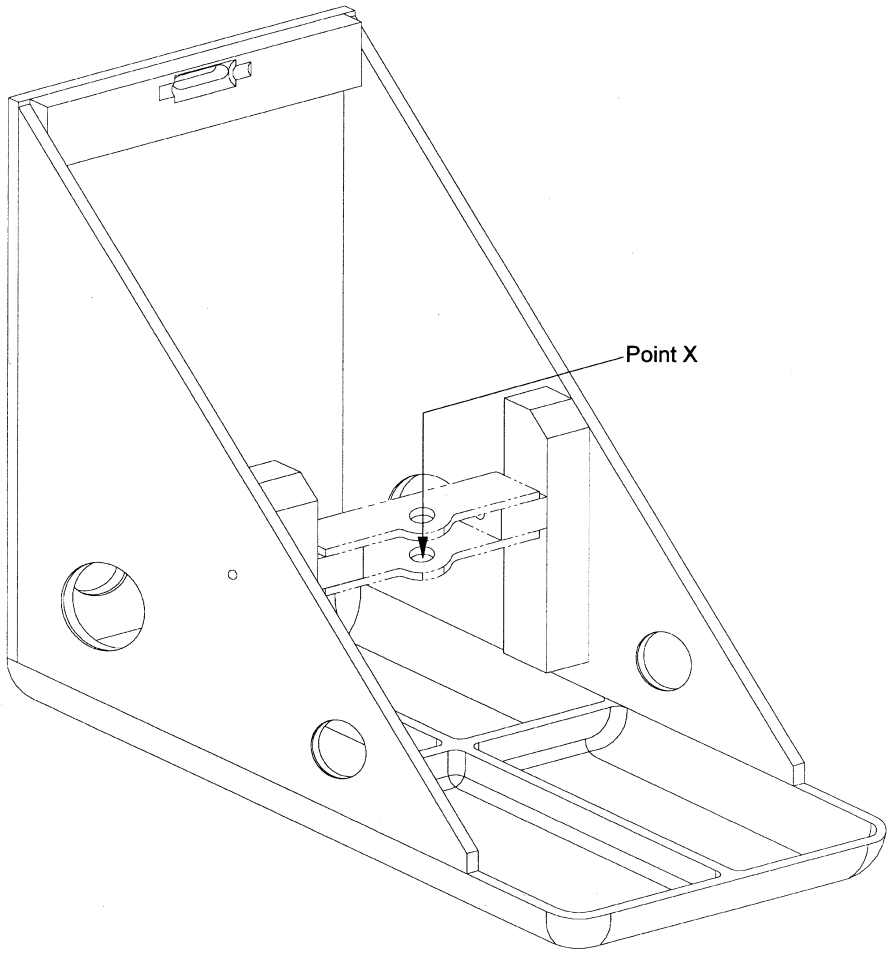
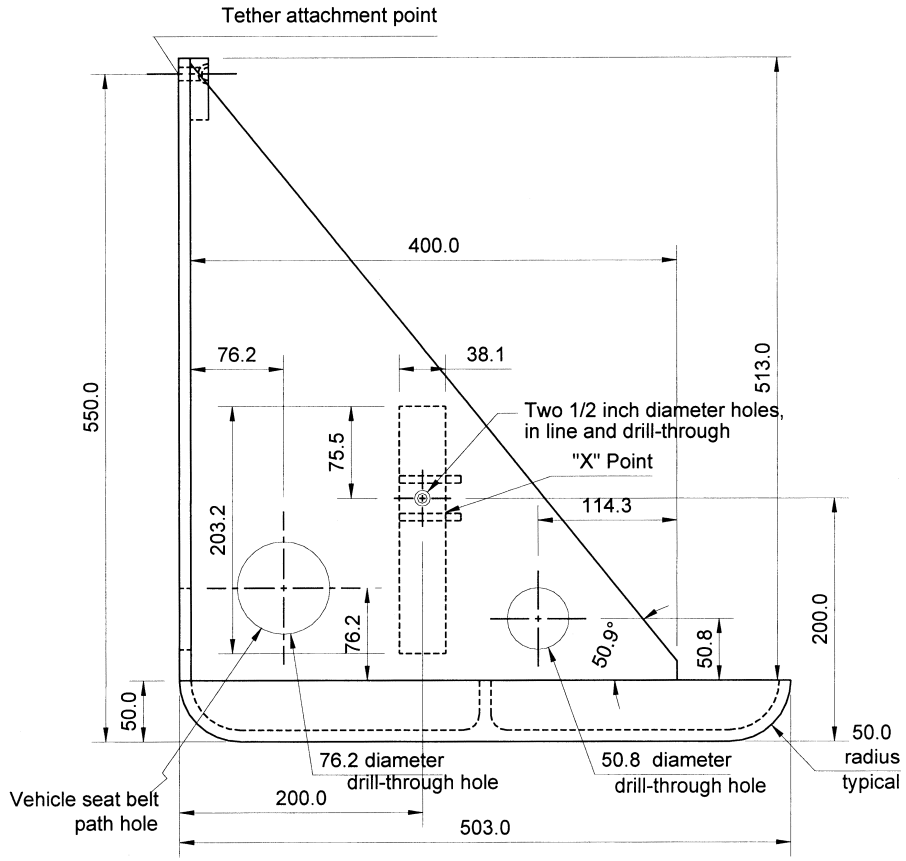


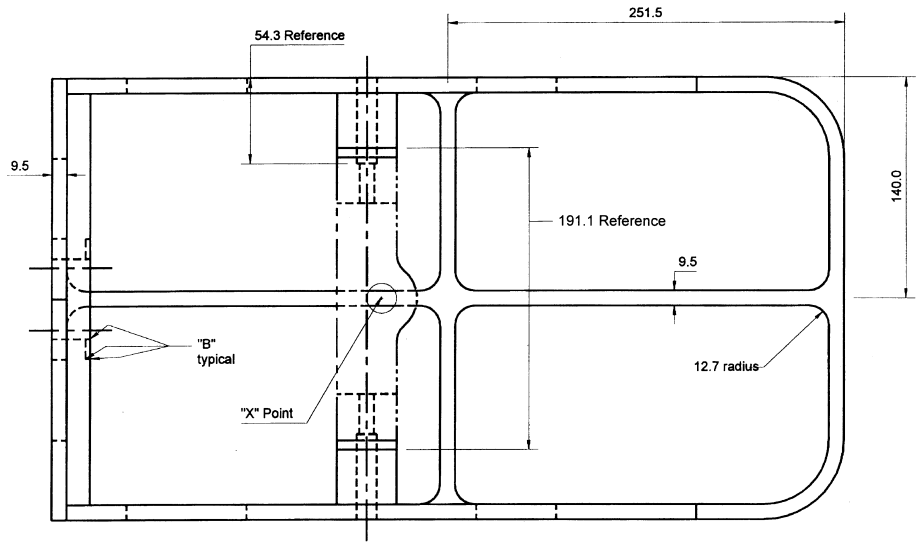
Figure 12 – Three Dimensional Schematic View of the Static Force Application Device 1 (SFAD 1)



Notes

1. Material: 6061-T6-910 Aluminum
2. Dimensions in mm, except where otherwise indicated
3. Drawing not to scale
4. Break all outside corners

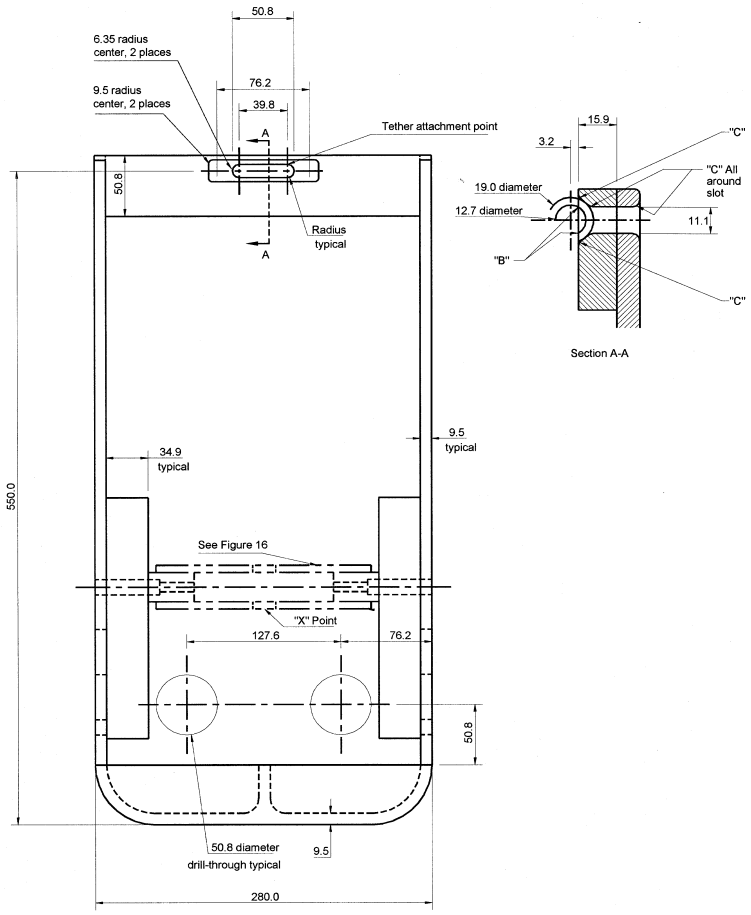
Figure 13 -- Side View, Static Force Application Device 1 (SFAD 1)



Notes

1. Material: 6061-T6-910 Aluminum
2. Dimensions in mm, except where otherwise indicated
3. Drawing not to scale
4. Break all outside corners and lightning hole edges 1.5 mm approximately.
5. Break edges of vehicle seat belt path holes at least 4 mm
6. "B" = approximately 0.8 mm

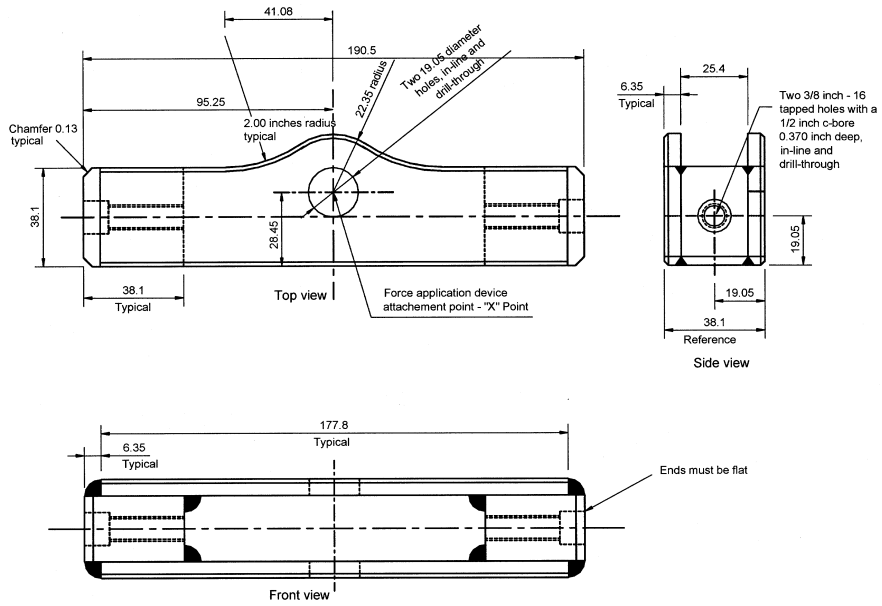
Figure 14 -- Plan View, Static Force Application Test Device 1 (SFAD 1)



Notes

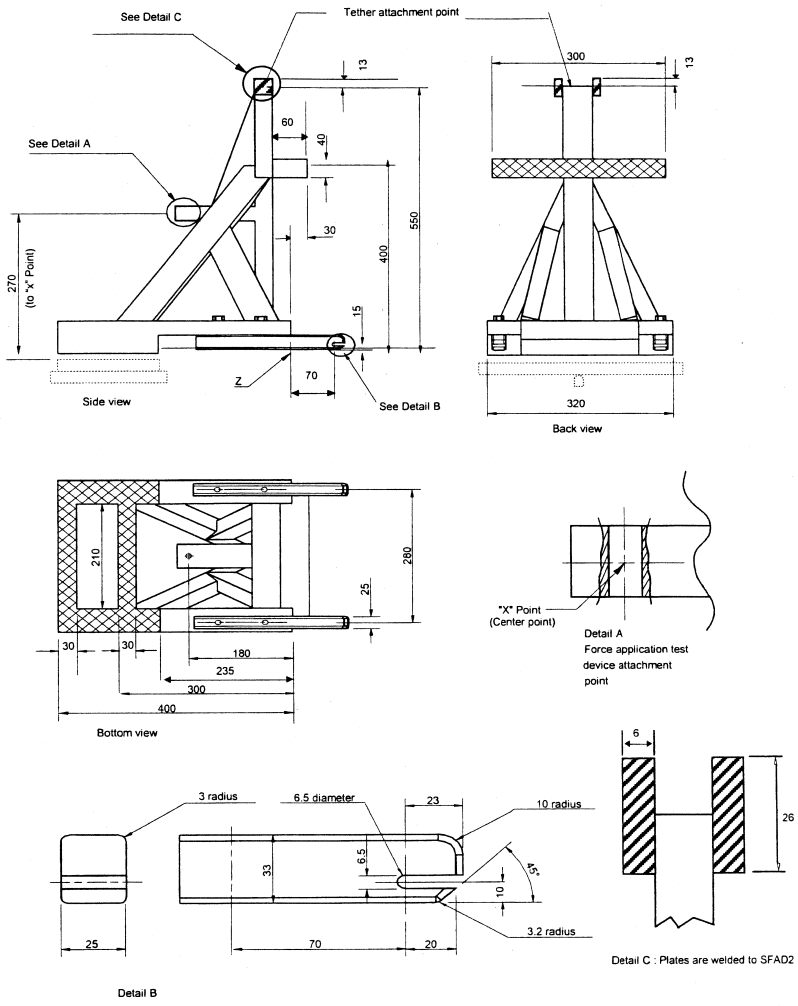
1. Material: 6061-T6-910 Aluminum
2. Dimensions in mm, except where otherwise indicated
3. Drawing not to scale
4. "B" = approximately 0.8 mm
5. "C" = approximately 3.2 mm

Figure 15 -- Front View, Static Force Application Device 1 (SFAD 1)



Notes
1. Material: Steel
2. Dimensions in mm, except where otherwise indicated
3. Drawing not to scale
4. Break all outside corners approximately 1.5 mm
5. Surfaces and edges are not to be machined unless otherwise specified for tolerance.
6. Saw-cut or stock size material whenever possible.
7. Construction to be securely welded.

Figure 16 -- Cross Bar, Static Force Application Device 1 (SFAD 1)



Notes:
1. Drawing not to scale
2. Dimensions in mm, except where otherwise indicated
3. Device stiffness satisfied when using a securely welded construction consisting of rectangular 3 mm steel tubing and 6 mm thick load application plate
4. If construction not as per note 3, stiffness of device is satisfied if movement of point "X" is not more than 2 mm in any direction when forces are applied as specified in S15.2.1, with device attached to rigid anchorage bars and the front cross member supported by a rigid bar that is held at the center by a longitudinal pivot 25 mm below the SFAD2 base (as shown in broken lines) to allow bending and twisting of the base of the device. Any deformation of the anchorage bars to be excluded from the measurements of the movement of point "X".

Figure 17- Side, Back and Bottom Views, ISO 13216-1 Static Force Application Device 2 (SFAD 2)

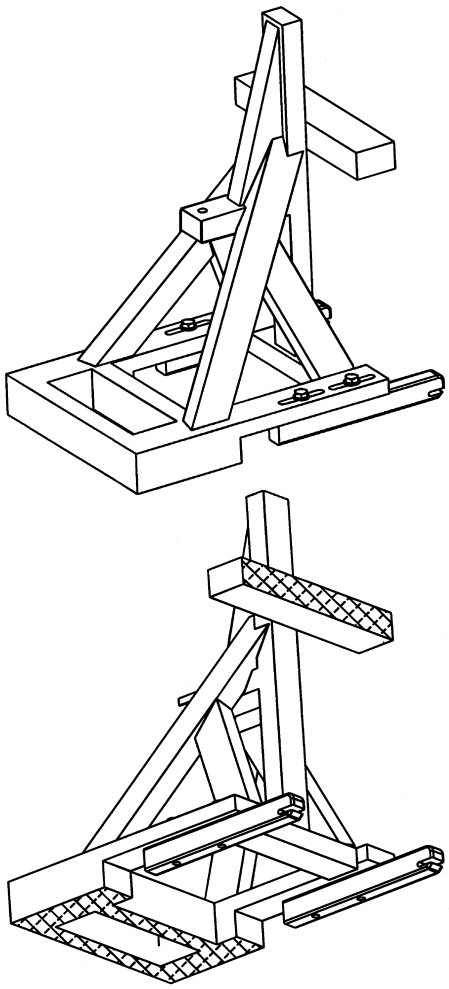


Figure 18 -- Three-dimensional Schematic Views of the ISO 13216-1 Static Force Application Device 2 (SFAD 2)

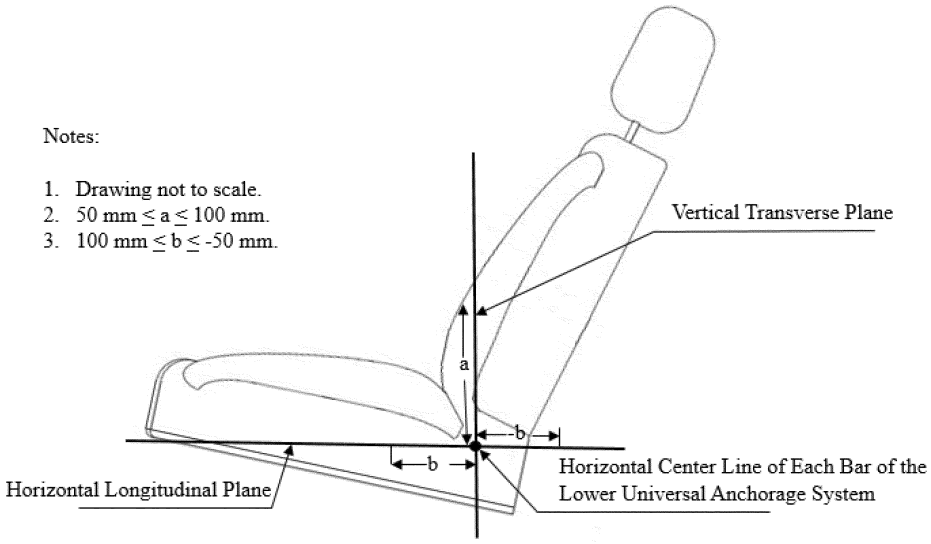
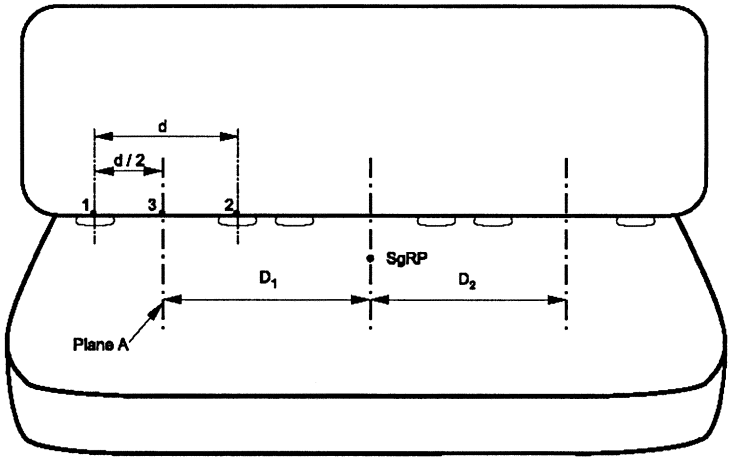


Figure 19 to §571.225. Placement of Symbol on the Seat Back and Seat Cushion of Vehicle

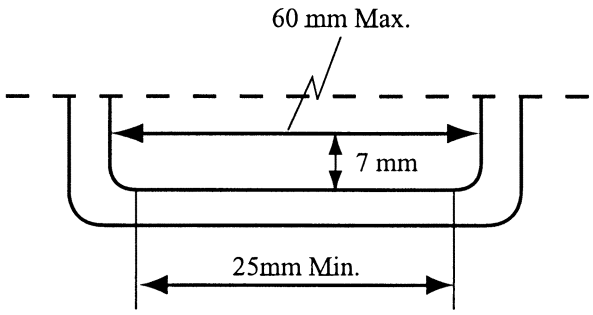


d = center to center distance between lower anchorages for a given seating position (nominally 280 mm).

D = distance between vertical longitudinal planes located midway between the anchorages for a given seating position.

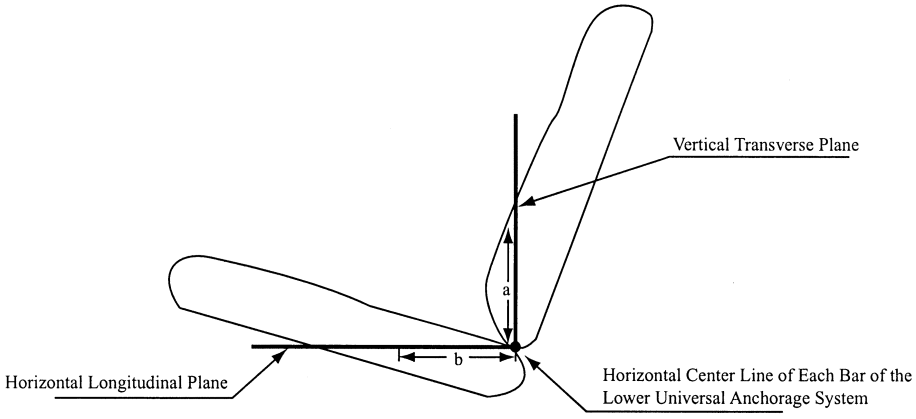
SgRP = Seating reference point, as defined in 49 CFR §571.3.

Figure 20 – Measurement of Distance Between Adjacent Seating Positions for Use in Simultaneous Testing



Configuration shown is for illustration purposes only.

Figure 21. Length of Lower Anchorage Bars



Notes:

1. Drawing not to scale.
2. 50 mm ≤ a ≤ 100 mm.
3. b = 100 mm ± 25 mm.

Figure 22. Placement of Symbol on the Seat Back and Seat Cushion of a vehicle

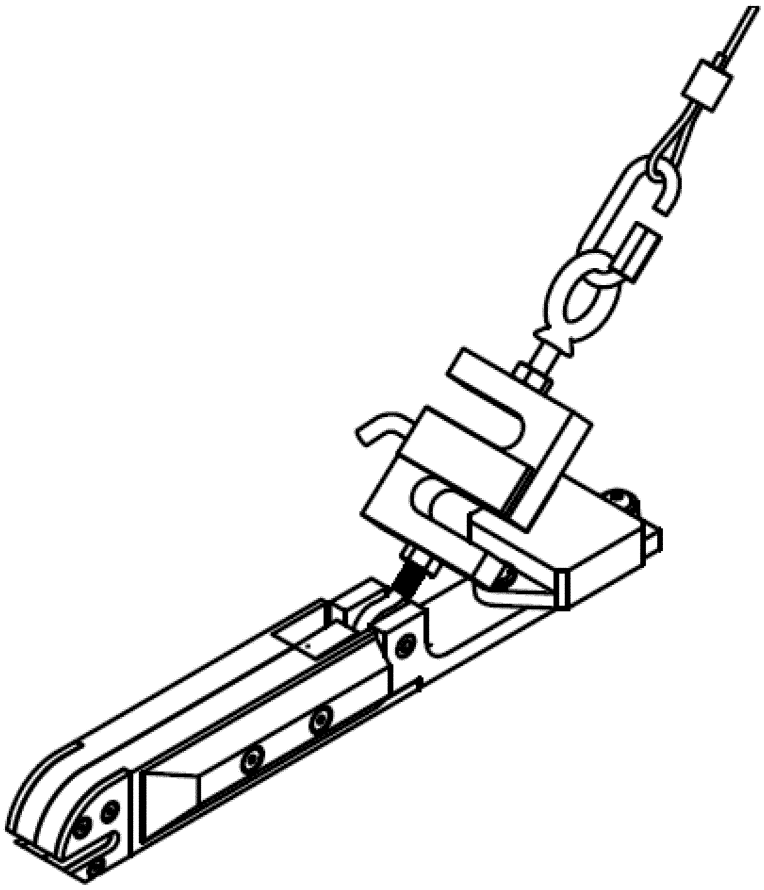


Figure 23 to §571.225. Clearance Angle Tool



Figure 24 to § 571.225—Lower Anchorage Symbol

Note 1 to Figure 24 to § 571.225: Drawing not to scale.

Note 2 to Figure 24 to § 71.225: Symbol may be shown in mirror image.

Note 3 to Figure 24 to § 571.225: Color of the symbol at the option of the manufacturer.

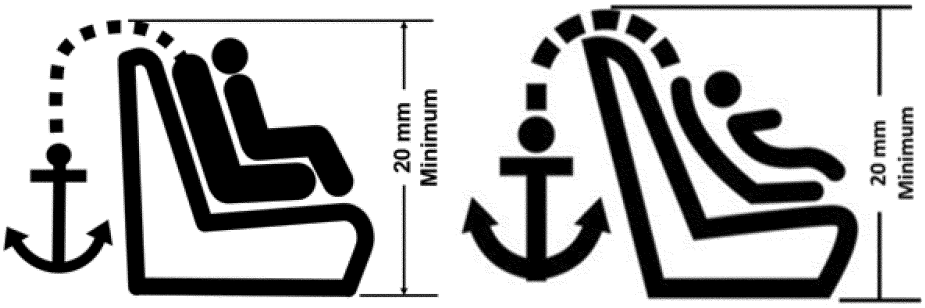


Figure 25 to § 571.225. Tether Anchorage Symbols

Note 1 to Figure 25 to § 571.225: Drawing not to scale.

Note 2 to Figure 25 to § 571.225: Symbol may be shown in mirror image.

Note 3 to Figure 25 to § 571.225: Color of the symbol at the option of the manufacturer.

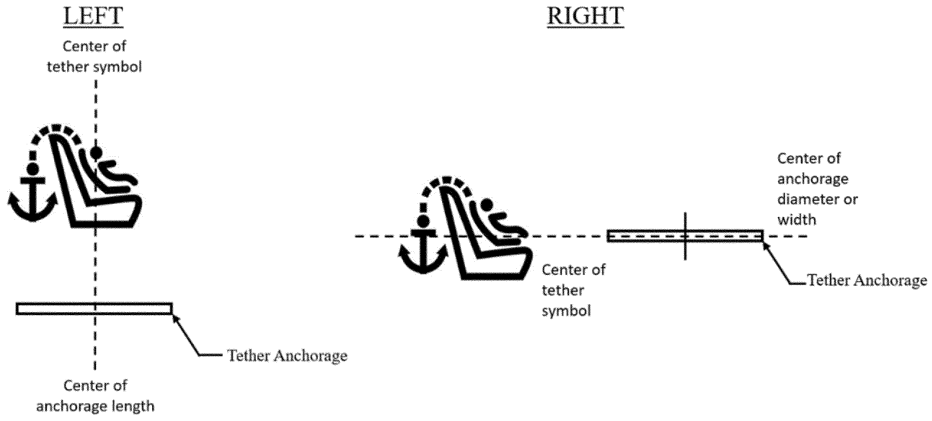


Figure 26 to §571.225. Tether Anchorage Marking Location—Alignment (No Cover)

Note 1 to Figure 26 to §571.225: (Tolerance of ± half of the anchorage length)/(Tolerance of ± half of the pictogram height).

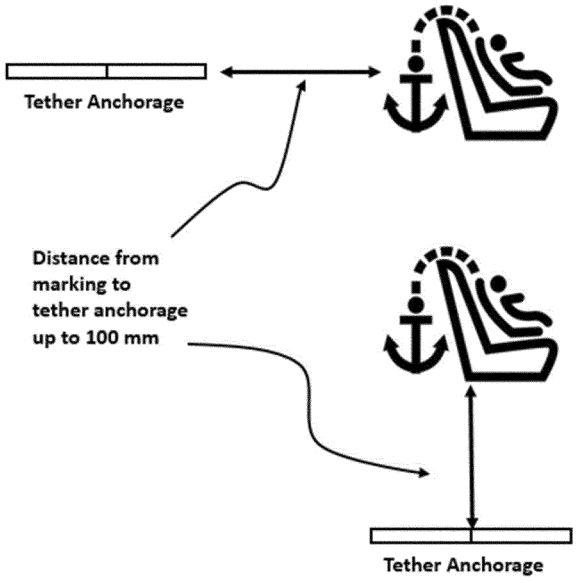


Figure 27 to §571.225. Tether Anchorage Marking Location—Distance (No Cover)

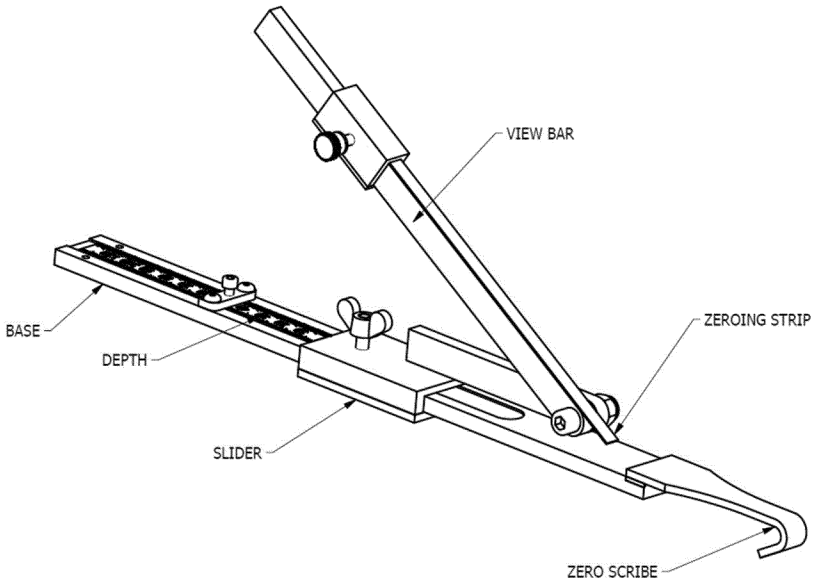


Figure 28 to § 571.225. Anchorage Depth Tool

[64 FR 10823, Mar. 5, 1999, as amended at 64 FR 47587, Aug. 31, 1999; 65 FR 46640, July 31, 2000; 68 FR 24667, May 8, 2003; 68 FR 38226, June 27, 2003; 69 FR 48823, Aug. 11, 2004; 69 FR 60565, Oct. 12, 2004; 69 FR 70915, Dec. 8, 2004; 77 FR 768, Jan. 6, 2012; 87 FR 18599, Mar. 30, 2022; 90 FR 1342, Jan. 7, 2025]

§ 571.226 Standard No. 226; Ejection Mitigation.

S1. *Purpose and Scope.* This standard establishes requirements for ejection mitigation systems to reduce the likelihood of complete and partial ejections of vehicle occupants through side windows during rollovers or side impact events.

S2. *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks designed to carry at least one person, and buses with a gross vehicle weight rating of 4,536 kg or less, except walk-in vans, modified roof vehicles, convertibles, and vehicles with no doors or with doors that are designed to be easily attached or removed so the vehicle can be operated without doors. Also excluded from this standard are law enforcement vehicles, correctional institution vehicles, taxis and limousines, if they have a fixed security partition separating the 1st and 2nd or 2nd and 3rd rows and if they are produced by more than one manufacturer or are altered (within the meaning of 49 CFR 567.7).

S3. *Definitions.*

Ejection impactor means a device specified in S7.1 of this standard that is a component of the ejection mitigation test device and is the moving mass that strikes the ejection mitigation countermeasure.

Ejection impactor targeting point means the intersection of the y-axis of the ejection headform and the outer surface of the ejection headform.

Ejection mitigation countermeasure means a device or devices, except seat belts, integrated into the vehicle that reduce the likelihood of occupant ejection through a side window opening, and that requires no action by the occupant for activation.

Ejection propulsion mechanism means a device that is a component of the ejection mitigation test device consisting of a mechanism capable of propelling the ejection impactor and constraining it to move along its axis or shaft.

Limited-line manufacturer means a manufacturer that sells three or fewer carlines, as that term is defined in 49 CFR 583.4, in the United States during a production year.

Modified roof means the replacement roof on a motor vehicle whose original roof has been removed, in part or in total, or a roof that has to be built over the occupant compartment in vehicles that did not have an original roof over the occupant compartment.

Movable window means a daylight opening composed of glazing designed to be moved with respect to the vehicle or frame while the vehicle is in motion.

Side daylight opening means, other than a door opening, the locus of all points where a horizontal line, perpendicular to the vehicle vertical longitudinal plane, is tangent to the periphery of the opening. The periphery includes surfaces 100 millimeters inboard of the inside surface of the window glazing and 25 mm outboard of the outside surface of the side glazing. The periphery excludes the following: any flexible gasket material or weather stripping used to create a waterproof seal between the glazing or door and the vehicle interior; grab handles used to facilitate occupant egress and ingress; and any part of a seat.

Small manufacturer means an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States.

Target means the x-z plane projection of the ejection headform face as shown in Figure 1.

Walk-in van means a special cargo/mail delivery vehicle that only has a driver designated seating position. The vehicle has a sliding (or folding) side door and a roof clearance that enables a person of medium stature to enter the passenger compartment area in an up-right position.

Zero displacement plane means, a vertical plane parallel to the vehicle longitudinal centerline and tangent to the most outboard surface of the ejection headform when the headform is aligned with an impact target location and just touching the inside surface of a window covering the side daylight opening.

S4. *Phase-in, performance and other requirements.*

S4.1 *Phase-in requirements.*

S4.1.1 Except as provided in S4.1.3 of this standard, a percentage of each manufacturer's vehicle production, as specified in S8 of this standard, manufactured on or after September 1, 2013 to August 31, 2017, shall meet the requirements of S4.2. Vehicles that are not subject to the phase-in may be certified as meeting the requirements specified in this standard.

S4.1.2 Except as provided in S4.1.3 of this section, each vehicle manufactured on or after September 1, 2017 must meet the requirements of S4.2 without use of advanced credits.

S4.1.3 *Exceptions from the phase-in; special allowances.*

(a) Vehicles produced by a small manufacturer and by a limited line manufacturer are not subject to S4.1.1 of this standard, but are subject to S4.1.2.

(b) Vehicles that are altered (within the meaning of 49 CFR 567.7) before September 1, 2018, after having been previously certified in accordance with part 567 of this chapter, and vehicles manufactured in two or more stages before September 1, 2018, are not required to meet the requirements of S4.2. Vehicles that are altered on or after September 1, 2018, and vehicles that are manufactured in two or more stages on or after September 1, 2018, must meet the requirements of S4.2.

S4.2 *Performance and other requirements.*

S4.2.1 When the ejection propulsion mechanism propels the ejection impactor into the impact target locations of each side daylight opening of a vehicle according to the test procedures specified in S5 of this standard, the most outboard surface of the ejection headform must not displace more than 100 millimeters beyond the zero displacement plane.

S4.2.1.1 No vehicle shall use movable glazing as the sole means of meeting the displacement limit of S4.2.1.

S4.2.1.2 Vehicles with an ejection mitigation countermeasure that deploys in the event of a rollover must deploy the countermeasure for the side daylight opening being tested according to the procedure specified in S5 of this standard.

S4.2.1.3 If a side daylight opening contains no target locations, the impact test of S4.2.1 is not performed on that opening.

S4.2.2 Vehicles that have an ejection mitigation countermeasure that deploys in the event of a rollover must have a monitoring system with a readiness indicator. The indicator shall monitor its own readiness and must be clearly visible from the driver's designated seating position. The same readiness indicator required by S4.5.2 of FMVSS No. 208 may be used to meet the requirement. A list of the elements of the system being monitored by the indicator shall be included with the information furnished in accordance with S4.2.3.

S4.2.3 *Written information.*

(a) Vehicles with an ejection mitigation countermeasure that deploys in the event of a rollover must be described as such in the vehicle's owner manual or in other written information provided by the vehicle manufacturer to the consumer.

(b) Vehicles that have an ejection mitigation countermeasure that deploys in the event of a rollover must include in written information a discussion of the readiness indicator required by S4.2.2, specifying a list of the elements of the system being monitored by the indicator, a discussion of the purpose and location of the telltale, and instructions to the consumer on the steps to take if the telltale is illuminated.

S4.2.4 *Technical Documentation.* For vehicles that have an ejection mitigation countermeasure that deploys in the event of a rollover, the vehicle manufacturer must make available to the agency, upon request, the following information: A discussion of the sensor system used to deploy the countermeasure, including the pertinent inputs to the computer or calculations within the computer and how its algorithm uses that information to determine if the countermeasure should be deployed.

S5. *Test procedures.*

S5.1 Demonstrate compliance with S4.2 of this standard in accordance with the test procedures specified in this standard, under the conditions of S6, using the equipment described in S7. In the impact test described by these procedures, target locations are identified (S5.2) and the zero displacement plane location is determined (S5.3). The glazing is pre-broken, fully retracted or removed prior to the impact test (S5.4). The countermeasure is deployed, if applicable, and an ejection impactor (see S7.1) strikes the countermeasure at the impact target locations, at the specified speeds and times (S5.5). The lateral displacement of the ejection impactor beyond the zero displacement plane is measured.

S5.2 *Determination of impact target locations.*

S5.2.1 *Boundary of target location.*

S5.2.1.1 *Initial determination of offset line.* Determine the location of an offset-line within the side daylight opening by projecting each point of the side daylight opening laterally onto a vehicle vertical longitudinal plane. Move each point by 25±2 mm towards the center of the side daylight opening projection and perpendicular to a line tangent to the projection at that point, while maintaining the point on a vehicle vertical longitudinal plane.

S5.2.1.2 *Rearmost limit of offset line.*

(a) *Seats fixed in a forward facing direction.* Except as provided in S5.2.1.2(b), if an offset line extends rearward of a transverse vertical vehicle plane located behind the seating reference point at the distance specified in 5.2.1.2(a)(1) or (2), the transverse vertical vehicle plane defines the rearward edge of the offset line for the purposes of determining target locations.

(1) For a vehicle with fewer than 3 rows—1,400 mm behind the rearmost SgRP.

(2) For a vehicle with 3 or more rows—600 mm behind the 3rd row SgRP.

(b) *Seats not fixed in a forward facing direction.* When the last row seat adjacent to the opening, in the case of a vehicle with fewer than 3 rows, or the 3rd row seat adjacent to the opening, in the case of a vehicle with 3 or more rows, is not fixed in the forward facing direction, the offset line may extend farther rearward than specified in S5.2.1.2(a) under the following conditions. With the seat in any non-forward facing orientation, the seat back set at an inclination position closest to the

manufacturer's design seat back angle, and all other seat adjustments at any possible position of adjustment, determine the location of a vertical transverse vehicle plane located behind the portion of the seat rearmost in the vehicle, at the distance specified in 5.2.1.2(b)(1) and (2). The boundary of target locations extends to this vertical plane if it is farther rearward than the plane determined in S5.2.1.2(a).

(1) For a vehicle with fewer than 3 rows—1,400 mm behind the portion of the seat rearmost in the vehicle.

(2) For a vehicle with 3 or more rows—600 mm behind the portion of the seat rearmost in the vehicle, for a seat in the 3rd row.

(c) *Vehicles with partitions or bulkheads.* If a vehicle has a fixed transverse partition or bulkhead behind which there are no designated seating positions, a vertical transverse vehicle plane 25 mm forward of the most forward portion of the partition or bulkhead defines the rearward edge of the offset line for the purposes of determining target locations when said plane is forward of the limiting plane defined in S5.2.1.2(a) or (b).

S5.2.2 *Preliminary target locations.*

(a) To identify the impact target locations, the following procedures are performed with the x and z axes of the target, shown in Figure 1 (provided for illustration purposes), aligned within ±1 degree of the vehicle longitudinal and vertical axes, respectively, and the target y axis pointing in the outboard direction.

(b) Place targets at any location inside the offset-line where the target is tangent to within ±2 mm of the offset-line at just two or three points (see Figure 2) (figure provided for illustration purposes).

S5.2.3 *Determination of primary target locations.* Divide the side daylight opening into four quadrants by passing a vertical line and a horizontal line, in a vehicle vertical longitudinal plane, through the geometric center of the side daylight opening.

S5.2.3.1 *Front windows.* For any side daylight opening forward of the vehicle B-pillar, the primary quadrants are the forward-lower and rearward-upper.

S5.2.3.2 *Rear windows.* For any side daylight opening rearward of the B-pillar, the primary quadrants are the forward-upper and rearward-lower.

S5.2.3.3 If a primary quadrant contains only one target center, that target is the primary target for that quadrant (*see* Figure 3) (figure provided for illustration purposes). If there is more than one target center in a primary quadrant, the primary target for that quadrant is the lowest target in a lower quadrant and the highest target in an upper quadrant. If there is a primary quadrant that does not contain a target center, the target center closest to the primary quadrant outline is the primary target.

S5.2.4 *Determination of secondary target locations.*

S5.2.4.1 *Front windows.* Measure the horizontal distance between the centers of the primary targets. For a side daylight opening forward of the B-pillar, place one secondary target center rearward of the forward primary target by one-third of the horizontal distance between the primary target centers and tangent with upper portion of the offset-line. Place another secondary target center rearward of the forward primary target by two-thirds of the horizontal distance between the primary target centers and tangent with the lower portion of the offset-line (*see* figure 4) (figure provided for illustration purposes).

S5.2.4.2 *Rear windows.* For side daylight openings rearward of the B-pillar, place one secondary target center rearward of the forward primary target by one-third of the horizontal distance between the primary target centers and tangent with lower portion of the offset-line. Place another secondary target center rearward of the forward primary target by two-thirds of the horizontal distance between the primary target centers and tangent with the upper portion of the offset-line (*see* Figure 4) (figure provided for illustration purposes).

S5.2.5 *Target adjustment.*

S5.2.5.1 *Target elimination and reconstitution.*

S5.2.5.1.1 *Target elimination.* Determine the horizontal and vertical distance between the centers of the targets. If the minimum distance between

the z axes of the targets is less than 135 mm and the minimum distance between the x axes of the targets is less than 170 mm, eliminate the targets in the order of priority given in steps 1 through 4 of Table 1 (see Figure 5, 5a and 5b) (figures provided for illustration purposes). In each case, both the z axes of the targets must be closer than 135 mm and x axes of the targets must be closer than 170 mm. If the minimum distance between the z axes of the targets is not less than 135 mm or the minimum distance between the x axes of the targets is not less than 170 mm, do not eliminate the target. Continue checking all the targets listed in steps 1 through 4 of Table 1.

TABLE 1—PRIORITY LIST OF TARGET DISTANCE TO BE CHECKED AGAINST LIMITS

Step	Measure distance from z axis to z axis and x axis to x axis for these targets	Eliminate this target if distances between z axes of targets and x axes of targets are less than 135 mm and 170 mm, respectively
1	Upper Secondary to Lower Secondary	Upper Secondary.
2	Upper Primary to Upper or Remaining Secondary	Upper or Remaining Secondary.
3	Lower Primary to Lower or Remaining Secondary	Lower or Remaining Secondary.
4	Upper Primary to Lower Primary	Upper Primary.

S5.2.5.1.2 *Target reconstitution.* If after following the procedure given in S5.2.5.1.1, there are only two targets remaining, determine the absolute distance between the centers of these targets. If this distance is greater than or equal to 360 mm, place a target such that its center bisects a line connecting the centers of the remaining targets.

S5.2.5.2 *Target reorientation—90 degree rotation.* If after following the procedure given in S5.2.5.1 there are less than four targets in a side daylight opening, repeat the procedure in 5.2 through 5.2.5.1.2, with a modification to S5.2 as follows. Reorient the target by rotating it 90 degrees about the y axis of the target such that the target positive z axis is aligned within ±1 degree of the vehicle longitudinal axis, pointing in the direction of the vehicle positive x axis (see Figures 5a and 5b) (figures provided for illustration purposes). If after performing the procedure in this section, the remaining targets exceed the number of targets determined with the original orientation of the target, the reoriented targets represent the final target locations for the side daylight opening.

S5.2.5.3 *Target reorientation incremental rotation.* If after following the procedure given in S5.2.5.2 there are no targets in a side daylight opening, starting with the target in the position defined in S5.2.2(a), reorient the target by rotating it in 5 degree increments about the y axis of the target by rotating the target positive z axis toward the vehicle positive x axis. At each increment of rotation, attempt to fit the target within the offset line of the side daylight opening. At the first increment of rotation where the target will fit, place the target center as close as possible to the geometric center of the side daylight opening. If more than one position exists that is closest to the geometric center of the side daylight opening, select the lowest.

S5.3 *Determination of zero displacement plane.* The glazing covering the target location of the side daylight opening being tested is intact and in place in the case of fixed glazing and intact and fully closed in the case of movable glazing. With the ejection impactor targeting point aligned within ±2 mm of the center of any target location specified in S5.2, and with the ejection impactor on the inside of the vehicle, slowly move the impactor towards the window until contact is made with the interior of the glazing with no more than 20 N of pressure being applied to the window. The location of the most outboard surface of the headform establishes the zero displacement plane for this target location.

S5.4 *Window position and condition.*Subject to S5.5(b), prior to impact testing, the glazing covering the target location must be removed from the side daylight opening, fully retracted, or pre-broken according to the procedure

in S5.4.1, at the vehicle manufacturer's option.

S5.4.1 *Window glazing pre-breaking procedure.*

S5.4.1.1 *Breakage pattern.* Locate the geometric center of the side daylight opening, established in S5.2.3 of this standard. Mark the outside surface of the window glazing in a horizontal and vertical grid of points separated by 75±2 mm with one point coincident within ±2 mm of the geometric center of the side daylight opening (see Figure 6) (figure provided for illustration purposes). Mark the inside surface of the window glazing in a horizontal and vertical grid of points separated by 75±2 mm with the entire grid horizontally offset by 37.5 ±2 mm from the grid of points on the outside of the glazing.

S5.4.1.2 *Breakage method.*

(a) Start with the inside surface of the window and forward-most, lowest mark made as specified in S5.4.1.1 of this standard. Use a center punch in this procedure. The punch tip has a 5 ±2 mm diameter prior to coming to a point. The spring is adjusted to require 150 ±25 N of force to activate the punch. Only once at each mark location, apply pressure to activate the spring in the center punch in a direction which is perpendicular to the tangent of the window surface at the point of contact, within ±10 degrees. Apply the pressure only once at each mark location, even if the glazing does not break or no hole results.

(b) Use a 100 ±10 mm × 100 ±10 mm piece of plywood with a minimum thickness of 18 mm as a reaction surface on the opposite side of the glazing to prevent to the extent possible the window surface from deforming by more than 10 mm when pressure is being applied to the hole-punch.

(c) Continue the procedure with the center punch by moving rearward in the grid until the end of a row is reached. When the end of a row is reached, move to the forward-most mark on the next higher row and continue the procedure. Continue in this pattern until the procedure is conducted at each marked location on the inside surface of the glazing.

(d) Repeat the process on the outside surface of the window.

(e) If punching a hole causes the glazing to disintegrate, halt the breakage procedure and proceed with the headform impact test.

S5.5 *Impact speeds and time delays.* The ejection impactor speeds specified below must be achieved after propulsion has ceased.

(a) *Vehicles with or without an ejection mitigation countermeasure that deploys in a rollover.* For a vehicle with an ejection mitigation countermeasure that deploys in a rollover, using the ejection propulsion mechanism, propel the ejection impactor such that it first strikes the countermeasure, while aligned with any target location specified in S5.2 of this standard, 1.5 ±0.1 seconds after activation of the ejection mitigation countermeasure that deploys in the event of a rollover, and at a speed of 20 ±0.5 km/h. For a vehicle without an ejection mitigation countermeasure that deploys in a rollover, propel the ejection impactor at any time such that it first strikes the countermeasure, while aligned with any target location specified in S5.2 of this standard, at a speed of 20 ±0.5 km/h.

(b) *Vehicles with an ejection mitigation countermeasure that deploys in a rollover.* For a vehicle with an ejection mitigation countermeasure that deploys in a rollover, remove or fully retract any movable glazing from the side daylight opening. Using the ejection propulsion mechanism, propel the ejection impactor such that it first strikes the countermeasure, while aligned with any target location specified in S5.2 of this standard, 6.0 ±0.1 seconds after activation of an ejection mitigation countermeasure that deploys in the event of a rollover, and at a speed of 16 ±0.5 km/h.

(c) An ejection mitigation countermeasure that deploys in the event of a rollover is described as such in the vehicle's owner manual or in other written information provided by the vehicle manufacturer to the consumer.

S5.6 *Ejection impactor orientation.*

S5.6.1 If the targets for the side daylight opening being impacted were determined by the procedure specified in S5.2.2 through S5.2.5.1 only, the ejection impactor orientation is as follows. At the time of launch of the ejection impactor the x, y and z axes of the ejection headform must be aligned

within ±1 degree of the vehicle longitudinal, transverse and vertical axes, respectively.

S5.6.2 If the targets for the side daylight opening being impacted were determined by the procedure specified in S5.2.5.2, the ejection impactor orientation is as follows. At the time of launch the ejection impactor is rotated by 90 degrees about the ejection headform y axis, from the orientation specified in S5.6.1, resulting in the headform positive z axis pointing in the direction of the vehicle positive x axis.

S5.6.3 If the targets for the side daylight opening being impacted were determined by the procedure specified in S5.2.5.3, the ejection impactor orientation is as follows. At the time of launch the ejection impactor is rotated about the y axis of the ejection headform by rotating the headform positive z axis towards the vehicle positive x axis, in the increment determined to be necessary in S5.2.5.3 to fit the target within the side daylight opening.

S5.6.4 After any test, extend the ejection impactor to the zero plane and determine that x, y and z axes of the ejection headform remain aligned within ±1 degree of its orientation at launch as specified in S5.6.1—5.6.3.

S6 *General test conditions.*

S6.1 *Vehicle test attitude.* The vehicle is supported off its suspension at an attitude determined in accordance with S6.1(a) through (f).

(a) The vehicle is loaded to its unloaded vehicle weight.

(b) All tires are inflated to the manufacturer's specifications listed on the vehicle's tire placard.

(c) Place vehicle on a level surface.

(d) Pitch: Measure the sill angle of the left front door sill and mark where the angle is measured.

(e) Roll: Mark a point on the vehicle body above the left and right front wheel wells. Determine the vertical height of these two points from the level surface.

(f) Support the vehicle off its suspension such that the left front door sill angle is within ±1 degree of that measured at the marked area in S6.1(d) and the vertical height difference of the two points marked in S6.1(e) is within ±5 mm of the vertical height difference determined in S6.1(e).

S6.2 *Doors.*

(a) Except as provided in S6.2(b) or S6.2(c), doors, including any rear hatchback or tailgate, are fully closed and latched but not locked.

(b) During testing, any side door on the opposite side of the longitudinal centerline of the vehicle from the target to be impacted may be open or removed.

(c) During testing, any rear hatchback or tailgate may be open or removed for testing any target.

S6.3 *Steering wheel, steering column, seats, grab handles, and exterior mirrors.* During targeting and testing, the steering wheel, steering column, seats, grab handles and exterior mirrors may be removed from the vehicle or adjusted to facilitate testing and/or provide an unobstructed path for headform travel through and beyond the vehicle.

S6.4 *Other vehicle components and structures.* During targeting and testing, interior vehicle components and vehicle structures other than specified in S6.2 and S6.3 may be removed or adjusted to the extent necessary to allow positioning of the ejection propulsion mechanism and provide an unobstructed path for the headform travel through and beyond the vehicle.

S6.5 *Temperature and humidity.*

(a) During testing, the ambient temperature is between 18 degrees C. and 29 degrees C., at any relative humidity between 10 percent and 70 percent.

(b) The headform specified in S7.1.1 of this standard is exposed to the conditions specified in S6.5(a) for a continuous period not less than one hour, prior to the test.

S7. *Ejection mitigation test device specifications.* The ejection mitigation test device consists of an ejection impactor and ejection propulsion mechanism with the following specifications. The ability of a test device to meet these specifications may be determined outside of the vehicle.

S7.1 *Ejection impactor.* The ejection impactor consists of an ejection headform attached to a shaft. The ejection impactor has a mass of 18 kg ±0.05 kg. The shaft is parallel to the y axis of the headform.

S7.1.1 *Ejection headform dimensions.* The ejection headform has the dimensions shown in Figure 1 and is depicted in the ''Parts List; Ejection Mitigation Headform Drawing Package,'' December 2010, and the ''Parts List and Drawings; Ejection Mitigation Headform Drawing Package,'' December 2010 (incorporated by reference; see §571.5).

S7.2 *Static deflection.* The ejection impactor targeting point must not deflect more than 20 mm in the x-z plane when a 981 N ±5 N force is applied in a vehicle vertical longitudinal plane, through the y axis of the headform and no more than 5 mm rear of the posterior surface of the headform. The force is applied once in each of the following headform axes: + z, −z, + x, −x. The static deflection measurement is made with the ejection impactor extended 400 mm outboard of the theoretical point of impact with the countermeasure and attached to the ejection propulsion mechanism, including any support frame and anchors.

S7.3 *Frictional characteristics.*

(a) Measure the dynamic coefficient of friction of the ejection impactor and any associated bearings and bearing housing in a test ready orientation. Repeat the measurement in three more orientations with the ejection impactor and any associated bearings and bearing housing rotated 90, 180 and 270 degrees about the headform y axis. Perform the measurement five consecutive times at each orientation.

(b) Measure the average force necessary to move the ejection impactor 200 mm rearward into the ejection propulsion mechanism at a rate of 50 (±13) mm per second, starting at a point 400 mm outboard of the theoretical point of impact with the countermeasure. Measure the force to an accuracy of ±5 N. The measurement excludes the force measured over the first 25 mm of travel and is recorded at a minimum frequency of 100 Hz. During the test a 100 kg ±0.5 kg mass is attached to the impactor with its center of gravity passing through the axis of motion of the impactor and no more than 5 mm rear of the posterior surface of the headform.

(c) Take the five force level averages made at each impactor orientation in S7.3(a) and average them. Take the maximum of the force average values and divide by 9.81 times the combined mass of the ejection impactor and mass added in S7.3(b). The resulting value must not exceed 0.25.

S7.4 *Targeting accuracy.* Determine that the ejection mitigation test device can deliver the ejection impactor targeting point through a zone defined by a cylinder with a 20 mm diameter and 100 mm length, when the ejection impactor is moving at the speed specified in S5.5. The projection of the long axis of the cylinder is normal to the target and passes through the target center. The long axis of the cylinder is bisected by a vehicle vertical longitudinal plane passing through the theoretical point of impact with the countermeasure.

S8 *Phase-in Schedule for Vehicle Certification.*

S8.1 *Vehicles manufactured on or after September 1, 2013 and before September 1, 2016.* At anytime during the production years ending August 31, 2014, August 31, 2015, and August 31, 2016, each manufacturer shall, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles (by make, model and vehicle identification number) that have been certified as complying with this standard. The manufacturer's designation of a vehicle as a certified vehicle is irrevocable.

S8.2 *Vehicles manufactured on or after September 1, 2013 and before September 1, 2014.* Subject to S8.9, for vehicles manufactured on or after September 1, 2013 and before September 1, 2014, the number of vehicles complying with S4.2 shall be not less than 25 percent of:

(a) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(b) The manufacturer's production in the current production year.

S8.3 *Vehicles manufactured on or after September 1, 2014 and before September 1, 2015.* Subject to S8.9, for vehicles manufactured on or after September 1, 2014 and before September 1, 2015, the number of vehicles complying with S4.2 shall be not less than 50 percent of:

(a) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(b) The manufacturer's production in the current production year.

S8.4 *Vehicles manufactured on or after September 1, 2015 and before September 1, 2016.* Subject to S8.9, for vehicles manufactured on or after September 1, 2015 and before September 1, 2016, the number of vehicles complying with S4.2 shall be not less than 75 percent of:

(a) The manufacturer's average annual production of vehicles manufactured in the three previous production years; or

(b) The manufacturer's production in the current production year.

S8.5 *Vehicles manufactured on or after September 1, 2016 and before September 1, 2017.* Subject to S8.9, for vehicles manufactured on or after September 1, 2016 and before September 1, 2017, the number of vehicles complying with S4.2 shall be not less than 100 percent of the manufacturer's production in the current production year.

8.6 *Vehicles produced by more than one manufacturer.* For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S8.1 through S8.4, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S8.7.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S8.7 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S8.5.

S8.8 For the purposes of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S8, do not count any vehicle that is excluded by this standard from the requirements.

S8.9 Calculation of complying vehicles.

(a) For the purposes of calculating the vehicles complying with S8.2, a manufacturer may count a vehicle if it is manufactured on or after March 1, 2011 but before September 1, 2014.

(b) For purposes of complying with S8.3, a manufacturer may count a vehicle if it—

(1) Is manufactured on or after March 1, 2011 but before September 1, 2015 and,

(2) Is not counted toward compliance with S8.2.

(c) For purposes of complying with S8.4, a manufacturer may count a vehicle if it—

(1) Is manufactured on or after March 1, 2011 but before September 1, 2016 and,

(2) Is not counted toward compliance with S8.2 or S8.3.

(d) For purposes of complying with S8.5, a manufacturer may count a vehicle if it—

(1) Is manufactured on or after March 1, 2011 but before September 1, 2017 and,

(2) Is not counted toward compliance with S8.2, S8.3, or S8.4.

(e) For the purposes of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer, each vehicle that is excluded from having to meet this standard is not counted.

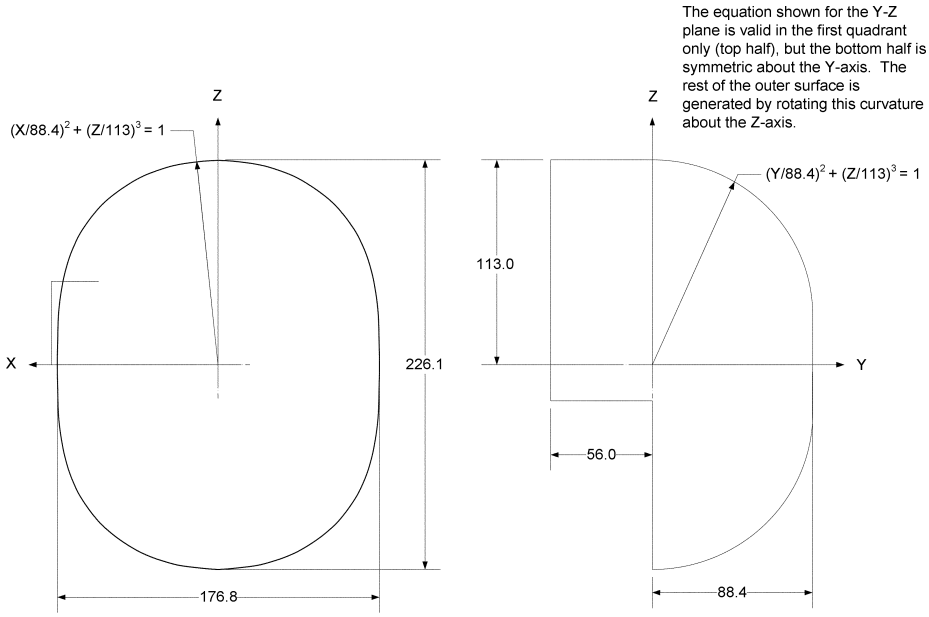


Figure 1 – Ejection Headform Face. All dimensions are millimeters.

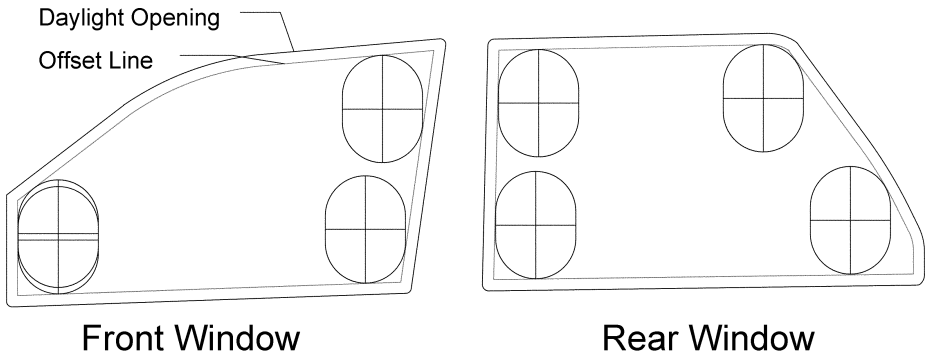


Figure 2

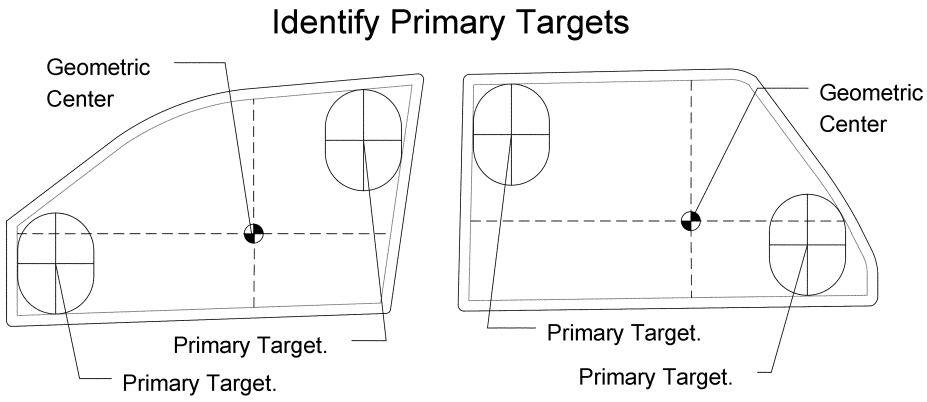


Figure 3

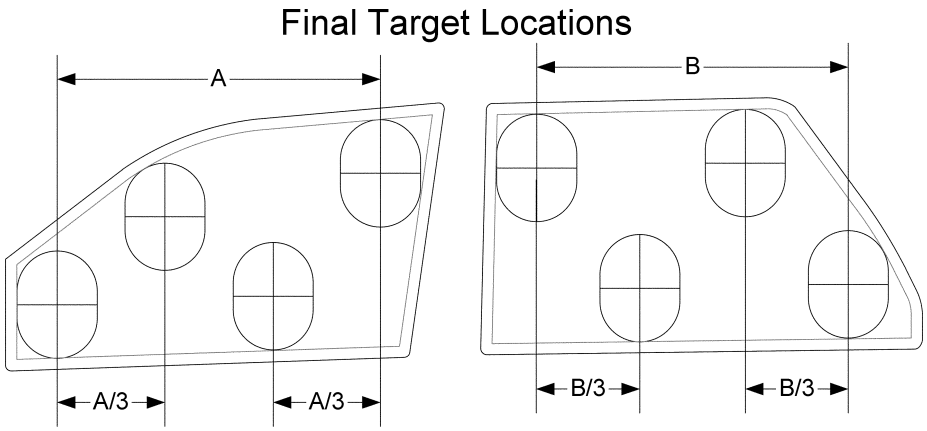


Figure 4

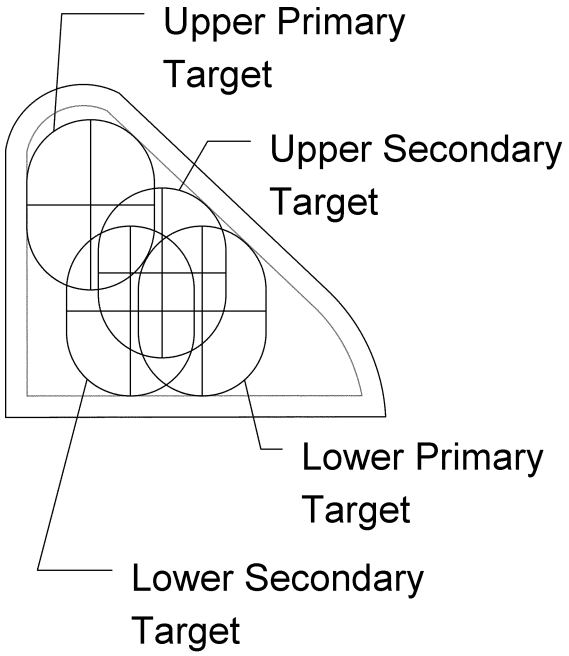

Upper Primary Target
Upper Secondary Target
Lower Primary Target
Lower Secondary Target

Figure 5

Facing Left Side of Vehicle
Target Orientation and Minimum Distance Between X and Z Axes of Targets

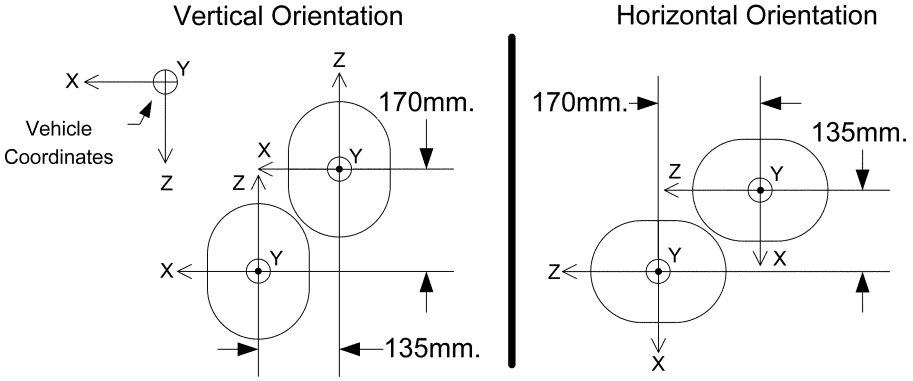


Figure 5a

Facing Right Side of Vehicle
Target Orientation and Minimum Distance Between X and Z Axes of Targets

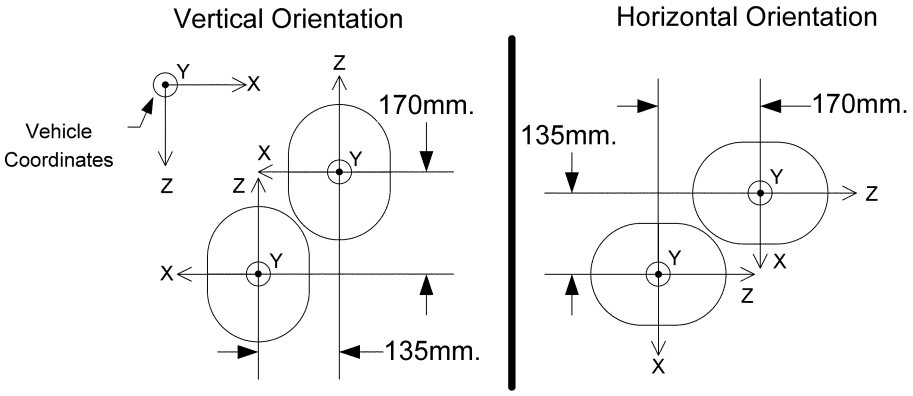


Figure 5b

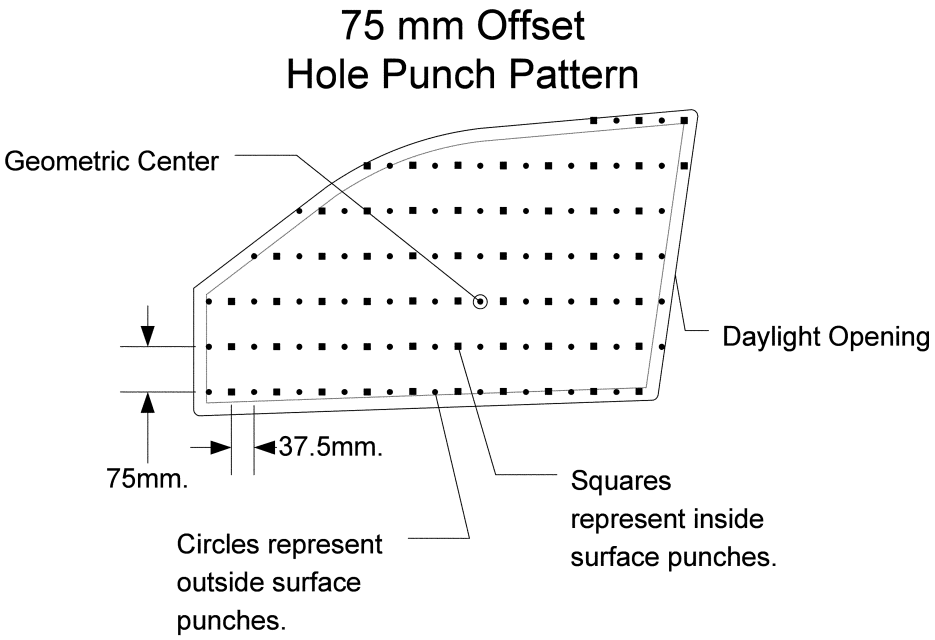


Figure 6

[76 FR 3296, Jan. 19, 2011; 76 FR 10524, Feb. 25, 2011, as amended at 78 FR 55165, Sept. 9, 2013; 85 FR 85535, Dec. 29, 2020; 87 FR 18599, Mar. 30, 2022]

§571.227 Standard No. 227; Bus rollover structural integrity.

S1. *Scope*. This standard establishes performance requirements for bus rollover structural integrity.

S2. *Purpose*. The purpose of this standard is to reduce death and injuries resulting from the structural collapse of the bus body structure in rollover crashes and from partial and complete ejections through emergency exits opening in such crashes.

S3. *Application*.

(a) Subject to S3(b), this standard applies to:

(1) Over-the-road buses; and

(2) Buses that are not over-the-road buses, and that have a gross vehicle weight rating (GVWR) greater than 11,793 kilograms (26,000 pounds).

(b) This standard does not apply to:

(1) School buses, school bus derivative buses, transit buses, and prison buses; and

(2) Buses with 7 or fewer designated seating positions rearward of the driver's seating position that are forward-facing or can convert to forward-facing without the use of tools.

S4. *Definitions*.

Occupant compartment means a space within the vehicle interior intended for driver and passenger use, excluding any space occupied by fixed appliances such as bars, kitchenettes, or toilets.

Over-the-road bus means a bus characterized by an elevated passenger deck located over a baggage compartment.

Prison bus means a bus manufactured for the purpose of transporting persons subject to involuntary restraint or confinement and has design features consistent with that purpose.

School bus is defined in §571.3.

School bus derivative bus means a bus that meets Federal motor vehicle safety standards for school buses regarding emergency exits (§571.217), rollover protection (§571.220), bus body joint

strength (§ 571.221), and fuel system integrity (§ 571.301).

Stop-request system means a vehicle-integrated system for passenger to use to signal to a vehicle operator that they are requesting a stop.

Survival space means all points within a three-dimensional space in the occupant compartment as defined within the following volume:

(1) The front boundary of the survival space is a transverse vertical plane forward of the most forward seat (whether passenger, or driver seat) when the seat back is in the manufacturer's nominal design riding position. This transverse vertical plane is:

(i) For a forward-facing seat, 600 millimeters (mm) in front of the forward most point on the longitudinal centerline of the front surface of the seat back when the seat is in its forward most position;

(ii) For a rearward-facing seat, through the most forward point (relative to the vehicle) on the longitudinal centerline of the seat back when the seat is in its forward most position with respect to the vehicle;

(iii) For a side-facing seat, through the most forward point (relative to the vehicle) on the seat, including the seat back, seat arm rest, and seat cushion.

(2) The rear boundary of the survival space is the inside surface of the rear wall of the occupant compartment of the vehicle.

(3) The outer boundary of the survival space at any transverse cross section between, or at the front and rear boundaries, is defined on each side of the vehicle by the occupant compartment floor and the following three line segments (see Figure 1 of this section, provided for illustration purposes only):

(i) Segment 1 extends vertically from the floor to an end point that is 500 mm above the floor and 150 mm inboard of the side wall.

(ii) Segment 2 starts at the end point of Segment 1. The end point of Segment 2 is 750 mm vertically above and 250 mm horizontally inboard of the end point of Segment 1.

(iii) Segment 3 is a horizontal line that starts at the end point of Segment 2 and ends at the vertical longitudinal center plane of the vehicle.

Transit bus means a bus that is equipped with a stop-request system sold for public transportation provided by, or on behalf of, a Federal, State, or local government and that is not an over-the-road bus.

S5. *Requirements.* When tested under the conditions in S6 and the test procedures specified in S7, each bus shall meet the requirements in S5.1 and S5.2.

S5.1 *Survival space intrusion.* No part of the vehicle that is outside the survival space shall intrude into the survival space during the movement of the tilting platform or resulting from impact of the vehicle on the impact surface, except as provided below in this paragraph.

(a) Items separated from the vehicle and with a mass less than 60.0 grams that enter the survival space will not be considered for this evaluation of survival space intrusion.

(b) Portions of a bus over which there is not a permanent roof, such as the upper level of an open-top double-decker bus, will not be considered for this evaluation.

S5.2 *Opening of Emergency exits.* Emergency exits shall not open during the movement of the tilting platform or resulting from impact of the vehicle on the impact surface.

S6. *Test conditions.*

S6.1 *Tilting platform.*

S6.1.1 The tilting platform has a top surface that rests horizontally at its initial position and is of sufficient size to fully contact the bottom of the vehicle's tires, as shown in Figure 2 of this section (figure provided for illustration purposes only).

S6.1.2 The top surface of the tilting platform, at its initial position, is 800 ± 20 millimeters (mm) above the impact surface specified in S6.1.6, as shown in Figures 1 and 2 of this section (figures provided for illustration purposes only).

S6.1.3 The axis of rotation of the tilting platform is a maximum of a 100 mm horizontal distance from the edge of the impact surface closest to the platform and a maximum of 100 mm below the horizontal plane at the top surface of the tilting platform as shown in Figure 3 of this section (figure provided for illustration purposes only).

S6.1.4 The tilting platform is equipped with rigid wheel supports on the top surface as illustrated in Figure 3 of this section (figure provided for illustration purposes only). At each vehicle axle, the wheel closest to the platform's axis of rotation is supported. The rigid wheel supports are positioned to make contact with the outboard tire sidewall of the supported wheels with the vehicle positioned as specified in S7(a) to prevent sliding of the vehicle during the test. Each rigid wheel support has the following dimensions:

(a) The height above the top surface of the tilting platform is no greater than two-thirds of the vertical height of the adjacent tire's sidewall.

(b) The width is a minimum of 19 mm.

(c) The length is a minimum of 500 mm.

(d) The top inboard edge has a radius of 10 mm.

S6.1.5 While raising the platform, the tilting platform roll angle, measured at the outside of each wheel farthest from the pivot point, does not differ by more than one degree.

S6.1.6 The impact surface is horizontal, uniform, dry, and smooth concrete. The impact surface covers an area that is large enough to ensure that the vehicle does not strike beyond the impact surface edges.

S6.2 *Vehicle preparation.*

S6.2.1 The vehicle's tires are inflated to the manufacturer's recommended tire pressure.

S6.2.2 Test equipment may be attached securely to the bus structure such that the equipment does not break away from the bus structure from the time the tilting platform begins movement to after the vehicle comes to rest on the impact surface.

S6.2.3 Fixed seats may be removed or adjustable seats repositioned for the installation of test equipment in the survival space. Ballast of any weight up to the weight of the removed seat and 68 kg per designated seating position may be secured to the bus floor. The ballasts are not placed farther forward than the forward most point of the vehicle seat immediately in front of the removed seat, and the ballasts are not placed farther rearward than the rear most point of the vehicle seat immediately behind the removed seat.

S6.2.4 The fuel tank is filled to any level from 90 to 95 percent of capacity. All other vehicle fluids are filled to any level from 90 to 95 percent of capacity. Fluids may be substituted if the weight of the original fluid is maintained.

S6.2.5 *Ballasting.* The vehicle is loaded to any weight up to and including the GVWR. Up to 68 kilograms (150 pounds) of ballast is installed at all designated seating positions that are equipped with occupant restraints. The ballast is placed on the top of each seat cushion and attached securely to the seat frame such that it does not break away from the seat from the time the tilting platform begins movement to after the vehicle comes to rest on the impact surface.

S7 *Rollover structural integrity test procedure.* Each vehicle shall meet the requirements of S5 when prepared as specified in S6.2 and tested in accordance with the procedures set forth in paragraphs (a) through (f) of this S7.

(a) Position the vehicle on the tilting platform as illustrated in the examples of Figures 2 and 3 of this section with its longitudinal centerline parallel to the tilt platform's axis of rotation, the right or left side facing the impact surface at NHTSA's option, and with the outboard tire sidewall at the widest axle within 100 mm of the axis of rotation. (Figures provided for illustration purposes only.)

(b) Apply the vehicle parking brakes.

(c) Attach a rigid wheel support to the tilting platform at each axle of the vehicle so that it contacts the outboard tire sidewall of the wheel closest to the impact surface.

(d) Block the suspension system of the vehicle to be within ±25 mm of the normal riding attitude as loaded in S6.2.5.

(e) Vehicle windows, doors, and emergency exits are fully closed and latched but not locked.

(f) Tilt the vehicle at a rate not to exceed 5 degrees/second until it starts to rollover on its own.

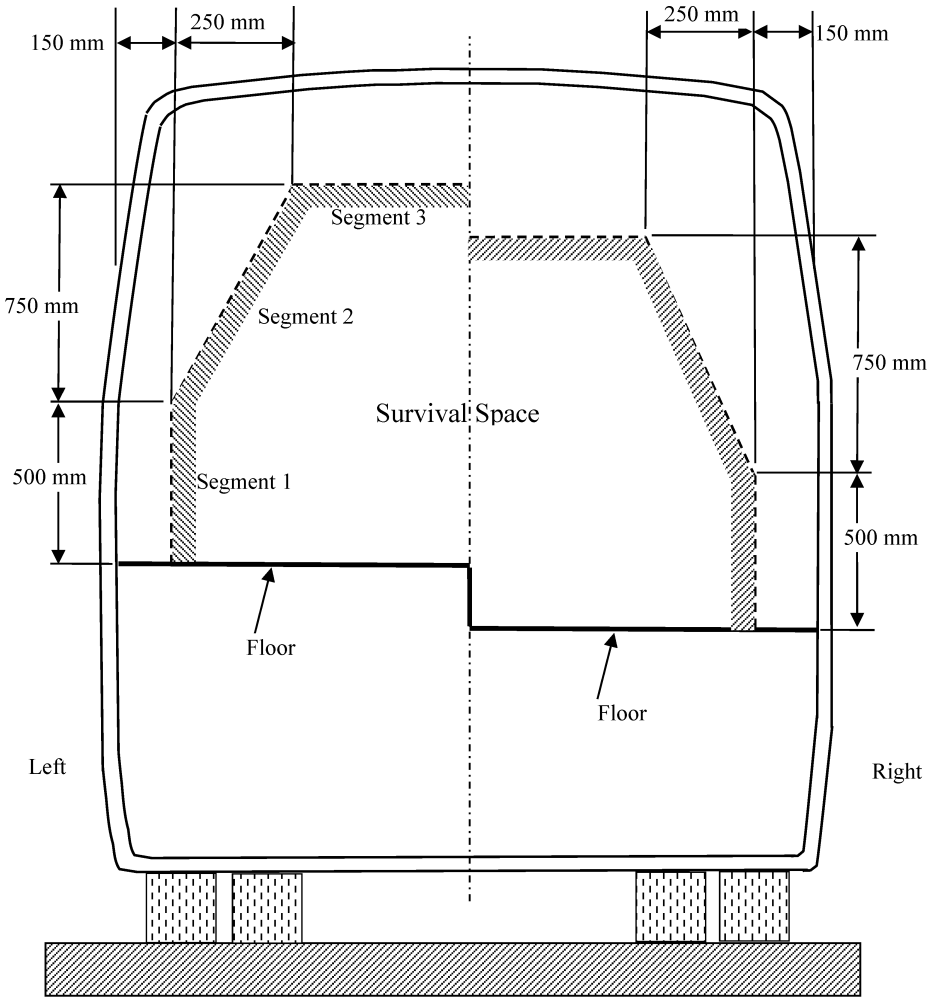


Figure 1 to § 571.227: Survival Space
(Rear View - For Illustration Purposes)

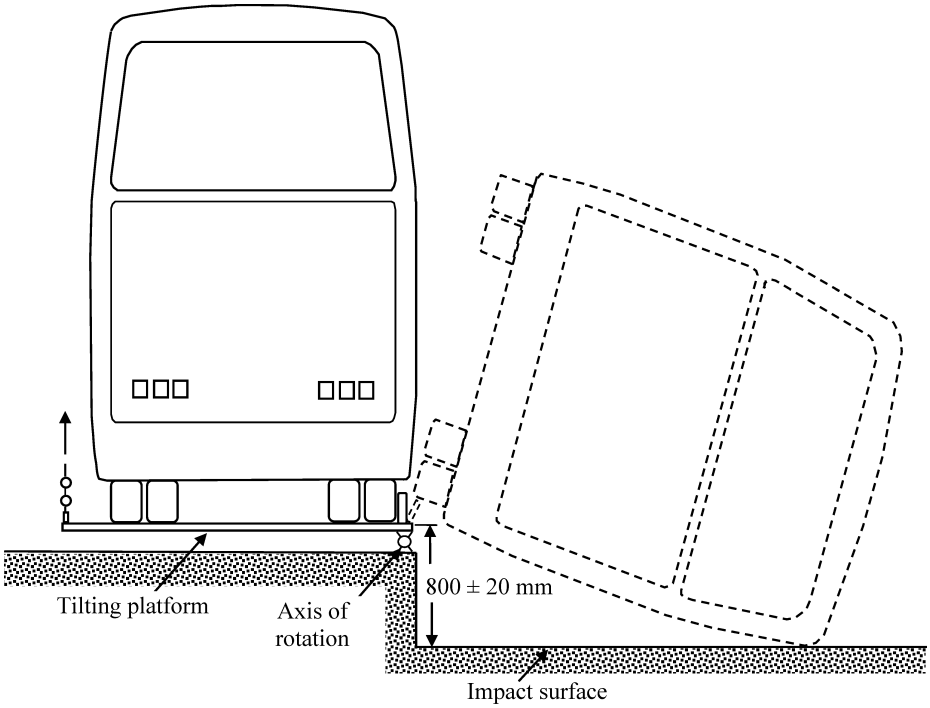


Figure 2 to § 571.227: Vehicle on Tilting Platform (Rear View – For Illustration Purposes)

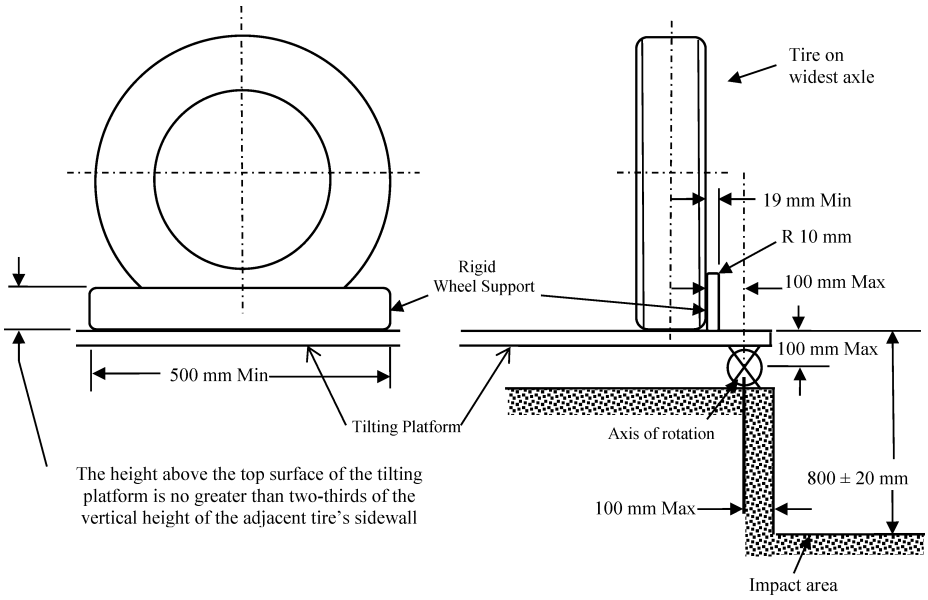


Figure 3 to § 571.227: Axis of Rotation (For Illustration Purposes)

[86 FR 74302, Dec. 29, 2021, as amended at 88 FR 77532, Nov. 13, 2023]

§ 571.301 Standard No. 301; Fuel system integrity.

S1. *Scope.* This standard specifies requirements for the integrity of motor vehicle fuel systems.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries occurring from fires that result from fuel spillage during and after motor vehicle crashes, and resulting from ingestion of fuels during siphoning.

S3. *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses that have a GVWR of 4,536 kg or less and use fuel with a boiling point above 0 °C, and to school buses that have a GVWR greater than 4,536 kg and use fuel with a boiling point above 0 °C.

S4. *Definition. Fuel spillage* means the fall, flow, or run of fuel from the vehicle but does not include wetness resulting from capillary action.

S5. *General requirements.*

S5.1 *Passenger cars, and multipurpose passenger vehicles, trucks, and buses with a GVWR of 10,000 pounds or less.* Each passenger car and each multipurpose passenger vehicle, truck, and bus with a GVWR of 10,000 pounds or less shall meet the requirements of S6.1 through S6.4. Each of these types of vehicles that is manufactured to use alcohol fuels shall also meet the requirements of S6.6.

S5.2 [Reserved]

S5.3 [Reserved]

S5.4 *Schoolbuses with a GVWR greater than 10,000 pounds.* Each schoolbus with a GVWR greater than 10,000 pounds shall meet the requirements of S6.5. Each schoolbus with a GVWR greater than 10,000 pounds that is manufactured to use alcohol fuels shall meet the requirements of S6.6.

S5.5 *Fuel spillage; Barrier crash.* Fuel spillage in any fixed or moving barrier crash test shall not exceed 28 g from impact until motion of the vehicle has ceased, and shall not exceed a total of 142 g in the 5-minute period following

cessation of motion. For the subsequent 25-minute period, fuel spillage during any 1 minute interval shall not exceed 28 g.

S5.6 *Fuel spillage; rollover.* Fuel spillage in any rollover test, from the onset of rotational motion, shall not exceed a total of 142 g for the first 5 minutes of testing at each successive 90° increment. For the remaining test period, at each increment of 90° fuel spillage during any 1 minute interval shall not exceed 28 g.

S5.7. *Alcohol fuel vehicles.* Each vehicle manufactured to operate on an alcohol fuel (e.g., methanol, ethanol) or a fuel blend containing at least 20 percent alcohol fuel shall meet the requirements of S6.6.

S6. *Test requirements.* Each vehicle with a GVWR of 4,536 kg or less shall be capable of meeting the requirements of any applicable barrier crash test followed by a static rollover, without alteration of the vehicle during the test sequence. A particular vehicle need not meet further requirements after having been subjected to a single barrier crash test and a static rollover test. Where manufacturer options are specified in this standard, the manufacturer must select an option not later than the time it certifies the vehicle and may not thereafter select a different option for that vehicle. Each manufacturer must, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S6.1 *Frontal barrier crash.* When the vehicle travelling longitudinally forward at any speed up to and including 48 km/h impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at any angle up to 30° in either direction from the perpendicular to the line of travel of the vehicle, with 50th-percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208, under the applicable conditions of S7., fuel spillage shall not exceed the limits of S5.5.

S6.2 *Rear moving barrier crash.* (a) *Vehicles manufactured before September 1, 2006.* When the vehicle is impacted from the rear by the barrier specified in S7.3(a) of this standard moving at 48 km/h, with 50th percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position, under the applicable conditions of S7, fuel spillage must not exceed the limits of S5.5.

(b) *Vehicles manufactured on or after September 1, 2006.* When the vehicle is impacted from the rear by a moving deformable barrier 80 ±1.0 km/h with a 70 percent overlap, with 50th percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position, under the applicable conditions of S7, fuel spillage must not exceed the limits of S5.5.

(c) *Small volume manufacturers.* Notwithstanding S6.2(b) of this standard, vehicles manufactured on or after September 1, 2004 and before September 1, 2008 by a manufacturer that produces fewer than 5,000 vehicles annually for sale in the United States may meet the requirements of S6.2(a). Vehicles manufactured on or after September 1, 2008 by small volume manufacturers must meet the requirements of S6.2(b).

S6.3 *Side moving barrier crash.* (a) *Vehicles manufactured before September 1, 2004.* When the vehicle is impacted laterally on either side by a barrier moving at 32 km/h with 50th percentile test dummies as specified in part 572 of this chapter at positions required for testing to Standard No. 208 (49 CFR 571.208), under the applicable conditions of S7, fuel spillage must not exceed the limits of S5.5.

(b) *Vehicles manufactured on or after September 1, 2004.* When the vehicle is impacted laterally on either side by a moving deformable barrier at 53 ± 1.0 km/h with the appropriate 49 CFR part 572 test dummies specified in 571.214 at positions required for testing by S7.1.1, S7.2.1, or S7.2.2 of Standard 214, under the applicable conditions of S7 of this standard, fuel spillage shall not exceed the limits of S5.5 of this standard.

(c)(1) Notwithstanding S6.3(b) of this standard, vehicles having a GVWR greater than 6,000 lb (2,722 kg) may meet S6.3(a) instead of S6.3(b) of this standard until September 1, 2005.

(2) Notwithstanding S6.3(b) of this standard, vehicles having a GVWR greater than 6,000 lb (2,722 kg) manufactured on or after September 1, 2005 must meet the requirements of S6.3(b) of this standard unless they are excluded from S6.3(b) under the phase-in specified in this paragraph. Excluded vehicles must meet the requirements of S6.3(a) of this standard. For vehicles having a GVWR greater than 6,000 lb (2,722 kg) manufactured on or after September 1, 2005 and before September 1, 2006, the number of vehicles complying with S6.3(b) shall be not less than 90 percent of:

(i) The manufacturer's average annual production of vehicles with a GVWR greater than 6,000 lb (2,722 kg) manufactured on or after September 1, 2002 and before September 1, 2005; or

(ii) The manufacturer's production of vehicles with a GVWR greater than 6,000 lb (2,722 kg) on or after September 1, 2004 and before September 1, 2005.

(iii) Vehicles that have a GVWR greater than 6,000 lb (2,722 kg) and that are manufactured on or after September 1, 2006 must meet the requirements of S6.3(b) of this standard.

(3) *Vehicles produced by more than one manufacturer*. For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S6.3(c)(2)(i) and S6.3(c)(2)(ii) of this standard, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S6.3(c)(4).

(i) A vehicle which is imported shall be attributed to the importer.

(ii) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

(4) A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR 568.6, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S6.3(c)(3).

(d) Notwithstanding S6.3(b) of this standard, vehicles with a GVWR of 6,000 lb (2,722 kg) or less that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with part 567 of this chapter may meet S6.3(a) of this standard until September 1, 2005. Vehicles with a GVWR of 6,000 lb (2,722 kg) or less that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with part 567 of this chapter and that are manufactured on or after September 1, 2005 must meet the requirements of S6.3(b)

(e) Notwithstanding S6.3(b) and (c) of this standard, vehicles with a GVWR greater than 6,000 lb (2,722 kg) that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with part 567 of this chapter may meet S6.3(a) of this standard until September 1, 2006. Vehicles with a GVWR greater than 6,000 lb (2,722 kg) that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with part 567 of this chapter and that are manufactured on or after September 1, 2006 must meet the requirements of S6.3(b).

S6.4 *Static rollover*. When the vehicle is rotated on its longitudinal axis to each successive increment of 90°, following an impact crash of S6.1, S6.2, or S6.3, fuel spillage shall not exceed the limits of S5.6.

S6.5 *Moving contoured barrier crash*. When the moving contoured barrier assembly traveling longitudinally forward at any speed up to and including 48 km/h impacts the test vehicle (school bus with a GVWR exceeding 4,536 kg) at any point and angle, under the applicable conditions of S7.1 and S7.5, fuel spillage shall not exceed the limits of S5.5.

S6.6 *Anti-siphoning test for alcohol fuel vehicles*. Each vehicle shall have means that prevent any hose made of vinyl plastic or rubber, with a length of not less than 1200 millimeters (mm) and an outside diameter of not less than 5.2 mm, from contacting the level

surface of the liquid fuel in the vehicle's fuel tank or fuel system, when the hose is inserted into the filler neck attached to the fuel tank with the fuel tank filled to any level from 90 to 95 percent of capacity.

S7. *Test conditions.* The requirements of S5.1 through S5.6 and S6.1 through S6.5 shall be met under the following conditions. Where a range is specified, the vehicle must be capable of meeting the requirements at all points within the range.

S7.1 *General test conditions.* The following conditions apply to all tests.

S7.1.1 The fuel tank is filled to any level from 90 to 95 percent of capacity with Stoddard solvent, having the physical and chemical properties of type 1 solvent, Table I of ASTM D484–71 (incorporated by reference, see §571.5).

S7.1.2 The fuel system other than the fuel tank is filled with Stoddard solvent to its normal operating level.

S7.1.3 In meeting the requirements of S6.1 through S6.3, if the vehicle has an electrically driven fuel pump that normally runs when the vehicle's electrical system is activated, it is operating at the time of the barrier crash.

S7.1.4 The parking brake is disengaged and the transmission is in neutral, except that in meeting the requirements of S6.5 the parking brake is set.

S7.1.5 Tires are inflated to manufacturer's specifications.

S7.1.6 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) Except as specified in S7.1.1, a passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the necessary test dummies as specified in S6., restrained only by means that are installed in the vehicle for protection at its seating position.

(b) Except as specified in S7.1.1, a multipurpose passenger vehicle, truck, or bus with a GVWR of 4,536 kg or less is loaded to its unloaded vehicle weight, plus the necessary test dummies as specified in S6, plus 136 kg or its rated cargo and luggage capacity weight, whichever is less, secured in the load carrying area and distributed as nearly as possible in proportion to its GAWR. For the purpose of this standard, unloaded vehicle weight does not include the weight of work-performing accessories. Each dummy is restrained only by means that are installed in the vehicle for protection at its seating position.

(c) Except as specified in S7.1.1, a school bus with a GVWR greater than 4,536 kg is loaded to its unloaded vehicle weight, plus 54 kg of unsecured mass at each designated seating position.

S7.2 *Side moving barrier test conditions.* (a) *Vehicles manufactured before September 1, 2004.* The side moving barrier crash test conditions are those specified in S8.2 of Standard No. 208 (49 CFR 571.208).

(b) *Vehicles manufactured on or after September 1, 2004.* The side moving deformable barrier crash test conditions are those specified in S8 of Standard 214 (49 CFR 571.214).

S7.3 *Rear moving barrier test conditions.* (a) *Vehicles manufactured before September 1, 2006.* The rear moving barrier test conditions are those specified in S8.2 of Standard No. 208 (49 CFR 571.208), except for the positioning of the barrier and the vehicle. The barrier and test vehicle are positioned so that at impact—

(1) The vehicle is at rest in its normal attitude;

(2) The barrier is traveling at 48 km/h with its face perpendicular to the longitudinal centerline of the vehicle; and

(3) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface coincides with the longitudinal centerline of the vehicle.

(b) *Vehicles manufactured on or after September 1, 2006.* The rear moving deformable barrier is the same as that shown in Figure 2 of Standard No. 214 (49 CFR 571.214) and specified in 49 CFR part 587, except as otherwise specified in paragraph S7.3 (b). The barrier and test vehicle are positioned so that at impact—

(1) The vehicle is stationary;

(2) The deformable face of the barrier is mounted on the barrier 50 mm (2 inches) lower than the height from the

ground specified in Figure 2 of Standard No. 214 (49 CFR 571.214) (All dimensions from the ground in Figure 2, Front View should be reduced by 50 mm (2 inches.));

(3) The barrier is traveling 80 ±1.0 km/h; and

(4) The barrier impacts the test vehicle with the longitudinal centerline of the vehicle parallel to the line of travel and perpendicular to the barrier face within a tolerance of ±5 degrees. The test vehicle and barrier face are aligned so that the barrier strikes the rear of the vehicle with 70 percent overlap toward either side of the vehicle. So aligned, the barrier face fully engages one half of the rear of the vehicle and partially engages the other half. At impact, the vehicle's longitudinal centerline is located inboard either of the side edges of the barrier by a distance equal to 20 percent of the vehicle's width ±50 mm (*see* Figure 3). The vehicle's width is the maximum dimension measured across the widest part of the vehicle, including bumpers and molding, but excluding such components as exterior mirrors, flexible mud flaps, marker lamps, and dual rear wheel configurations.

S7.4 *Static rollover test conditions.* The vehicle is rotated about its longitudinal axis, with the axis kept horizontal, to each successive increment of 90°, 180°, and 270° at a uniform rate, with 90° of rotation taking place in any time interval from 1 to 3 minutes. After reaching each 90° increment the vehicle is held in that position for 5 minutes.

S7.5 *Moving contoured barrier test conditions.* The following conditions apply to the moving contoured barrier crash test.

S7.5.1 The moving barrier, which is mounted on a carriage as specified in Figure 1, is of rigid construction, symmetrical about a vertical longitudinal plane. The contoured impact surface, which is 629 mm high and 1,981 mm wide, conforms to the dimensions shown in Figure 2, and is attached to the carriage as shown in that figure. The ground clearance to the lower edge of the impact surface is 133 mm ±13 mm. The wheelbase is 3,048 mm ±50 mm.

S7.5.2 The moving contoured barrier, including the impact surface, supporting structure, and carriage, has a mass of 1,814 kg ±23 kg with the mass distributed so that 408 kg ±11 kg is at each rear wheel and 499 kg ±11 kg is at each front wheel. The center of gravity is located 1,372 mm ±38 mm rearward of the front wheel axis, in the vertical longitudinal plane of symmetry, 401 mm ±13 mm above the ground.

S7.5.3 The moving contoured barrier has a solid nonsteerable front axle and fixed rear axle attached directly to the frame rails with no spring or other type of suspension system on any wheel. (The moving barrier assembly is equipped with a braking device capable of stopping its motion.)

S7.5.4 The concrete surface upon which the vehicle is tested is level, rigid, and of uniform construction, with a skid number of 75 when measured in accordance with ASTM E274–65T (incorporated by reference, see § 571.5) at 64 km/h, omitting water delivery as specified in paragraph 7.1 of that method.

S7.5.5 The barrier assembly is released from the guidance mechanism immediately prior to impact with the vehicle.

S7.6 The moving barrier assemblies specified in S7.2, S7.3 and S7.5 are equipped with P205/75R15 pneumatic tires inflated to 200 kPa ±21 kPa.

S8 *Phase-In schedule.*

S8.1 *Rear impact test upgrade.* (a) *Vehicles manufactured on or after September 1, 2006 and before September 1, 2007.* For vehicles manufactured on or after September 1, 2006, and before September 1, 2007, the number of vehicles complying with S6.2(b) of this standard must not be less than 40 percent of:

(1) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2004, and before September 1, 2007; or

(2) The manufacturer's production on or after September 1, 2006, and before September 1, 2007.

(b) *Vehicles manufactured on or after September 1, 2007 and before September 1, 2008.* For vehicles manufactured on or after September 1, 2007 and before September 1, 2008, the number of vehicles complying with S6.2(b) of this standard must not be less than 70 percent of:

(1) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2005, and before September 1, 2008; or

(2) The manufacturer's production on or after September 1, 2007, and before September 1, 2008.

(c) *Vehicles manufactured on or after September 1, 2008.* For vehicles manufactured on or after September 1, 2008, the number of vehicles complying with S6.2(b) of this standard must be 100 percent of the manufacturer's production during that period.

S8.2 *Vehicles manufactured in two or more stages.* A final stage manufacturer or alterer may, at its option, comply with the requirements set forth in S8.2.1 and S8.2.2.

S8.2.1 Vehicles manufactured on or after September 1, 2006 and before September 1, 2009 are not required to comply with the requirements specified in S6.2(b) of this standard.

S8.2.2 Vehicles manufactured on or after September 1, 2009 must comply with the requirements specified in S6.2(b) of this standard.

S8.3 *Vehicles produced by more than one manufacturer.*

S8.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S8.1, a vehicle produced by more than one manufacturer must be attributed to a single manufacturer as follows, subject to S8.3.2:

(a) A vehicle that is imported must be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, must be attributed to the manufacturer that markets the vehicle.

S8.3.2 A vehicle produced by more than one manufacturer must be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 586, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S8.3.1.

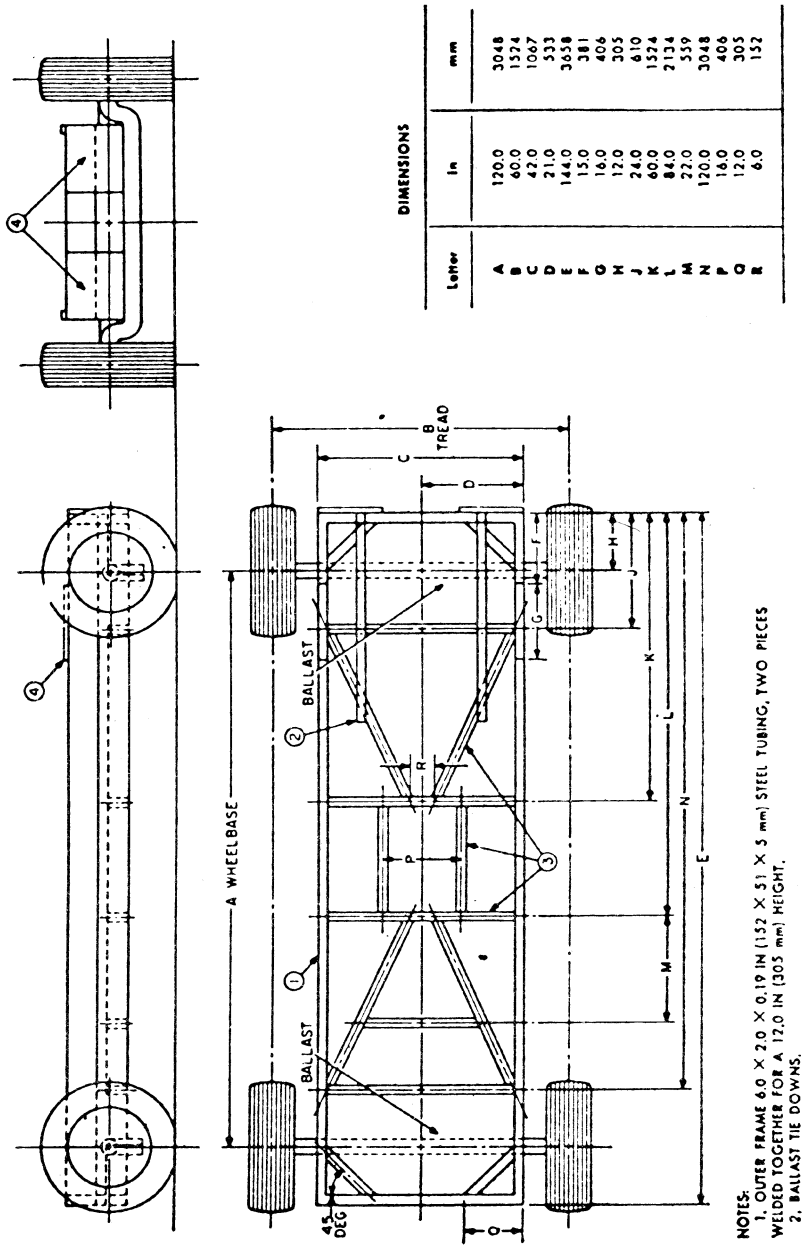
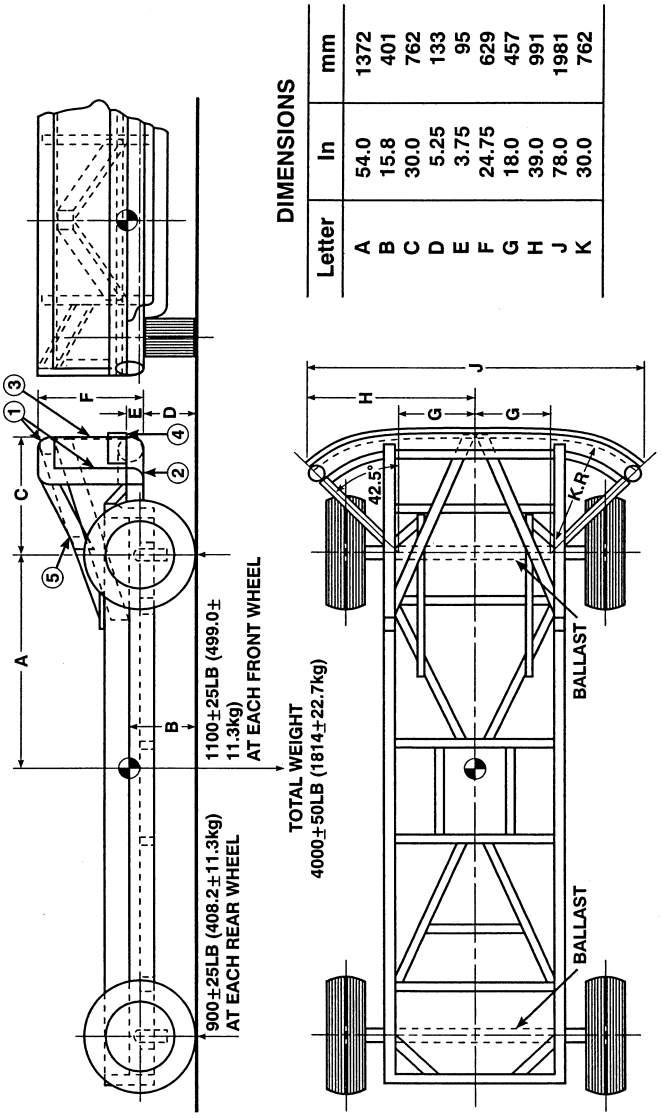


FIG. 1–COMMON CARRIAGE FOR MOVING BARRIERS



NOTES:

1. UPPER FRAME 4.0 IN DIA X 0.25 IN WALL (102 mm DIA X 6 mm WALL) STEEL TUBING (THREE SIDES).
2. LOWER FRAME 6.0 IN DIA X 0.50 IN WALL (152 mm DIA X 13 mm WALL) STEEL TUBING.
3. FACE PLATE 0.75 IN (19 mm) THICK COLD ROLLED STEEL.
4. LEADING EDGE 1.0 X 4.0 IN (25 X 102 mm) STEEL BAND, SHARP EDGES BROKEN.
5. ALL INNER REINFORCEMENTS 4.0 X 2.0 X 0.19 IN (102 X 51 X 5 mm) STEEL TUBING.

Fig. 2 – Common Carriage with Contoured Impact Surface Attached

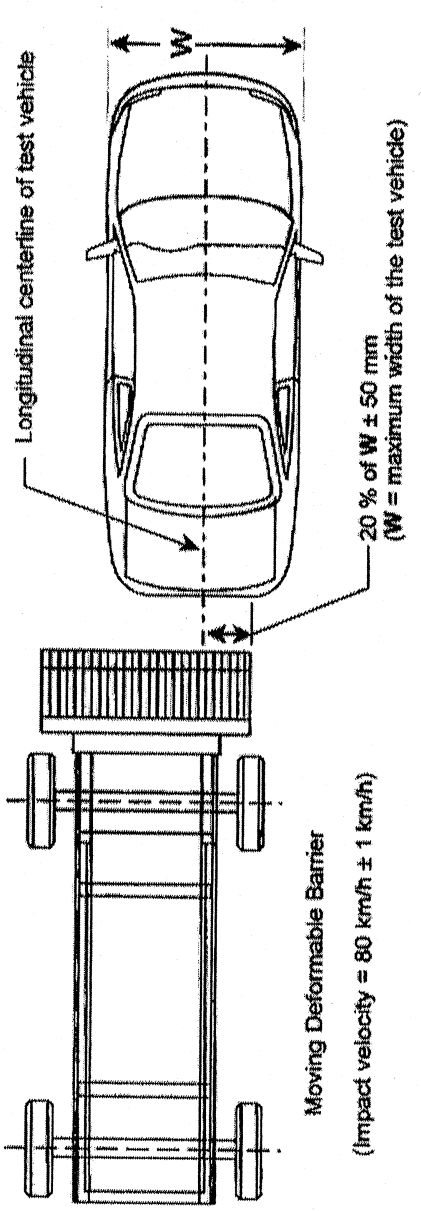


FIGURE 3 – MOVING DEFORMABLE BARRIER REAR IMPACT - 70 % OVERLAP

[40 FR 48353, Oct. 15, 1975]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting § 571.301, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.govinfo.gov*.

§ 571.302 Standard No. 302; Flammability of interior materials.

S1. *Scope.* This standard specifies burn resistance requirements for materials used in the occupant compartments of motor vehicles.

S2. *Purpose.* The purpose of this standard is to reduce the deaths and injuries to motor vehicle occupants caused by vehicle fires, especially those originating in the interior of the vehicle from sources such as matches or cigarettes.

S3. *Application.* This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3A. *Definitions. Occupant compartment air space* means the space within the occupant compartment that normally contains refreshable air.

S4. *Requirements.*

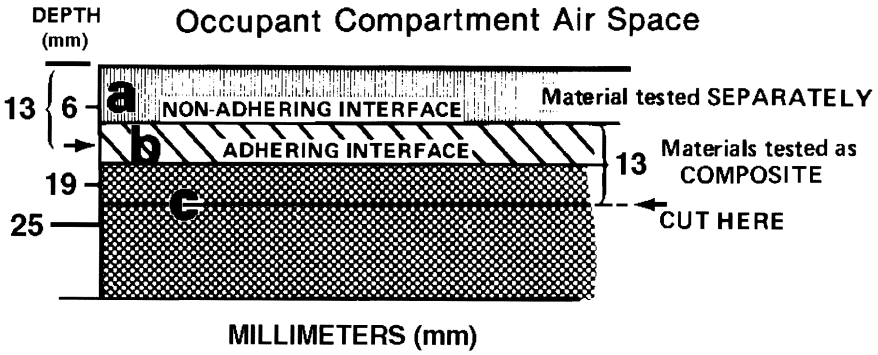
S4.1 The portions described in S4.2 of the following components of vehicle occupant compartments shall meet the requirements of S4.3: Seat cushions, seat backs, seat belts, headlining, convertible tops, arm rests, all trim panels including door, front, rear, and side panels, compartment shelves, head restraints, floor coverings, sun visors, curtains, shades, wheel housing covers, engine compartment covers, mattress covers, and any other interior materials, including padding and crash-deployed elements, that are designed to absorb energy on contact by occupants in the event of a crash.

S4.1.1 [Reserved]

S4.2 Any portion of a single or composite material which is within 13 mm of the occupant compartment air space shall meet the requirements of S4.3.

S4.2.1 Any material that does not adhere to other material(s) at every point of contact shall meet the requirements of S4.3 when tested separately.

S4.2.2 Any material that adheres to other materials at every point of contact shall meet the requirements of S4.3 when tested as a composite with the other material(s).



Occupant Compartment Air Space
All Dimensions in Millimeters (mm)

Material A has a non-adhering interface with material B and is tested separately. Part of material B is within 13 mm of the occupant compartment air space, and materials B and C adhere at every point of contact; therefore, B and C are tested as a composite. The cut is in material C as shown, to make a specimen 13 mm thick.

S4.3(a) When tested in accordance with S5, material described in S4.1 and S4.2 shall not burn, nor transmit a flame front across its surface, at a rate of more than 102 mm per minute. The requirement concerning transmission

of a flame front shall not apply to a surface created by cutting a test specimen for purposes of testing pursuant to S5.

(b) If a material stops burning before it has burned for 60 seconds from the start of timing, and has not burned more than 51 mm from the point where the timing was started, it shall be considered to meet the burn-rate requirement of S4.3(a).

S5.1 *Conditions.*

S5.1.1 The test is conducted in a metal cabinet for protecting the test specimens from drafts. The interior of the cabinet is 381 mm long, 203 mm deep, and 356 mm high. It has a glass observation window in the front, a closable opening to permit insertion of the specimen holder, and a hole to accommodate tubing for a gas burner. For ventilation, it has a 13 mm clearance space around the top of the cabinet, ten holes in the base of the cabinet, each hole 19 mm in diameter and legs to elevate the bottom of the cabinet by 10 mm, all located as shown in Figure 1.

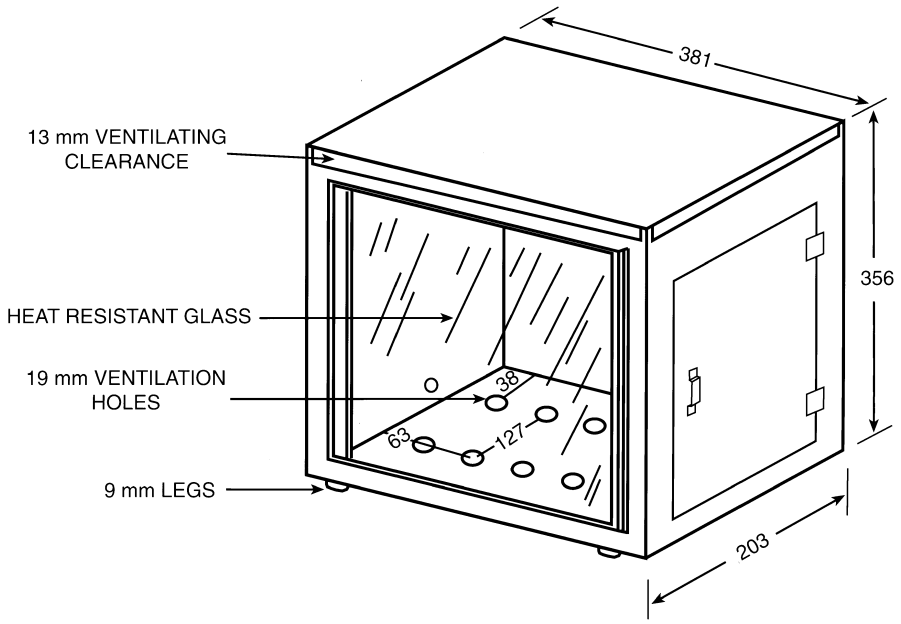


Figure 1
All dimensions in millimeters (mm)

S5.1.2 Prior to testing, each specimen is conditioned for 24 hours at a temperature of 21 °C, and a relative humidity of 50 percent, and the test is conducted under those ambient conditions.

S5.1.3 The test specimen is inserted between two matching U-shaped frames of metal stock 25 mm wide and 10 mm high. The interior dimensions of the U-shaped frames are 51 mm wide by 330 mm long. A specimen that softens and bends at the flaming end so as to cause

erratic burning is kept horizontal by supports consisting of thin, heat-resistant wires, spanning the width of the U-shaped frame under the specimen at 25 mm intervals. A device that may be used for supporting this type of material is an additional U-shaped frame, wider than the U-shaped frame containing the specimen, spanned by 10-mil wires of heat-resistant composition at 25 mm intervals, inserted over the bottom U-shaped frame.

S5.1.4 A bunsen burner with a tube of 10 mm inside diameter is used. The gas adjusting valve is set to provide a flame, with the tube vertical, of 38 mm in height. The air inlet to the burner is closed.

S5.1.5 The gas supplied to the burner has a flame temperature equivalent to that of natural gas.

S5.2 *Preparation of specimens.*

S5.2.1 Each specimen of material to be tested shall be a rectangle 102 mm wide by 356 mm long, wherever possible. The thickness of the specimen is that of the single or composite material used in the vehicle, except that if the material's thickness exceeds 13 mm, the specimen is cut down to that thickness measured from the surface of the specimen closest to the occupant compartment air space. Where it is not possible to obtain a flat specimen because of surface curvature, the specimen is cut to not more than 13 mm in thickness at any point. The maximum available length or width of a specimen is used where either dimension is less than 356 mm or 102 mm, respectively, unless surrogate testing is required under S4.1.1.

S5.2.2 The specimen is produced by cutting the material in the direction that provides the most adverse test results. The specimen is oriented so that the surface closest to the occupant compartment air space faces downward on the test frame.

S5.2.3 Material with a napped or tufted surface is placed on a flat surface and combed twice against the nap with a comb having seven to eight smooth, rounded teeth per 25 mm.

S5.3 *Procedure.*

(a) Mount the specimen so that both sides and one end are held by the U-shaped frame, and one end is even with the open end of the frame. Where the maximum available width of a specimen is not more than 51 mm, so that the sides of the specimen cannot be held in the U-shaped frame, place the specimen in position on wire supports as described in S5.1.3, with one end held by the closed end of the U-shaped frame.

(b) Place the mounted specimen in a horizontal position, in the center of the cabinet.

(c) With the flame adjusted according to S5.1.4, position the bunsen burner and specimen so that the center of the burner tip is 19 mm below the center of the bottom edge of the open end of the specimen.

(d) Expose the specimen to the flame for 15 seconds.

(e) Begin timing (without reference to the period of application of the burner flame) when the flame from the burning specimen reaches a point 38 mm from the open end of the specimen.

(f) Measure the time that it takes the flame to progress to a point 38 mm from the clamped end of the specimen. If the flame does not reach the specified end point, time its progress to the point where flaming stops.

(g) Calculate the burn rate from the formula:

$$B = 60 \times (D/T)$$

Where:

B = Burn rate in millimeters per minute
D = Length the flame travels in millimeters, and
T = Time in seconds for the flame to travel D millimeters.

[36 FR 22902, Dec. 2, 1971, as amended at 40 FR 14319, Mar. 31, 1975; 40 FR 42747, Sept. 16, 1975; 40 FR 56667, Dec. 4, 1975; 63 FR 28954, 28956, May 27, 1998; 63 FR 51003, Sept. 24, 1998]

§ 571.303 Standard No. 303; Fuel system integrity of compressed natural gas vehicles.

S1. *Scope.* This standard specifies requirements for the integrity of motor vehicle fuel systems using compressed natural gas (CNG), including the CNG fuel systems of bi-fuel, dedicated, and dual fuel CNG vehicles.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries occurring from fires that result from fuel leakage during and after motor vehicle crashes.

S3. *Application*. This standard applies to passenger cars, multipurpose passenger vehicles, trucks and buses that have a gross vehicle weight rating (GVWR) of 10,000 pounds or less and use CNG as a motor fuel. This standard also applies to school buses regardless of weight that use CNG as a motor fuel.

S4. *Definitions*.

Bi-fuel CNG vehicle means a vehicle equipped with two independent fuel systems, one of which is designed to supply CNG and the second to supply a fuel other than CNG.

CNG fuel container means a container designed to store CNG as motor fuel onboard a motor vehicle.

CNG fuel system means all components used to store or supply CNG to a vehicle's engine.

Dedicated CNG vehicle means a vehicle equipped with one fuel system and designed to operate on CNG.

Dual-fuel CNG vehicle means a vehicle which is fueled by two fuels simultaneously, one of which is CNG and the second is a fuel other than CNG.

High pressure portion of a fuel system means all the components from and including each CNG fuel container up to, but not including, the first pressure regulator.

Service pressure means the internal pressure of a CNG fuel container when filled to design capacity with CNG at 20 °Celsius (68 °Fahrenheit).

S5. *General requirements*.

S5.1 *Vehicle requirements*.

S5.1.1 *Vehicles with GVWR of 10,000 pounds or less*. Each passenger car, multipurpose passenger vehicle, truck, and bus with a GVWR of 10,000 pounds or less that uses CNG as a motor fuel and that is manufactured on or after September 1, 1995 shall meet the requirements of S6, except S6.4.

S5.1.2 *Schoolbuses with a GVWR greater than 10,000 pounds*. Each schoolbus with a GVWR greater than 10,000 pounds that uses CNG as a motor fuel and that is manufactured on or after September 1, 1995 shall meet the requirements of S6.4.

S5.2 *Fuel system pressure drop: barrier crash*.

(a) For all vehicles, the pressure drop in the high pressure portion of the fuel system, expressed in kiloPascals (kPa), in any fixed or moving barrier crash from vehicle impact through the 60 minute period following cessation of motion shall not exceed:

(1) 1062 kPa (154 psi), or

(2) 895 (T/V_{FS}); whichever is higher

where T is the average temperature of the test gas in degrees Kelvin, stabilized to ambient temperature before testing, where average temperature (T) is calculated by measuring ambient temperature at the start of the test time and then every 15 minutes until the test time of 60 minutes is completed; the sum of the ambient temperatures is then divided by five to yield the average temperature (T); and where V_{FS} is the internal volume in liters of the fuel container and the fuel lines up to the first pressure regulator.

(b) For bi-fuel or dual fuel CNG vehicles, the test requirement in S5.2(a) shall apply to the CNG fuel system, and the test requirement of Standard No. 301 shall apply to the other fuel system, if that standard is applicable.

S5.3 Each CNG vehicle shall be permanently labeled, near the vehicle refueling connection, with the information specified in S5.3.1 and S5.3.2 of this section. The information shall be visible to a person standing next to the vehicle during refueling, in English, and in letters and numbers that are not less than 4.76 mm (3/16 inch) high.

S5.3.1 The statement: ''Service pressure _____ kPa (_____ psig).''

S5.3.2 The statement ''See instructions on fuel container for inspection and service life.''

S5.4 When a motor vehicle is delivered to the first purchaser for purposes other than resale, the manufacturer shall provide the purchaser with a written statement of the information in S5.3.1 and S5.3.2 in the owner's manual, or, if there is no owner's manual, on a one-page document. The information shall be in English and in not less than 10 point type.

S6. *Test requirements: fuel system integrity*. Each vehicle with a GVWR of 10,000 pounds or less shall meet the requirements of any applicable barrier crash test. A particular vehicle need not meet further requirements after having been subjected to a single barrier crash test.

S6.1 *Frontal barrier crash.* When the vehicle traveling longitudinally forward at any speed up to and including 30 mph impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, with 50th percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S6.2 *Rear moving barrier crash.* When the vehicle is impacted from the rear by a barrier moving at any speed up to and including 30 mph, with test dummies as specified in part 572 of this chapter at each front outboard designated seating position, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S6.3 *Lateral moving barrier crash.* When the vehicle is impacted laterally on either side by a barrier moving at any speed up to and including 20 mph with 50th percentile test dummies as specified in part 572 of this chapter at positions required for testing to Standard No. 208, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S6.4 *Moving contoured barrier crash.* When the moving contoured barrier assembly traveling longitudinally forward at any speed up to and including 30 mph impacts the test vehicle (schoolbus with a GVWR exceeding 10,000 pounds) at any point and angle, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S7. *Test conditions.* The requirements of S5 and S6 shall be met under the following conditions. Where a range of conditions is specified, the vehicle must be capable of meeting the requirements at all points within the range.

S7.1 *General test conditions.* The following conditions apply to all tests.

S7.1.1 Each fuel storage container is filled to 100 percent of service pressure with nitrogen, N_2. The gas pressure shall stabilize to ambient temperature before testing may be conducted.

S7.1.2 After each fuel storage container is filled as specified in S7.1.1, the fuel system other than each fuel storage container is filled with nitrogen, N_2, to normal operating pressures. All manual shutoff valves are to be in the open position.

S7.1.3 In meeting the requirements of S6.1 through S6.4, if the vehicle has an electrically driven fuel pump that normally runs when the vehicle's electrical system is activated, it is operating at the time of the barrier crash. If the vehicle has any high pressure electric shutoff valve that is normally open when the electrical system is activated, it is open at the time of the barrier crash. Furthermore, if any electric shutoff valve prevents sensing of system pressure by the pressure transducer when closed, it must be open for both the initial pressure measurement and the pressure measurement 60 minutes after the vehicle ceases motion from impact. Any valve shall be open for a period of one minute to equalize the system pressure.

S7.1.4 The parking brake is disengaged and the transmission is in neutral, except that in meeting the requirements of S6.4, the parking brake is set.

S7.1.5 Tires are inflated to manufacturer's specifications.

S7.1.6 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) A passenger car, with its fuel system filled as specified in S7.1.1 and S7.1.2, is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the necessary test dummies as specified in S6, restrained only by means that are installed in the vehicle for protection at its seating position.

(b) A multipurpose passenger vehicle, truck, or bus with a GVWR of 10,000 pounds or less, whose fuel system is filled as specified in S7.1.1 and S7.1.2, is loaded to its unloaded vehicle weight, plus the necessary test dummies as specified in S6, plus 136.1 kilograms (kg.) (300 pounds (lb.)), or its rated cargo and luggage capacity weight,

whichever is less, secured to the vehicle and distributed so that the weight on each axle as measured at the tire-ground interface is in proportion to its GAWR. Each dummy shall be restrained only by means that are installed in the vehicle for protection at its seating position.

(c) A schoolbus with a GVWR greater than 10,000 pounds, whose fuel system is filled as specified in S7.1.1 and S7.1.2, is loaded to its unloaded vehicle weight, plus 54.4 kg. (120 lb.) of unsecured weight at each designated seating position.

S7.1.7 The ambient temperature is not to vary more than 5.6 °C (10 °F) during the course of the test.

S7.1.8 The pressure drop measurement specified in S5.2 is to be made using a location on the high pressure side of the fuel system in accordance with the vehicle manufacturer's recommendation.

S7.2 *Lateral moving barrier crash test conditions.* The lateral moving barrier crash test conditions are those specified in S8.2 of Standard No. 208, 49 CFR 571.208.

S7.3 *Rear moving barrier test conditions.* The rear moving barrier test conditions are those specified in S8.2 of Standard No. 208, 49 CFR 571.208, except for the positioning of the barrier and the vehicle. The barrier and test vehicle are positioned so that at impact—

(a) The vehicle is at rest in its normal attitude;

(b) The barrier is traveling at any speed up to and including 30 mph with its face perpendicular to the longitudinal centerline of the vehicle; and

(c) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface coincides with the longitudinal centerline of the vehicle.

S7.4 *Moving contoured barrier test conditions.* The moving contoured barrier crash test conditions are those specified in S7.5 of Standard No. 301, 49 CFR 571.301.

[59 FR 19659, Apr. 25, 1994, as amended at 60 FR 2543, Jan. 10, 1995; 60 FR 57948, Nov. 24, 1995]

§ 571.304 Standard No. 304; Compressed natural gas fuel container integrity.

S1. *Scope.* This standard specifies requirements for the integrity of compressed natural gas (CNG), motor vehicle fuel containers.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries occurring from fires that result from fuel leakage during and after motor vehicle crashes.

S3. *Application.* This standard applies to each passenger car, multipurpose passenger vehicle, truck, and bus that uses CNG as a motor fuel and to each container designed to store CNG as motor fuel on-board any motor vehicle.

S4. *Definitions.*

Brazing means a group of welding processes wherein coalescence is produced by heating to a suitable temperature above 800 °F and by using a nonferrous filler metal, having a melting point below that to the base metals. The filler metal is distributed between the closely fitted surfaces of the joint by capillary attraction.

Burst pressure means the highest internal pressure reached in a CNG fuel container during a burst test at a temperature of 21 °C (70 °F).

CNG fuel container means a container designed to store CNG as motor fuel on-board a motor vehicle.

Fill pressure means the internal pressure of a CNG fuel container attained at the time of filling. Fill pressure varies according to the gas temperature in the container which is dependent on the charging parameters and the ambient conditions.

Full wrapped means applying the reinforcement of a filament or resin system over the entire liner, including the domes.

Hoop wrapped means winding of filament in a substantially circumferential pattern over the cylindrical portion of the liner so that the filament does not transmit any significant stresses in a direction parallel to the cylinder longitudinal axis.

Hydrostatic pressure means the internal pressure to which a CNG fuel container is taken during testing set forth in S5.4.1.

Liner means the inner gas tight container or gas cylinder to which the overwrap is applied.

Service pressure means the internal settled pressure of a CNG fuel container at a uniform gas temperature of 21 °C (70 °F) and full gas content. It is the pressure for which the container has been constructed under normal conditions.

S5 *Container and material requirements.*

S5.1 *Container designations.* Container designations are as follows:

S5.1.1 *Type 1—Non-composite metallic container* means a metal container.

S5.1.2 *Type 2—Composite metallic hoop wrapped container* means a metal liner reinforced with resin impregnated continuous filament that is ''hoop wrapped.''

S5.1.3 *Type 3—Composite metallic full wrapped container* means a metal liner reinforced with resin impregnated continuous filament that is ''full wrapped.''

S5.1.4 *Type 4—Composite non-metallic full wrapped container* means resin impregnated continuous filament with a non-metallic liner ''full wrapped.''

S6 *General requirements.*

S6.1 Each passenger car, multipurpose passenger vehicle, truck, and bus that uses CNG as a motor fuel shall be equipped with a CNG fuel container that meets the requirements of S7 through S7.4.

S6.2 Each CNG fuel container manufactured on or after March 27, 1995 shall meet the requirements of S7 through S7.4.

S7 *Test requirements.* Each CNG fuel container shall meet the applicable requirements of S7 through S7.4.

S7.1 *Pressure cycling test at ambient temperature.* Each CNG fuel container shall not leak when tested in accordance with S8.1.

S7.2 *Hydrostatic burst test.*

S7.2.1 Each Type 1 CNG fuel container shall not leak when subjected to burst pressure and tested in accordance with S8.2. Burst pressure shall not be less than 2.25 times the service pressure for non-welded containers and shall not be less than 3.5 times the service pressure for welded containers.

S7.2.2 Each Type 2, Type 3, or Type 4 CNG fuel container shall not leak when subjected to burst pressure and tested in accordance with S8.2. Burst pressure shall be not less than 2.25 times the service pressure.

S7.3 *Bonfire test.* Each CNG fuel container shall be equipped with a pressure relief device. Each CNG fuel container shall completely vent its contents through a pressure relief device or shall not burst while retaining its entire contents when tested in accordance with S8.3.

S7.4 *Labeling.* Each CNG fuel container shall be permanently labeled with the information specified in paragraphs (a) through (h) of this section. Any label affixed to the container in compliance with this section shall remain in place and be legible for the manufacturer's recommended service life of the container. The information shall be in English and in letters and numbers that are at least 6.35 mm (¼ inch) high.

(a) The statement: ''If there is a question about the proper use, installation, or maintenance of this container, contact_____,'' inserting the *CNG fuel container manufacturer's name, address, and telephone number.*

(b) The statement: ''Manufactured in _____,'' inserting the month and year of manufacture of the CNG fuel container.

(c) The statement: ''Service pressure _____ kPa, (_____ psig).''

(d) The symbol DOT, constituting a certification by the CNG container manufacturer that the container complies with all requirements of this standard.

(e) The container designation (e.g., Type 1, 2, 3, 4).

(f) The statement: ''CNG Only.''

(g) The statement: ''This container should be visually inspected for damage and deterioration after a motor vehicle accident or fire, and either (a) at least every 12 months when installed on a vehicle with a GVWR greater than 4,536 kg, or (b) at least every 36 months or 36,000 miles, whichever comes first, when installed on a vehicle with a GVWR less than or equal to 4,536 kg.''

(h) The statement: ''Do Not Use After _____'' inserting the month and year that mark the end of the manufacturer's recommended service life for the container.

S8 *Test conditions: fuel container integrity*.

S8.1 *Pressure cycling test*. The requirements of S7.1 shall be met under the conditions of S8.1.1 through S8.1.4.

S8.1.1 Hydrostatically pressurize the CNG container to the service pressure, then to not more than 10 percent of the service pressure, for 13,000 cycles.

S8.1.2 After being pressurized as specified in S8.1.1, hydrostatically pressurize the CNG container to 125 percent of the service pressure, then to not more than 10 percent of the service pressure, for 5,000 cycles.

S8.1.3 The cycling rate for S8.1.1 and S8.1.2 shall be any value up to and including 10 cycles per minute.

S8.1.4 The cycling is conducted at ambient temperature.

S8.2 *Hydrostatic burst test*. The requirements of S7.2 shall be met under the conditions of S8.2.1 through S8.2.2.

S8.2.1 Hydrostatically pressurize the CNG fuel container, as follows: The pressure is increased up to the minimum prescribed burst pressure determined in S7.2.1 or S7.2.2, and held constant at the minimum burst pressure for 10 seconds.

S8.2.2 The pressurization rate throughout the test shall be any value up to and including 1,379 kPa (200 psi) per second.

S8.3 *Bonfire test*. The requirements of S7.3 shall be met under the conditions of S8.3.1 through S8.3.7.

S8.3.1 Fill the CNG fuel container with compressed natural gas and test it at:

(a) 100 percent of service pressure; and

(b) 25 percent of service pressure.

S8.3.2 *Container positioning*.

(a) Position the CNG fuel container in accordance with paragraphs (b) and (c) of S8.3.2.

(b) Position the CNG fuel container so that its longitudinal axis is horizontal and its bottom is 100 mm (4 inches) above the fire source.

(c)(1) Position a CNG fuel container that is 1.65 meters (65 inches) in length or less and is fitted with one pressure relief device so that the center of the container is over the center of the fire source.

(2) Position a CNG fuel container that is greater than 1.65 meters (65 inches) in length and is fitted with one pressure relief device at one end of the container so that the center of the fire source is 0.825 meters (32.5 inches) from the other end of the container, measured horizontally along a line parallel to the longitudinal axis of the container.

(3) Position a CNG fuel container that is fitted with pressure relief devices at more than one location along its length so that the portion of container over the center of the fire source is the portion midway between the two pressure relief devices that are separated by the greatest distance, measured horizontally along a line parallel to the longitudinal axis of the container.

(4) Test a CNG fuel container that is greater than 1.65 meters (65 inches) in length, is protected by thermal insulation, and does not have pressure relief devices, twice at 100 percent of service pressure. In one test, position the center of the container over the center of the fire source. In another test, position one end of the container so that the fire source is centered 0.825 meters (32.5 inches) from one end of the container, measured horizontally along a line parallel to the longitudinal axis of the container.

S8.3.3 *Number and placement of thermocouples*. To monitor flame temperature, place three thermocouples so that they are suspended 25 mm (one inch) below the bottom of the CNG fuel container. Position thermocouples so that they are equally spaced over the length of the fire source or length of the container, whichever is shorter.

S8.3.4 *Shielding*.

(a) Use shielding to prevent the flame from directly contacting the CNG fuel container valves, fittings, or pressure relief devices.

(b) To provide the shielding, use steel with 0.6 mm (.025 in) minimum nominal thickness.

(c) Position the shielding so that it does not directly contact the CNG fuel container valves, fittings, or pressure relief devices.

S8.3.5 *Fire source*. Use a uniform fire source that is 1.65 meters long (65 inches). Beginning five minutes after the fire is ignited, maintain an average flame temperature of not less than 430

degrees Celsius (800 degrees Fahrenheit) as determined by the average of the two thermocouples recording the highest temperatures over a 60 second interval:

$$\frac{1}{2}\left[\left(\frac{T_{High\ 1}+T_{High\ 2}}{2}\right)_{@\ time\ 30\ sec}+\left(\frac{T_{High\ 1}+T_{High\ 2}}{2}\right)_{@\ time\ 60\ sec}\right]\geq 430\ ^{o}C$$

If the pressure relief device releases before the end of the fifth minute after ignition, then the minimum temperature requirement does not apply.

S8.3.6 *Recording data.* Record time, temperature, and pressure readings at 30 second intervals, beginning when the fire is ignited and continuing until the pressure release device releases.

S8.3.7 *Duration of exposure to fire source.* The CNG fuel container is exposed to the fire source for 20 minutes after ignition or until the pressure release device releases, whichever period is shorter.

S8.3.8 *Number of tests per container.* A single CNG fuel container is not subjected to more than one bonfire test.

S8.3.9 *Wind velocity.* The average ambient wind velocity at the CNG fuel container during the period specified in S8.3.6 of this standard is not to exceed 2.24 meters/second (5 mph).

S8.3.10 The average wind velocity at the container is any velocity up to and including 2.24 meters/second (5 mph).

[59 FR 49021, Sept. 26, 1994; 59 FR 66776, Dec. 28, 1994; 60 FR 37843, July 24, 1995; 60 FR 57948, Nov. 24, 1995; 61 FR 19204, May 1, 1996; 61 FR 47089, Sept. 6, 1996; 63 FR 66765, Dec. 3, 1998; 65 FR 51772, Aug. 25, 2000; 65 FR 64626, Oct. 30, 2000; 87 FR 7964, Feb. 11, 2022]

§571.305 Standard No. 305; electric-powered vehicles: electrolyte spillage and electrical shock protection; applicable unless a vehicle is certified to §571.305a.

S1. *Scope.* This standard specifies requirements for limitation of electrolyte spillage and retention of electric energy storage/conversion devices during and after a crash, and protection from harmful electric shock during and after a crash and during normal vehicle operation.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries during and after a crash that occur because of electrolyte spillage from electric energy storage devices, intrusion of electric energy storage/conversion devices into the occupant compartment, and electrical shock, and to reduce deaths and injuries during normal vehicle operation that occur because of electric shock or driver error.

S3. *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating (GVWR) of 4,536 kilograms (kg) or less, that use electrical propulsion components with working voltages greater than 60 volts direct current (VDC) or 30 volts alternating current (VAC), and whose speed attainable over a distance of 1.6 km on a paved level surface is more than 40 km/h, that are manufactured before September 1, 2027.

S4. *Definitions.*

Automatic disconnect means a device that when triggered, conductively separates a high voltage source from the electric power train or the rest of the electric power train.

Charge connector is a conductive device that, by insertion into a vehicle charge inlet, establishes an electrical connection of the vehicle to the external electric power supply for the purpose of transferring energy and exchanging information.

Connector means a device providing mechanical connection and disconnection of high voltage electrical conductors to a suitable mating component, including its housing.

Direct contact is the contact of persons with high voltage live parts.

Electric energy storage device means a high voltage source that stores energy for vehicle propulsion. This includes, but is not limited to, a high voltage battery or battery pack, rechargeable

energy storage device, and capacitor module.

Electric energy storage/conversion device means a high voltage source that stores or converts energy for vehicle propulsion. This includes, but is not limited to, a high voltage battery or battery pack, fuel cell stack, rechargeable energy storage device, and capacitor module.

Electric energy storage/conversion system means an assembly of electrical components that stores or converts electrical energy for vehicle propulsion. This includes, but is not limited to, high voltage batteries or battery packs, fuel cell stacks, rechargeable energy storage systems, capacitor modules, inverters, interconnects, and venting systems.

Electric power train means an assembly of electrically connected components which includes, but is not limited to, electric energy storage/conversion systems and propulsion systems.

Electrical chassis means conductive parts of the vehicle whose electrical potential is taken as reference and which are: (1) conductively linked together, and (2) not high voltage sources during normal vehicle operation.

Electrical isolation of a high voltage source in the vehicle means the electrical resistance between the high voltage source and any of the vehicle's electrical chassis divided by the working voltage of the high voltage source.

Electrical protection barrier is the part providing protection against direct contact with high voltage live parts from any direction of access.

Exposed conductive part is the conductive part that can be touched under the provisions of the IPXXB protection degree and that is not normally energized, but that can become electrically energized under isolation fault conditions. This includes parts under a cover, if the cover can be removed without using tools.

External electric power supply is a power supply external to the vehicle that provides electric power to charge the electric energy storage device in the vehicle through the charge connector.

Fuel cell system is a system containing the fuel cell stack(s), air processing system, fuel flow control system, exhaust system, thermal management system, and water management system.

High voltage live part means a live part of a high voltage source.

High voltage source means any electric component which is contained in the electric power train or conductively connected to the electric power train and has a working voltage greater than 30 VAC or 60 VDC.

Indirect contact is the contact of persons with exposed conductive parts.

Live part is a conductive part of the vehicle that is electrically energized under normal vehicle operation.

Luggage compartment is the space in the vehicle for luggage accommodation, separated from the passenger compartment by the front or rear bulkhead and bounded by a roof, hood or trunk lid, floor, and side walls, as well as by electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

Passenger compartment is the space for occupant accommodation that is bounded by the roof, floor, side walls, doors, outside glazing, front bulkhead and rear bulkhead or rear gate, as well as electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

Possible active driving mode is the vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system causes the electric power train to move the vehicle.

Propulsion system means an assembly of electric or electro-mechanical components or circuits that propel the vehicle using the energy that is supplied by a high voltage source. This includes, but is not limited to, electric motors, inverters/converters, and electronic controllers.

Protection degree IPXXB is protection from contact with high voltage live parts. It is tested by probing electrical protection barriers with the jointed test finger probe, IPXXB, in Figure 7b.

Protection degree IPXXD is protection from contact with high voltage live parts. It is tested by probing electrical

protection barriers with the test wire probe, IPXXD, in Figure 7a.

Service disconnect is the device for deactivation of an electrical circuit when conducting checks and services of the vehicle electrical propulsion system.

VAC means volts of alternating current (AC) expressed using the root mean square value.

VDC means volts of direct current (DC).

Vehicle charge inlet is the device on the electric vehicle into which the charge connector is inserted for the purpose of transferring energy and exchanging information from an external electric power supply.

Working Voltage means the highest root mean square voltage of the voltage source, which may occur across its terminals or between its terminals and any conductive parts in open circuit conditions or under normal operating conditions.

S5. *General requirements.* Each vehicle to which this standard applies, must meet the requirements in S5.1, S5.2, and S5.3 when tested according to S6 under the conditions of S7.

S5.1 *Electrolyte spillage from propulsion batteries.* Not more than 5.0 liters of electrolyte from propulsion batteries shall spill outside the passenger compartment, and no visible trace of electrolyte shall spill into the passenger compartment. Spillage is measured from the time the vehicle ceases motion after a barrier impact test until 30 minutes thereafter, and throughout any static rollover after a barrier impact test.

S5.2 *Electric energy storage/conversion device retention.* During and after each test specified in S6 of this standard:

(a) Electric energy storage/conversion devices shall remain attached to the vehicle by at least one component anchorage, bracket, or any structure that transfers loads from the device to the vehicle structure, and

(b) Electric energy storage/conversion devices located outside the occupant compartment shall not enter the occupant compartment.

S5.3 *Electrical safety.* After each test specified in S6 of this standard, each high voltage source in a vehicle must meet one of the following requirements: electrical isolation requirements of subparagraph (a), the voltage level requirements of subparagraph (b), or the physical barrier protection requirements of subparagraph (c).

(a) The electrical isolation of the high voltage source, determined in accordance with the procedure specified in S7.6, must be greater than or equal to one of the following:

(1) 500 ohms/volt for an AC high voltage source; or

(2) 100 ohms/volt for an AC high voltage source if it is conductively connected to a DC high voltage source, but only if the AC high voltage source meets the physical barrier protection requirements specified in S5.3(c)(1) and S5.3(c)(2); or

(3) 100 ohms/volt for a DC high voltage source.

(b) The voltages V1, V2, and Vb of the high voltage source, measured according to the procedure specified in S7.7, must be less than or equal to 30 VAC for AC components or 60 VDC for DC components.

(c) Protection against electric shock by direct and indirect contact (physical barrier protection) shall be demonstrated by meeting the following three conditions:

(1) The high voltage source (AC or DC) meets the protection degree IPXXB when tested according to the procedure specified in S9.1 using the IPXXB test probe shown in Figures 7a and 7b;

(2) The resistance between exposed conductive parts of the electrical protection barrier of the high voltage source and the electrical chassis is less than 0.1 ohms when tested according to the procedures specified in S9.2. In addition, the resistance between an exposed conductive part of the electrical protection barrier of the high voltage source and any other simultaneously reachable exposed conductive parts of electrical protection barriers within 2.5 meters of it must be less than 0.2 ohms when tested using the test procedures specified in S9.2; and

(3) The voltage between exposed conductive parts of the electrical protection barrier of the high voltage source and the electrical chassis is less than or equal to 30 VAC or 60 VDC as measured in accordance with S9.3. In addition, the voltage between an exposed

conductive part of the electrical protection barrier of the high voltage source and any other simultaneously reachable exposed conductive parts of electrical protection barriers within 2.5 meters of it must be less than or equal to 30 VAC or 60 VDC as measured in accordance with S9.3.

S5.4 *Electrical safety during normal vehicle operation.*

S5.4.1 *Protection against direct contact.*

S5.4.1.1 *Marking.* The symbol shown in Figure 6 shall be present on or near electric energy storage devices. The symbol in Figure 6 shall also be visible on electrical protection barriers which, when removed, expose live parts of high voltage sources. The symbol shall be yellow and the bordering and the arrow shall be black.

S5.4.1.1.1 The marking is not required for electrical protection barriers that cannot be physically accessed, opened, or removed without the use of tools. Markings are not required for electrical connectors or the vehicle charge inlet.

S5.4.1.2 *High voltage cables.* Cables for high voltage sources which are not located within electrical protection barriers shall be identified by having an outer covering with the color orange.

S5.4.1.3 *Service disconnect.* For a service disconnect which can be opened, disassembled, or removed without tools, protection degree IPXXB shall be provided when tested under procedures specified in S9.1 using the IPXXB test probe shown in Figures 7a and 7b.

S5.4.1.4 *Protection degree of high voltage live parts.*

(a) Protection degree IPXXD shall be provided for high voltage live parts inside the passenger or luggage compartment when tested according to the procedures specified in S9.1 using the IPXXD test probe shown in Figure 7a.

(b) Protection degree IPXXB shall be provided for high voltage live parts in areas other than the passenger or luggage compartment when tested according to the procedures specified in S9.1 using the IPXXB test probe shown in Figures 7a and 7b.

S5.4.1.5 *Connectors.* All connectors shall provide direct contact protection by:

(a) Meeting the requirements specified in S5.4.1.4 when the connector is connected to its corresponding mating component; and,

(b) If a connector can be separated from its mating component without the use of a tool, meeting at least one of the following conditions from (b)(1), (2), or (3) of this section:

(1) The connector meets the requirements of S5.4.1.4 when separated from its mating component;

(2) The voltage of the live parts becomes less than or equal to 60 VDC or 30 VAC within one second after the connector is separated from its mating component; or,

(3) The connector requires at least two distinct actions to separate from its mating component and there are other components that must be removed in order to separate the connector from its mating component and these other components cannot be removed without the use of tools.

S5.4.1.6 *Vehicle charge inlet.* Direct contact protection for a vehicle charge inlet shall be provided by meeting the requirements specified in S5.4.1.4 when the charge connector is connected to the vehicle inlet and by meeting at least one of the requirements of subparagraphs (a) or (b).

(a) The vehicle charge inlet meets the requirements of S5.4.1.4 when the charge connector is not connected to it; or

(b) The voltage of the high voltage live parts becomes equal to or less than 60 VDC or equal to or less than 30 VAC within 1 second after the charge connector is separated from the vehicle charge inlet.

S5.4.2 *Protection against indirect contact.*

S5.4.2.1 The resistance between all exposed conductive parts of electrical protection barriers and the electrical chassis shall be less than 0.1 ohms when tested according to the procedures specified in S9.2.

S5.4.2.2 The resistance between any two simultaneously reachable exposed conductive parts of the electrical protection barriers that are less than 2.5 meters from each other shall be less than 0.2 ohms when tested according to the procedures specified in S9.2.

S5.4.3 *Electrical isolation.*

S5.4.3.1 *Electrical isolation of AC and DC high voltage sources.* The electrical

isolation of a high voltage source, determined in accordance with the procedure specified in S7.6 must be greater than or equal to one of the following:

(a) 500 ohms/volt for an AC high voltage source;

(b) 100 ohms/volt for an AC high voltage source if it is conductively connected to a DC high voltage source, but only if the AC high voltage source meets the requirements for protection against direct contact in S5.4.1.4 and the protection from indirect contact in S5.4.2; or

(c) 100 ohms/volt for a DC high voltage source.

S5.4.3.2 *Exclusion of high voltage sources from electrical isolation requirements.* A high voltage source that is conductively connected to an electric component which is conductively connected to the electrical chassis and has a working voltage less than or equal to 60 VDC, is not required to meet the electrical isolation requirements in S5.4.3.1 if the voltage between the high voltage source and the electrical chassis is less than or equal to 30 VAC or 60 VDC.

S5.4.3.3 *Electrical isolation of high voltage sources for charging the electric energy storage device.* For the vehicle charge inlet intended to be conductively connected to the AC external electric power supply, the electric isolation between the electrical chassis and the high voltage sources that are conductively connected to the vehicle charge inlet during charging of the electric energy storage device shall be greater than or equal to 500 ohms/volt when the charge connector is disconnected. The electrical isolation is measured at the high voltage live parts of the vehicle charge inlet and determined in accordance with the procedure specified in S7.6. During the measurement, the rechargeable electric energy storage system may be disconnected.

S5.4.4 *Electrical isolation monitoring.* DC high voltage sources of vehicles with a fuel cell system shall be monitored by an electrical isolation monitoring system that displays a warning for loss of isolation when tested according to S8. The system must monitor its own readiness and the warning display must be visible to the driver seated in the driver's designated seating position.

S5.4.5 *Electric shock protection during charging.* For motor vehicles with an electric energy storage device that can be charged through a conductive connection with a grounded external electric power supply, a device to enable conductive connection of the electrical chassis to the earth ground shall be provided. This device shall enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.

S5.4.6 *Mitigating driver error.*

S5.4.6.1 *Indicator of possible active driving mode.* At least a momentary indication shall be given to the driver each time the vehicle is first placed in possible active driving mode after manual activation of the propulsion system. This requirement does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle's propulsion power when the vehicle is first placed in a possible active driving mode after manual activation of the propulsion system.

S5.4.6.2 *Indicator of possible active driving mode when leaving the vehicle.* When leaving the vehicle, the driver shall be informed by an audible or visual signal if the vehicle is still in the possible active driving mode.

S5.4.6.3 *Prevent drive-away.* If the onboard electric energy storage device can be externally charged, vehicle movement of more than 150 mm by its own propulsion system shall not be possible as long as the charge connector of the external electric power supply is physically connected to the vehicle charge inlet in a manner that would permit charging of the electric energy storage device.

S6. *Test requirements.* Each vehicle to which this standard applies, under the conditions of S7, must be capable of meeting the requirements of any applicable single barrier crash/static rollover test sequence, without alteration of the vehicle during the test sequence. A particular vehicle need not meet further test requirements after having been subjected to a single barrier crash/static rollover test sequence.

S6.1 *Frontal barrier crash.* The vehicle must meet the requirements of S5.1, S5.2 and S5.3 when it is traveling longitudinally forward at any speed, up to and including 48 km/h, and impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle.

S6.2 *Rear moving barrier impact.* The vehicle must meet the requirements of S5.1, S5.2, and S5.3 when it is impacted from the rear by a barrier that conforms to S7.3(b) of 571.301 of this chapter and that is moving at any speed up to and including 80 km/h (50 mph) with dummies in accordance with S6.2 of 571.301 of this chapter.

S6.3 *Side moving deformable barrier impact.* The vehicle must meet the requirements of S5.1, S5.2 and S5.3 when it is impacted from the side by a barrier that conforms to part 587 of this chapter that is moving at any speed up to and including 54 km/h, with the appropriate 49 CFR part 572 test dummies specified in 571.214 of this chapter.

S6.4 *Post-impact test static rollover.* The vehicle must meet the requirements of S5.1, S5.2, and S5.3, after being rotated on its longitudinal axis to each successive increment of 90 degrees after each impact test specified in S6.1, S6.2, and S6.3.

S7. *Test conditions.* When the vehicle is tested according to S6, the requirements of S5.1 through S5.3 must be met under the conditions specified in S7.1 through S7.7. All measurements for calculating voltage(s) and electrical isolation are made after a minimum of 5 seconds after the vehicle comes to rest in tests specified in S6. Where a range is specified, the vehicle must be capable of meeting the requirements at all points within the range.

S7.1 *Electric energy storage device state-of-charge.* The electric energy storage device shall be at the state-of-charge specified in either subparagraph (a), (b), or (c):

(a) At the maximum state-of-charge in accordance with the vehicle manufacturer's recommended charging procedures, as stated in the vehicle owner's manual or on a label that is permanently affixed to the vehicle; or

(b) If the manufacturer has made no recommendation for charging procedures in the owner's manual or on a label permanently affixed to the vehicle, at a state-of-charge of not less than 95 percent of the maximum capacity of the electric energy storage device; or

(c) If the electric energy storage device(s) is/are rechargeable only by an energy source on the vehicle, at any state-of-charge within the normal operating voltage defined by the vehicle manufacturer.

S7.2 *Vehicle conditions.* The switch or device that provides power from the electric energy storage/conversion system to the propulsion system is in the activated position or the ready-to-drive position.

S7.2.1 The parking brake is disengaged and the transmission, if any, is in the neutral position. In a test conducted under S6.3, the parking brake is set.

S7.2.2 Tires are inflated to the manufacturer's specifications.

S7.2.3 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) A passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the necessary test dummies as specified in S6, restrained only by means that are installed in the vehicle for protection at its seating position.

(b) A multipurpose passenger vehicle, truck, or bus with a GVWR of 4536 kg or less is loaded to its unloaded vehicle weight plus the necessary dummies, as specified in S6, plus 136 kg or its rated cargo and luggage capacity weight, whichever is less. Each dummy is restrained only by means that are installed in the vehicle for protection at its seating position.

S7.3 *Static rollover test conditions.* In addition to the conditions of S7.1 and S7.2, the conditions of S7.4 of Sec. 571.301 of this chapter apply to the conduct of static rollover tests specified in S6.4.

S7.4 *Rear moving barrier impact test conditions.* In addition to the conditions of S7.1 and S7.2, the conditions of S7.3(b) and S7.6 of 571.301 of this chapter apply to the conducting of the rear

moving deformable barrier impact test specified in S6.2.

S7.5 *Side moving deformable barrier impact test conditions.* In addition to the conditions of S7.1 and S7.2, the conditions of S8.9, S8.10, and S8.11 of 571.214 of this chapter apply to the conduct of the side moving deformable barrier impact test specified in S6.3.

S7.6 *Electrical isolation test procedure.* In addition to the conditions of S7.1 and S7.2, the conditions in S7.6.1 through S7.6.7 apply to the measuring of electrical isolation specified in S5.3(a).

S7.6.1 Prior to any barrier impact test, the energy storage/conversion system is connected to the vehicle's propulsion system, and the vehicle ignition is in the ''on'' (propulsion system energized) position. Bypass any devices or systems that do not allow the propulsion system to be energized at the time of impact when the vehicle ignition is on and the vehicle is in neutral. For a high voltage source that has an automatic disconnect that is physically contained within itself, the electrical isolation measurement after the test is made from the side of the automatic disconnect connected to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train. For a high voltage source that has an automatic disconnect that is not physically contained within itself, the electrical isolation measurement after the test is made from both the high voltage source side of the automatic disconnect and from the side of the automatic disconnect connected to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train.

S7.6.2 The voltmeter used in this test has an internal resistance of at least 10 MΩ.

S7.6.3 The voltage(s) is/are measured as shown in Figure 1 and the high voltage source voltage(s) (Vb) is/are recorded. Before any vehicle impact test, Vb is equal to or greater than the nominal operating voltage as specified by the vehicle manufacturer.

S7.6.4 The voltage V1 between the negative side of the high voltage source and the electrical chassis is measured as shown in Figure 2.

S7.6.5 The voltage V2 between the positive side of the high voltage source and the electrical chassis is measured as shown in Figure 3.

S7.6.6 If V1 is greater than or equal to V2, insert a known resistance (Ro) between the negative side of the high voltage source and the electrical chassis. With the Ro installed, measure the voltage (V1′) as shown in Figure 4 between the negative side of the high voltage source and the electrical chassis. Calculate the electrical isolation resistance (Ri) according to the formula shown. Divide Ri (in ohms) by the working voltage of the high voltage source (in volts) to obtain the electrical isolation (in ohms/volt).

S7.6.7 If V2 is greater than V1, insert a known resistance (Ro) between the positive side of the high voltage source and the electrical chassis. With the Ro installed, measure the voltage (V2′) as shown in Figure 5 between the positive side of the high voltage source and the electrical chassis. Calculate the electrical isolation resistance (Ri) according to the formula shown. Divide Ri (in ohms) by the working voltage of the high voltage source (in volts) to obtain the electrical isolation (in ohms/volt).

S7.7 *Voltage measurement.* For the purpose of determining the voltage level of the high voltage source specified in S5.3(b), voltage is measured as shown in Figure 1. Voltage Vb is measured across the two terminals of the voltage source. Voltages V1 and V2 are measured between the source and the electrical chassis. For a high voltage source that has an automatic disconnect that is physically contained within itself, the voltage measurement after the test is made from the side of the automatic disconnect connected to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train. For a high voltage source that has an automatic disconnect that is not physically contained within itself, the voltage measurement after the test is made from both the high voltage source side of the automatic disconnect and from the side of the automatic disconnect connected

to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train.

S8. *Test procedure for on-board electrical isolation monitoring system.* Prior to any impact test, the requirements of S5.4.4 for the on-board electrical isolation monitoring system shall be tested using the following procedure.

(1) The electric energy storage device is at the state-of-charge specified in S7.1.

(2) The switch or device that provides power from the electric energy storage/conversion system to the propulsion system is in the activated position or the ready-to-drive position.

(3) Determine the isolation resistance, Ri, of the high voltage source with the electrical isolation monitoring system using the procedure outlined in S7.6.2 through S7.6.7.

(4) Insert a resistor with resistance Ro equal to or greater than 1/(1/(95 times the working voltage of the high voltage source) − 1/Ri) and less than 1/(1/(100 times the working voltage of the high voltage source) − 1/Ri) between the positive terminal of the high voltage source and the electrical chassis.

(5) The electrical isolation monitoring system indicator shall display a warning visible to the driver seated in the driver's designated seating position.

S9 *Test methods for physical barrier protection from electric shock due to direct and indirect contact with high voltage sources.*

S9.1 *Test method to evaluate protection from direct contact with high voltage sources.*

(a) Any parts surrounding the high voltage components are opened, disassembled, or removed without the use of tools.

(b) The selected access probe is inserted into any gaps or openings of the electrical protection barrier with a test force of 10 N ± 1 N with the IPXXB probe or 1 to 2 N with the IPXXD probe. If the probe partly or fully penetrates into the electrical protection barrier, it is placed in every possible position to evaluate contact with high voltage live parts. If partial or full penetration into the electrical protection barrier occurs with the IPXXB probe, the IPXXB probe shall be placed as follows: starting from the straight position, both joints of the test finger are rotated progressively through an angle of up to 90 degrees with respect to the axis of the adjoining section of the test finger and are placed in every possible position.

(c) A low voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp may be connected between the access probe and any high voltage live parts inside the electrical protection barrier to indicate whether high voltage live parts were contacted.

(d) A mirror or fiberscope may be used to inspect whether the access probe touches high voltage live parts inside the electrical protection barrier.

(e) Protection degree IPXXD or IPXXB is verified when the following conditions are met:

(i) The access probe does not touch high voltage live parts. The IPXXB access probe may be manipulated as specified in S9.1(b) for evaluating contact with high voltage live parts. The methods specified in S9.1(c) or S9.1(d) may be used to aid the evaluation. If method S9.1(c) is used for verifying protection degree IPXXB or IPXXD, the lamp shall not light up.

(ii) The stop face of the access probe does not fully penetrate into the electrical protection barrier.

S9.2 *Test method to evaluate protection against indirect contact with high voltage sources.* At the option of the manufacturer, protection against indirect contact with high voltage sources shall be determined using the test method in subparagraph (a) or subparagraph (b).

(a) *Test method using a resistance tester.* The resistance tester is connected to the measuring points (the electrical chassis and any exposed conductive part of electrical protection barriers or any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other), and the resistance is measured using a resistance tester that can supply current levels of at least 0.2 Amperes with a resolution of 0.01 ohms or less. The resistance between two exposed conductive parts of electrical protection

barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

(b) *Test method using a DC power supply, voltmeter and ammeter.*

(1) Connect the DC power supply, voltmeter and ammeter to the measuring points (the electrical chassis and any exposed conductive part or any two simultaneously reachable exposed conductive parts that are less than 2.5 meters from each other) as shown in Figure 8.

(2) Adjust the voltage of the DC power supply so that the current flow becomes more than 0.2 Amperes.

(3) Measure the current I and the voltage V shown in Figure 8.

(4) Calculate the resistance R according to the formula, R=V/I.

(5) The resistance between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

S9.3 *Test method to determine voltage between exposed conductive parts of electrical protection barriers and the electrical chassis and between exposed conductive parts of electrical protection barriers.*

(a) Connect the voltmeter to the measuring points (exposed conductive part of an electrical protection barrier and the electrical chassis or any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other).

(b) Measure the voltage.

(c) The voltage between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured voltages between the relevant electrical protection barriers and the electrical chassis.

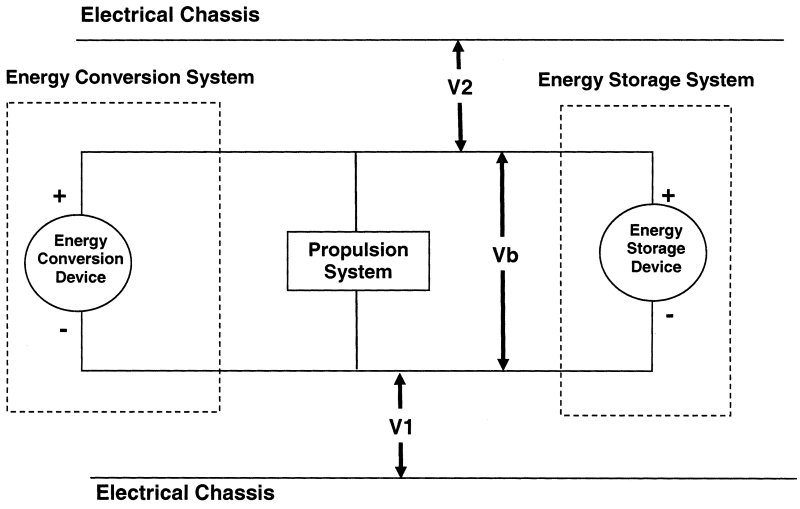


Figure 1. S7.6.3 and S7.7 Voltage Measurements of the High Voltage Source

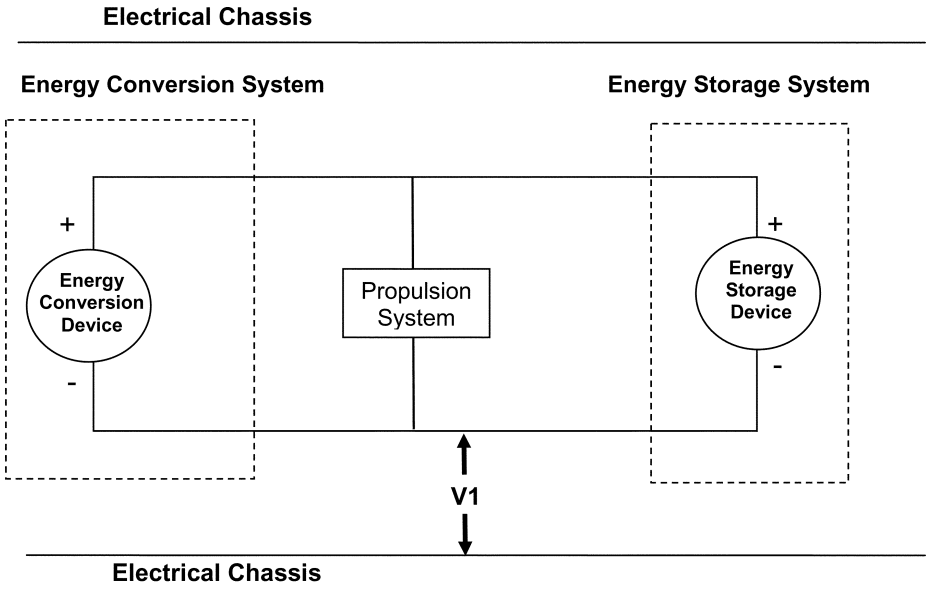


Figure 2. S7.6.4 Measurement for V1 Voltage between the Negative Side of the High Voltage Source and the Electrical Chassis

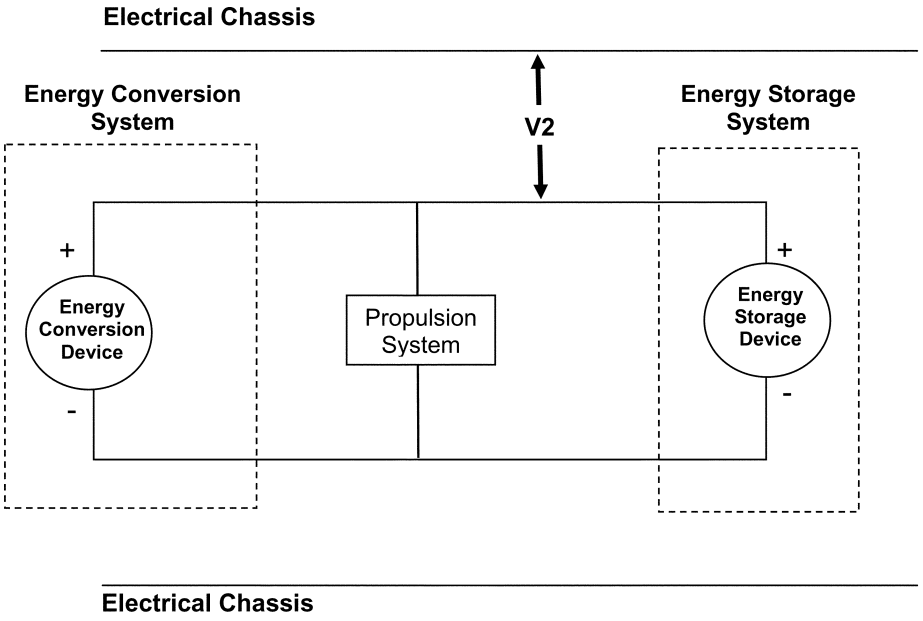
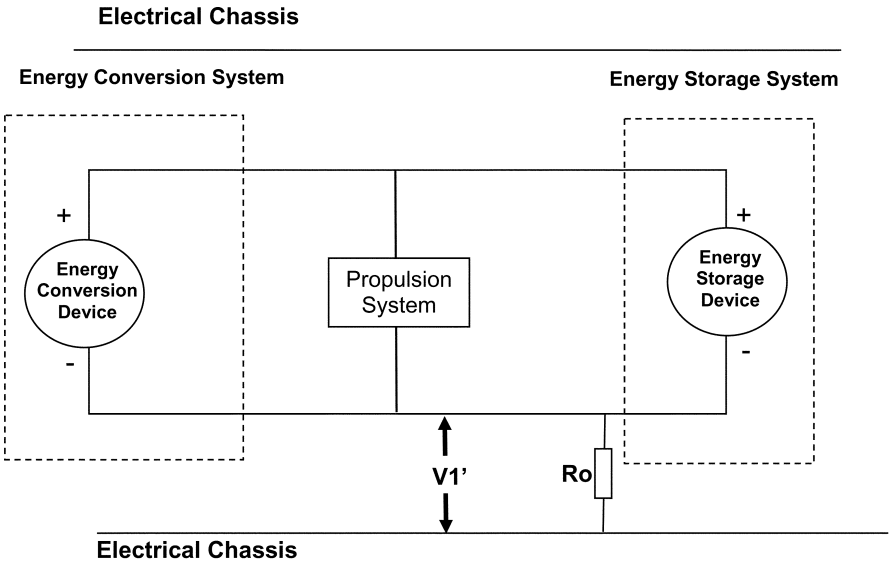
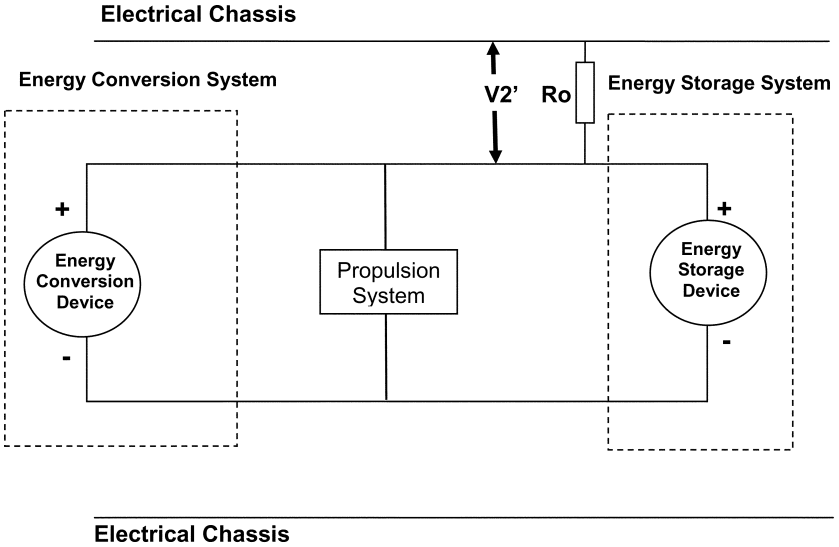


Figure 3. S7.6.5 Measurement for V2 Voltage between the Positive Side of the High Voltage Source and the Electrical Chassis



$$Ri = Ro\ (1+V2/V1)((V1-V1')/V1')$$

Figure 4. S7.6.6 Measurement for V1' Voltage across Resistor between Negative Side of the High Voltage Source and Electrical Chassis



$$Ri = Ro\ (1+V1/V2)((V2-V2')/V2')$$

Figure 5. S7.6.7 Measurement for V2' Voltage across Resistor between Positive Side of the High Voltage Source and Electrical Chassis

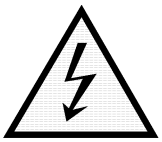


Figure 6. S5.4.1.1 Marking of high voltage equipment.

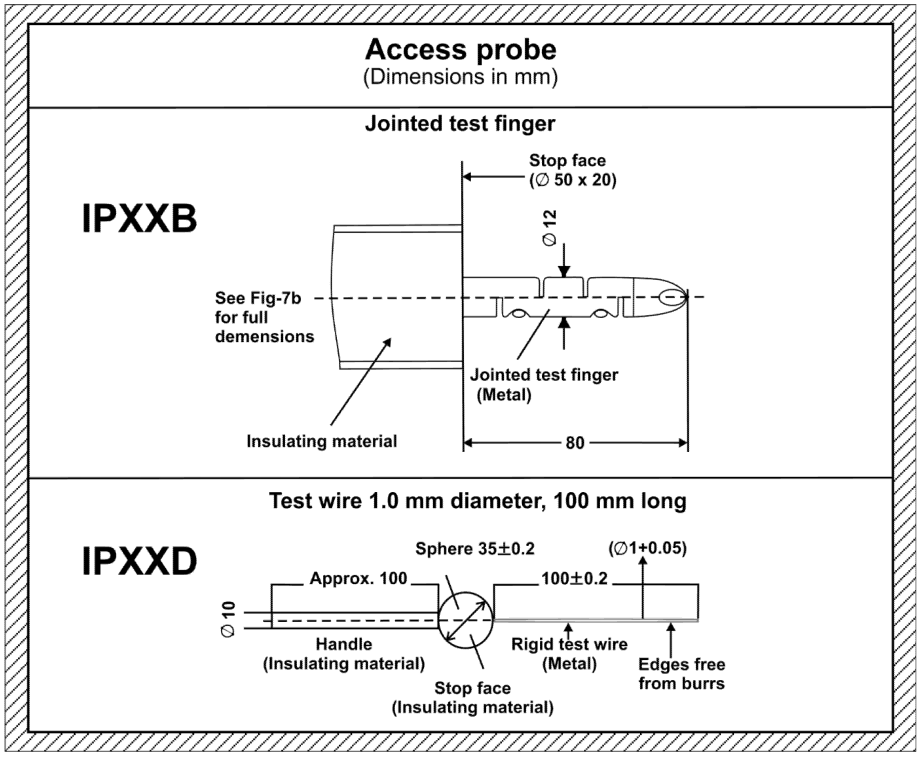
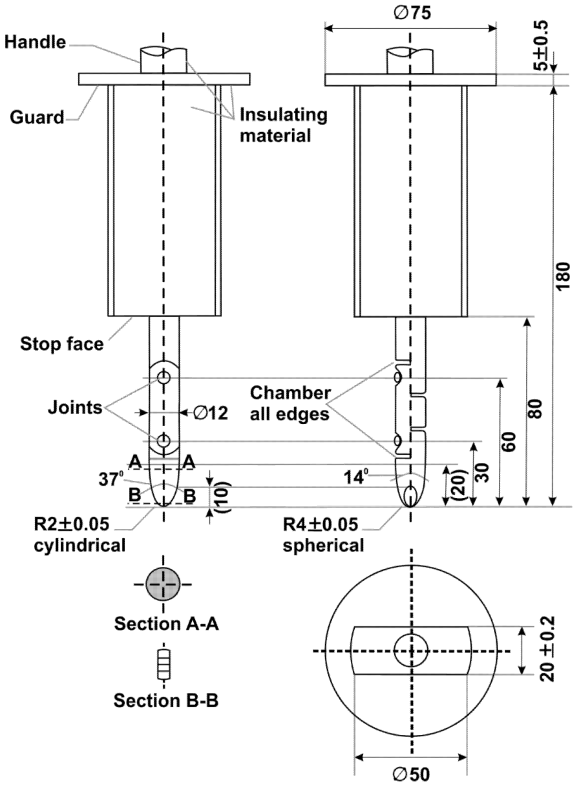


Figure 7a. S4, S5.3, S5.4.1.3, and S5.4.1.4 Access probes for the tests of direct contact protection. Access probe IPXXB (top) and Access probe IPXXD (bottom).

Access probe
(Dimensions in mm)

IPXXB **Jointed test finger**



Material: metal, except where otherwise specified
Linear dimensions in millimeters
Tolerances on dimensions without specific tolerance:
on angles, 0/10 degrees
on linear dimensions:
up to 25 mm: 0/-0.05 mm
over 25 mm: ±0.2 mm
Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0° to +10° tolerance.

Figure 7b. S4, S5.3, S5.4.1.3, and S5.4.1.4 Jointed test finger IPXXB

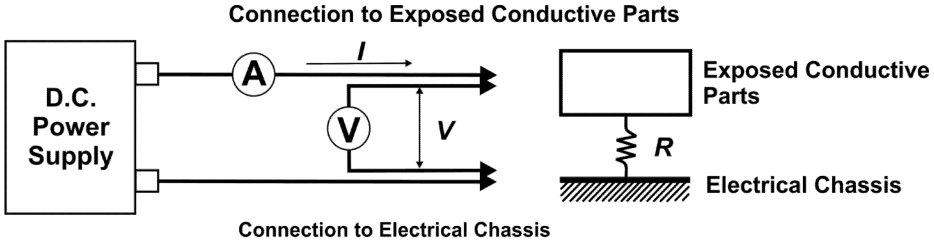


Figure 8. S9.2 Connection to determine resistance between exposed conductive parts of electrical protection barrier and electrical chassis

[65 FR 57988, Sept. 27, 2000, as amended at 66 FR 60160, Dec. 3, 2001; 69 FR 51399, Aug. 19, 2004; 72 FR 51972, Sept. 11, 2007; 75 FR 12141, Mar. 15, 2010; 75 FR 33527, June 14, 2010; 76 FR 45448, July 29, 2011; 80 FR 2325, Jan. 16, 2015; 82 FR 44960, Sept. 27, 2017; 84 FR 44257, Aug. 23, 2019; 89 FR 104352, Dec. 20, 2024]

§571.305a Standard No. 305a; electric-powered vehicles: Electric powertrain integrity; mandatory applicability begins on September 1, 2027.

S1. *Scope*. This standard specifies requirements for protection from harmful electric shock, fire, explosion, and gas venting during normal vehicle operation and during and after a crash.

S2. *Purpose*. The purpose of this standard is to reduce deaths and injuries during normal vehicle operations and during and after a crash that occur because of electrolyte leakage, intrusion of electric energy storage/conversion devices into the occupant compartment, electric shock, fire, explosion, and gas venting, including deaths and injuries due to driver error.

S3. *Application*. (a) This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses that use electrical propulsion components with working voltages greater than 60 volts direct current (VDC) or 30 volts alternating current (VAC), and whose speed attainable over a distance of 1.6 km on a paved level surface is more than 40 km/h.

(b) Mandatory applicability begins September 1, 2027, for vehicles with a gross vehicle weight rating of 4,536 kilograms (kg) or less and September 1, 2028, for vehicles with a gross vehicle weight rating over 4,536 kg. Small-volume manufacturers, final-stage manufacturers, and alterers are provided an additional year to comply with the requirements beyond the dates identified in this paragraph (b).

S4. *Definitions*.

Active driving possible mode means the vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system causes the electric power train to move the vehicle.

Automatic disconnect means a device that when triggered, conductively separates a high voltage source from the electric power train or the rest of the electric power train.

Breakout harness means connector wires that are connected for testing purposes to the REESS on the traction side of the automatic disconnect.

Capacitor means a device used to store electrical energy, consisting of one or more pairs of conductors separated by an insulator: x-capacitors are connected between electrical mains or neutral and y-capacitors are connected between a main to ground.

Charge connector is a conductive device that, by insertion into a vehicle charge inlet, establishes an electrical connection of the vehicle to an external electric power supply for the purpose of transferring energy.

Chassis dynamometer means a mechanical device that uses one or more fixed roller assemblies to simulate different road conditions within a controlled environment and is used for a wide variety of vehicle testing.

Connector means a device providing mechanical connection and disconnection of high voltage electrical conductors to a suitable mating component, including its housing.

n C Rate means the constant current of the REESS, which takes 1/n hours to charge or discharge the REESS between 0 and 100 percent state of charge.

Direct contact is the contact of any person or persons with high voltage live parts.

Electric energy storage device means a high voltage source that stores energy for vehicle propulsion. This includes, but is not limited to, a high voltage battery or battery pack, rechargeable energy storage device, and capacitor module.

Electric energy storage/conversion device means a high voltage source that stores or converts energy for vehicle propulsion. This includes, but is not limited to, a high voltage battery or battery pack, fuel cell stack, rechargeable energy storage device, and capacitor module.

Electric energy storage/conversion system means an assembly of electrical components that stores or converts electrical energy for vehicle propulsion. This includes, but is not limited to, high voltage batteries or battery packs, fuel cell stacks, rechargeable energy storage systems, capacitor modules, inverters, interconnects, and venting systems.

Electric power train means an assembly of electrically connected components which includes, but is not limited to, electric energy storage/conversion systems and propulsion systems.

Electrical chassis means conductive parts of the vehicle whose electrical potential is taken as reference and which are:

(1) Conductively linked together, and

(2) Not high voltage sources during normal vehicle operation.

Electrical isolation of a high voltage source in the vehicle means the electrical resistance between the high voltage source and any of the vehicle's electrical chassis divided by the working voltage of the high voltage source.

Electrical protection barrier is the part providing protection against direct contact with high voltage live parts from any direction of access.

Electrolyte leakage means the escape of liquid electrolyte from the REESS.

Exposed conductive part is a conductive part that can be touched under the provisions of the IPXXB protection degree and that is not normally energized, but that can become electrically energized under isolation fault conditions. This includes parts under a cover if the cover can be removed without using tools.

External charging mode means the vehicle mode when the REESS is charging with external electric power supply connected through the charge connector to the vehicle charge inlet.

External electric power supply is a power supply external to the vehicle that provides electric power to charge the electric energy storage device in the vehicle through the charge connector.

Fuel cell system is a system containing the fuel cell stack(s), air processing system, fuel flow control system, exhaust system, thermal management system, and water management system.

High voltage live part means a live part of a high voltage source.

High voltage source means any electric component which is contained in the electric power train or conductively connected to the electric power train and has a working voltage greater than 30 VAC or 60 VDC.

Indirect contact is the contact of any person or persons with exposed conductive parts.

Live part is a conductive part of the vehicle that is electrically energized under normal vehicle operation.

Luggage compartment is the space in the vehicle for luggage accommodation, separated from the passenger compartment by the front or rear bulkhead and bounded by a roof, hood or trunk lid, floor, and side walls, as well as by electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

Normal vehicle operation includes operating modes and conditions that can reasonably be encountered during typical operation of the vehicle, such as driving, parking, and standing in traffic, as well as charging using chargers that are compatible with the specific

charging ports installed on the vehicle. It does not include conditions where the vehicle is damaged, either by a crash or road debris, subjected to fire or water submersion, or in a state where service and/or maintenance is needed or being performed.

Parking mode is the vehicle mode in which the vehicle power is turned off, the vehicle propulsion system and ancillary equipment such as the radio are not operational, and the vehicle is stationary.

Passenger compartment is the space for occupant accommodation that is bounded by the roof, floor, side walls, doors, outside glazing, front bulkhead and rear bulkhead or rear gate, as well as electrical protection barriers provided for protecting the occupants from direct contact with high voltage live parts.

Propulsion system means an assembly of electric or electro-mechanical components or circuits that propel the vehicle using the energy that is supplied by a high voltage source. This includes, but is not limited to, electric motors, inverters/converters, and electronic controllers.

Protection degree IPXXB is protection from contact with high voltage live parts. It is tested by probing electrical protection barriers with the jointed test finger probe, IPXXB, in figure 7b to this standard.

Protection degree IPXXD is protection from contact with high voltage live parts. It is tested by probing electrical protection barriers with the test wire probe, IPXXD, in figure 7a to this standard.

Rechargeable Electrical Energy Storage System (REESS) means the rechargeable electric energy storage system that provides electric energy for electrical propulsion.

Rupture means an opening through the casing of the REESS that would permit the IPXXB test probe to penetrate and contact live parts.

Service disconnect is the device for deactivation of an electrical circuit when conducting checks and services of the vehicle electrical propulsion system.

State of charge (SOC) means the available electrical charge in a REESS expressed as a percentage of the normal operating capacity specified by the vehicle manufacturer.

Thermal event means the condition when the temperature within the REESS is significantly higher than the maximum operating temperature.

Thermal runaway means an uncontrolled increase of cell temperature caused by exothermic reactions inside the cell.

Thermal propagation means the sequential occurrence of thermal runaway within a REESS triggered by thermal runaway of a cell in the REESS.

VAC means volts of alternating current (AC) expressed using the root mean square value.

VDC means volts of direct current (DC).

Vehicle charge inlet is the device on the electric vehicle into which the charge connector is inserted for the purpose of transferring energy and exchanging information from an external electric power supply.

Venting means the release of excessive internal pressure from cell or battery in a manner intended by design to preclude rupture or explosion.

Working voltage means the highest root mean square voltage of the voltage source, which may occur across its terminals or between its terminals and any conductive parts in open circuit conditions or under normal operating conditions.

S5. *General requirements.*

S5.1 *Vehicles of GVWR of 4,536 kilograms (kg) or less (light vehicles).* Each vehicle with a GVWR of 4,536 kg or less shall meet the requirements set forth in S6 (normal vehicle operation safety), S8 (post-crash safety), S11 (vehicle controls managing REESS safe operations), S13 (warning in the case of thermal event in REESS), and S14 (water exposure safety) of this standard.

S5.2 *Vehicles with a GVWR greater than 4,536 kg other than school buses (heavy vehicles other than school buses).* Each heavy vehicle with a GVWR greater than 4,536 kg, other than school buses, shall meet the requirements set forth in S6 (normal vehicle operation safety), S11 (vehicle controls managing REESS safe operations), S13 (warning in the case of thermal event in

REESS), and S14 (water exposure safety) of this standard.

S5.3 *School buses with a GVWR greater than 4,536 kg*. Each school bus with a GVWR greater than 4,536 kg shall meet the requirements set forth in S6 (normal vehicle operation safety), S8 (post-crash safety), S11 (vehicle controls managing REESS safe operations), S13 (warning in the case of thermal event in REESS), and S14 (water exposure safety) of this standard.

S6. *Normal vehicle operation safety*. Each vehicle to which this standard applies must meet the requirements in S6.1 to S6.6 of this standard, when tested according to the relevant provisions in S7 of this standard.

S6.1 *Protection against direct contact*.

S6.1.1 *Marking*. The symbol shown in figure 6 to this standard shall be present on or near electric energy storage devices. The symbol in figure 6 shall also be visible on electrical protection barriers which, when removed, expose live parts of high voltage sources. The symbol shall be yellow and the bordering and the arrow shall be black.

S6.1.1.1 The marking is not required for electrical protection barriers that cannot be physically accessed, opened, or removed without the use of tools. Markings are not required for electrical connectors or the vehicle charge inlet.

S6.1.2 *High voltage cables*. Cables for high voltage sources which are not located within electrical protection barriers shall be identified by having an outer covering with the color orange.

S6.1.3 *Service disconnect*. For a service disconnect which can be opened, disassembled, or removed without tools, protection degree IPXXB shall be provided when tested under procedures specified in S7.3.1 of this standard using the IPXXB test probe shown in figures 7a and 7b to this standard.

S6.1.4 *Protection degree of high voltage live parts*. (a) Protection degree IPXXD shall be provided for high voltage live parts inside the passenger or luggage compartment when tested according to the procedures specified in S7.3.1 of this standard using the IPXXD test probe shown in figure 7a to this standard.

(b) Protection degree IPXXB shall be provided for high voltage live parts in areas other than the passenger or luggage compartment when tested according to the procedures specified in S7.3.1 of this standard using the IPXXB test probe shown in figures 7a and 7b to this standard. High voltage live parts that are not energized except during charging of the REESS are excluded from protection degree IPXXB if they are located on the vehicle roof such that the wrap around distance from the instep of the vehicle, or the lowest step (if multiple steps are present) of the vehicle, to the high voltage source is at least 3 meters.

S6.1.5 *Connectors*. All connectors shall provide direct contact protection by:

(a) Meeting the requirements specified in S6.1.4 when the connector is connected to its corresponding mating component; and,

(b) If a connector can be separated from its mating component without the use of a tool, meeting at least one of the following conditions from S6.1.5(b)(1), (2), or (3):

(1) The connector meets the requirements of S6.1.4 when separated from its mating component;

(2) The voltage of the live parts becomes less than or equal to 60 VDC or 30 VAC within one second after the connector is separated from its mating component; or

(3) The connector requires at least two distinct actions to separate from its mating component and there are other components that must be removed in order to separate the connector from its mating component and these other components cannot be removed without the use of tools.

S6.1.6 *Vehicle charge inlet*. Direct contact protection for a vehicle charge inlet shall be provided by meeting the requirements specified in S6.1.4 when the charge connector is connected to the vehicle inlet and by meeting at least one of the requirements of S6.1.6(a) or (b).

(a) The vehicle charge inlet meets the requirements of S6.1.4 when the charge connector is not connected to it; or

(b) The voltage of the high voltage live parts becomes equal to or less than

60 VDC or equal to or less than 30 VAC within 1 second after the charge connector is separated from the vehicle charge inlet.

S6.2 *Protection against indirect contact*.

S6.2.1 The resistance between all exposed conductive parts of electrical protection barriers and the electrical chassis shall be less than 0.1 ohms when tested according to the procedures specified in S7.3.2 of this standard.

S6.2.2 The resistance between any two simultaneously reachable exposed conductive parts of the electrical protection barriers that are less than 2.5 meters from each other shall be less than 0.2 ohms when tested according to the procedures specified in S7.3.2 of this standard.

S6.3 *Electrical isolation*.

S6.3.1 *Electrical isolation of AC and DC high voltage sources*. The electrical isolation of a high voltage source, determined in accordance with the procedure specified in S7.2 of this standard, must be greater than or equal to one of the following:

(a) 500 ohms/volt for an AC high voltage source;

(b) 100 ohms/volt for an AC high voltage source if it is conductively connected to a DC high voltage source, but only if the AC high voltage source meets the requirements for protection against direct contact in S6.1.4 and the protection from indirect contact in S6.2; or

(c) 100 ohms/volt for a DC high voltage source.

S6.3.2 *Exclusion of high voltage sources from electrical isolation requirements*. A high voltage source that is conductively connected to an electric component which is conductively connected to the electrical chassis and has a working voltage less than or equal to 60 VDC, including a pulsating DC voltage source without a change in polarity, is not required to meet the electrical isolation requirements in S6.3.1 if the voltage between the high voltage source and the electrical chassis is less than or equal to 30 VAC or 60 VDC.

S6.3.3 *Electrical isolation of high voltage sources for charging the electric energy storage device*. For the vehicle charge inlet intended to be conductively connected to the AC external electric power supply, the electric isolation between the electrical chassis and the high voltage sources that are conductively connected to the vehicle charge inlet during charging of the electric energy storage device shall be greater than or equal to 500 ohms/volt when the charge connector is disconnected. The electrical isolation is measured at the high voltage live parts of the vehicle charge inlet and determined in accordance with the procedure specified in S7.2 of this standard. During the measurement, the electric energy storage device may be disconnected.

S6.4 *Electrical isolation monitoring*. DC high voltage sources of vehicles with a fuel cell system shall be monitored by an electrical isolation monitoring system that displays a warning for loss of isolation when tested according to S7.4 of this standard. The system must monitor its own readiness and the visual warning display must be provided to the driver. For a vehicle with automated driving systems and without manually operated driving controls, the visual warning must be provided to all the front row occupants.

S6.5 *Electric shock protection during charging*. For motor vehicles with an electric energy storage device that can be charged through a conductive connection with a grounded external electric power supply, a device to enable conductive connection of the electrical chassis to the earth ground shall be provided. This device shall enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.

S6.6 *Mitigating driver error*.

S6.6.1 *Indicator of active driving possible mode*. At least a momentary indication shall be given to the driver each time the vehicle is first placed in active driving possible mode after manual activation of the propulsion system. This requirement does not apply under conditions where an internal combustion engine directly or indirectly provides the vehicle's propulsion power when the vehicle is first placed in the active driving possible mode

after manual activation of the propulsion system.

S6.6.2 *Indicator of active driving possible mode when leaving the vehicle.* When leaving the vehicle, the driver shall be informed by an auditory or visual signal if the vehicle is still in the active driving possible mode.

S6.6.3 *Prevent drive-away.* If the onboard electric energy storage device can be externally charged, vehicle movement of more than 150 mm by its own propulsion system shall not be possible as long as the charge connector of the external electric power supply is physically connected to the vehicle charge inlet in a manner that would permit charging of the electric energy storage device.

S7. *Electrical safety test procedures for normal vehicle operation safety.* The following provisions specify the test procedures associated with the requirements of S6 of this standard.

S7.1 *Voltage measurements.* For the purpose of determining the voltage level of the high voltage source, voltage is measured as shown in figure 1 to this standard using a voltmeter that has an internal resistance of at least 10 MΩ. All post-crash voltage measurements for determining electrical isolation of high voltage sources specified in S8.2(a) of this standard are made at least 10 seconds after impact. All post-crash voltage measurements for determining the voltage levels specified in S8.2(b) of this standard and the energy in capacitors specified in S8.2(d) of this standard are made between 10 to 60 seconds after impact.

S7.1.1 For a high voltage source that has an automatic disconnect that is physically contained within itself, the voltage measurement after the test is made from the side of the automatic disconnect connected to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train. For a high voltage source that has an automatic disconnect that is not physically contained within itself, the voltage measurement after the test is made from both the high voltage source side of the automatic disconnect and from the side of the automatic disconnect connected to the electric power train or to the rest of the electric power train if the high voltage source is a component contained in the power train.

S7.1.2 Voltage Vb is measured across the two terminals of the voltage source. Before a vehicle crash test, Vb is equal to or greater than the working voltage as specified by the vehicle manufacturer.

S7.1.3 Voltage V1 is measured between the negative side of the high voltage source and the electrical chassis as shown in figure 2 to this standard. Voltage V2 is measured between the positive side of the high voltage source and the electrical chassis as shown in figure 3 to this standard.

S7.2 *Test method for determining electrical isolation.* Measure the voltages V1, V2, and Vb as shown in figure 1 to this standard in accordance with S7.1.

S7.2.1 If V1 is greater than or equal to V2, insert a known resistance (Ro) between the negative side of the high voltage source and the electrical chassis. With the Ro installed, measure the voltage (V1') as shown in figure 4 to this standard between the negative side of the high voltage source and the electrical chassis. Calculate the electrical isolation resistance (Ri) according to the formula shown. Divide Ri (in ohms) by the working voltage of the high voltage source (in volts) to obtain the electrical isolation (in ohms/volt).

S7.2.2 If V2 is greater than V1, insert a known resistance (Ro) between the positive side of the high voltage source and the electrical chassis. With the Ro installed, measure the voltage (V2') as shown in figure 5 to this standard between the positive side of the high voltage source and the electrical chassis. Calculate the electrical isolation resistance (Ri) according to the formula shown. Divide Ri (in ohms) by the working voltage of the high voltage source (in volts) to obtain the electrical isolation (in ohms/volt).

S7.3 *Test methods for evaluating physical barrier protection.*

S7.3.1 *Test method to evaluate protection from direct contact with high voltage sources.* (a) Any parts surrounding the high voltage components are opened, disassembled, or removed without the use of tools.

(b) The selected access probe is inserted into any gaps or openings of the

electrical protection barrier with a test force between 9 Newton to 11 Newton with the IPXXB probe or 1 Newton to 2 Newton with the IPXXD probe. If the probe partly or fully penetrates into the electrical protection barrier, it is placed in every possible position to evaluate contact with high voltage live parts. If partial or full penetration into the electrical protection barrier occurs with the IPXXB probe, the IPXXB probe shall be placed as follows: starting from the straight position, both joints of the test finger are rotated progressively through an angle of up to 90 degrees with respect to the axis of the adjoining section of the test finger and are placed in every possible position.

(c) A low voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp may be connected between the access probe and any high voltage live parts inside the electrical protection barrier to indicate whether high voltage live parts were contacted.

(d) A mirror or fiberscope may be used to inspect whether the access probe touches high voltage live parts inside the electrical protection barrier.

(e) Protection degree IPXXD or IPXXB is verified when the following conditions are met:

(1) The access probe does not touch high voltage live parts. The IPXXB access probe may be manipulated as specified in S7.3.1(b) for evaluating contact with high voltage live parts. The methods specified in S7.3.1(c) or S7.3.1(d) may be used to aid the evaluation. If method S7.3.1(c) is used for verifying protection degree IPXXB or IPXXD, the lamp shall not light up.

(2) The stop face of the access probe does not fully penetrate into the electrical protection barrier.

S7.3.2 *Test method to evaluate protection against indirect contact with high voltage sources.* Any parts surrounding the high voltage components are opened, disassembled, or removed without the use of tools. At the option of the manufacturer, protection against indirect contact with high voltage sources shall be determined using the test method in S7.3.2(a) or (b).

(a) *Test method using a resistance tester.* The resistance tester is connected to the measuring points (the electrical chassis and any exposed conductive part of electrical protection barriers or any two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other), and the resistance is measured using a resistance tester that can supply current levels of at least 0.2 Amperes with a resolution of 0.01 ohms or less. The resistance between two exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

(b) *Test method using a DC power supply, voltmeter, and ammeter.* (1) Connect the DC power supply, voltmeter, and ammeter to the measuring points (the electrical chassis and any exposed conductive part or any two simultaneously reachable exposed conductive parts that are less than 2.5 meters from each other) as shown in figure 8 to this standard.

(2) Adjust the voltage of the DC power supply so that the current flow becomes more than 0.2 Amperes.

(3) Measure the current I and the voltage V shown in figure 8 to this standard.

(4) Calculate the resistance R according to the formula, R = V/I.

(5) The resistance between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured resistances of the relevant parts of the electric path.

S7.3.3 *Test method to determine voltage between exposed conductive parts of electrical protection barriers and the electrical chassis and between exposed conductive parts of electrical protection barriers.* (a) Any parts surrounding the high voltage components are opened, disassembled, or removed without the use of tools.

(b) Connect the voltmeter to the measuring points (exposed conductive part of an electrical protection barrier and the electrical chassis or any two simultaneously reachable exposed conductive parts of electrical protection

barriers that are less than 2.5 meters from each other).

(c) Measure the voltage.

(d) The voltage between two simultaneously reachable exposed conductive parts of electrical protection barriers that are less than 2.5 meters from each other may be calculated using the separately measured voltages between the relevant electrical protection barriers and the electrical chassis.

S7.4 *Test method for evaluating on-board electrical isolation monitoring system.* Prior to any impact test, the requirements of S6.4 of this standard for the on-board electrical isolation monitoring system shall be tested using the following procedure.

(a) The electric energy storage device is at the state of charge specified in S7.1.

(b) The switch or device that provides power from the electric energy storage/conversion system to the propulsion system is in the activated position or the ready-to-drive position.

(c) Determine the isolation resistance, Ri, of the high voltage source with the electrical isolation monitoring system using the procedure outlined in S7.2.

(d) Insert a resistor with resistance Ro equal to or greater than 1/(1/(95 times the working voltage of the high voltage source) − 1/Ri) and less than 1/(1/(100 times the working voltage of the high voltage source) − 1/Ri) between the positive terminal of the high voltage source and the electrical chassis.

(e) The electrical isolation monitoring system indicator shall provide a visual warning to the driver. For a vehicle with automated driving systems and without manually operated driving controls, the visual warning must be provided to all the front row occupants.

S7.5 *Test method for determining post-crash energy in capacitors.* (a) Prior to the crash tests, the vehicle manufacturer must identify the capacitors, type of capacitors (x-capacitors and y-capacitors) and their respective capacitance (Cx and Cy_1 and Cy_2) in the electric power train for which the low energy compliance option for post-crash electrical safety in S8.2(d) of this standard is applied.

(b) Voltages Vb, V1, and V2 are measured across the capacitors in accordance with S7.1.

(c) The total energy in a x-capacitor is equal to $0.5 \times Cx \times Vb^2$.

(d) The total energy in the y-capacitor Cy_1 is equal to $0.5 \times Cy_1 \times V1^2$ and the total energy in the y-capacitor Cy_2 is equal to $0.5 \times Cy_2 \times V2^2$.

S8. *Post-crash safety.* Each vehicle with a GVWR of 4,536 kg or less to which this standard applies must meet the requirements in S8.1, S8.2, S8.3, and S8.4 when tested according to S9 of this standard under the conditions of S10 of this standard. Each school bus with a GVWR greater than 4,536 kg to which this standard applies must meet the requirements in S8.1, S8.2, S8.3, and S8.4 when tested according to S9.5 of this standard under the conditions of S10.

S8.1 *Fire safety.* Starting from the time of impact and continuing until one hour after the completion of the sequence of tests specified in S9 of this standard, there shall be no evidence of fire or explosion in any part of the vehicle. The assessment of fire or explosion is verified by visual inspection without disassembly of the REESS or vehicle.

S8.2 *Electrical safety.* After each test specified in S9 of this standard, each high voltage source in a vehicle must meet one of the following electrical safety requirements: electrical isolation requirements of S8.2(a), the voltage level requirements of S8.2 (b), or the physical barrier protection requirements of S8.2(c); or the high voltage capacitors in the electric power train must meet the low-energy requirements of S8.2(d).

(a) The electrical isolation of the high voltage source, determined in accordance with the procedure specified in S7.2 of this standard, must be greater than or equal to one of the following:

(1) 500 ohms/volt for an AC high voltage source;

(2) 100 ohms/volt for an AC high voltage source if it is conductively connected to a DC high voltage source, but only if the AC high voltage source meets the physical barrier protection requirements specified in S8.2(c)(1) and (2); or

(3) 100 ohms/volt for a DC high voltage source.

(b) The voltages V1, V2, and Vb of the high voltage source, measured according to the procedure specified in S7.1 of this standard, must be less than or equal to 30 VAC for AC components or 60 VDC for DC components.

(c) Protection against electric shock by direct and indirect contact (physical barrier protection) shall be demonstrated by meeting the following three conditions:

(1) The high voltage source (AC or DC) meets the protection degree IPXXB when tested according to the procedure specified in S7.3.1 of this standard using the IPXXB test probe shown in figures 7a and 7b to this standard;

(2) The resistance between exposed conductive parts of the electrical protection barrier of the high voltage source and the electrical chassis is less than 0.1 ohms when tested according to the procedures specified in S7.3.2 of this standard. In addition, the resistance between an exposed conductive part of the electrical protection barrier of the high voltage source and any other simultaneously reachable exposed conductive parts of electrical protection barriers within 2.5 meters of it must be less than 0.2 ohms when tested using the test procedures specified in S7.3.2 of this standard; and

(3) The voltage between exposed conductive parts of the electrical protection barrier of the high voltage source and the electrical chassis is less than or equal to 30 VAC or 60 VDC as measured in accordance with S7.3.3 of this standard. In addition, the voltage between an exposed conductive part of the electrical protection barrier of the high voltage source and any other simultaneously reachable exposed conductive parts of electrical protection barriers within 2.5 meters of it must be less than or equal to 30 VAC or 60 VDC as measured in accordance with S7.3.3 of this standard.

(d) The total energy of unidirectional single impulse currents from capacitors shall be less than 0.2 Joules when determined in accordance with the procedure specified in S7.5 of this standard.

S8.3 *Electric energy storage/conversion device retention.* During and after each test specified in S9 of this standard:

(a) Electric energy storage/conversion devices shall remain attached to the vehicle by at least one component anchorage, bracket, or any structure that transfers loads from the device to the vehicle structure, and

(b) Electric energy storage/conversion devices located outside the occupant compartment shall not enter the occupant compartment.

S8.4 *Electrolyte leakage from electric energy storage devices.* Not more than 5.0 liters of electrolyte shall leak from electric energy storage devices, and no visible trace of electrolyte shall leak into the passenger compartment. Leakage is measured from the time of the impact until 30 minutes thereafter, and throughout any static rollover after a barrier impact test, specified in S9 of this standard.

S9. *Crash test specifications.* A test vehicle with a GVWR less than or equal to 4,536 kg, under the conditions of S10 of this standard, is subject to any one single barrier crash test of S9.1, S9.2, or S9.3, followed by the static rollover test of S9.4. A school bus with a GVWR greater than 4,536 kg, under the conditions of S10, is subject to the contoured barrier crash test of S9.5. A particular vehicle need not meet further test requirements after having been subjected to a single barrier crash/static rollover test sequence.

S9.1 *Frontal barrier crash.* The test vehicle, with test dummies in accordance with S6.1 of §571.301, traveling longitudinally forward at any speed up to and including 48 km/h, impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at an angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle.

S9.2 *Rear moving barrier impact.* The test vehicle, with test dummies in accordance with S6.1 of §571.301, is impacted from the rear by a barrier that conforms to S7.3(b) of §571.301 and that is moving at any speed between 79 and 81 km/h.

S9.3 *Side moving deformable barrier impact.* The test vehicle, with the appropriate 49 CFR part 572 test dummies

specified in § 571.214 at positions required for testing by S7.1.1, S7.2.1, or S7.2.2 of Standard 214 (§ 571.214), is impacted laterally on either side by a moving deformable barrier moving at any speed between 52.0 km/h and 54.0 km/h.

S9.4 *Post-impact test static rollover.* After each crash test specified in S9.1, S9.2, and S9.3, without any alteration of the vehicle, the vehicle is rotated on its longitudinal axis to each successive increment of 90 degrees under the test conditions of S10.3 of this standard.

S9.5 *Moving contoured barrier crash.* The test vehicle, under the conditions of S10.1 and S10.2 of this standard, is impacted at any point and at any angle by the moving contoured barrier assembly, specified in S7.5 and S7.6 in § 571.301, traveling longitudinally forward at any speed up to and including 48 km/h.

S10. *Crash test conditions.*

S10.1 *State of charge.* The electric energy storage device(s) shall be at the state of charge specified in either S10.1(a), (b), or (c):

(a) At the maximum state of charge in accordance with the vehicle manufacturer's recommended charging procedures, as stated in the vehicle owner's manual or on a label that is permanently affixed to the vehicle; or

(b) If the manufacturer has made no recommendation for charging procedures in the owner's manual or on a label permanently affixed to the vehicle, at a state of charge of not less than 95 percent of the maximum capacity of the electric energy storage device(s); or

(c) If the electric energy storage device(s) is/are rechargeable only by an energy source on the vehicle, at any state of charge within the normal operating voltage defined by the vehicle manufacturer.

S10.2 *Vehicle conditions.* The switch or device that provides power from the electric energy storage/conversion system to the propulsion system is in the activated position or the ready-to-drive position. Bypass any devices or systems that do not allow the propulsion system to be energized at the time of impact when the vehicle ignition is on and the vehicle is in neutral.

S10.2.1 The parking brake is disengaged and the vehicle drive system is in the neutral position. In a test conducted under S9.3 of this standard, the parking brake is set.

S10.2.2 Tires are inflated to the manufacturer's specifications.

S10.2.3 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) A passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage compartment, plus the necessary test dummies as specified in S9 of this standard, restrained only by means that are installed in the vehicle for protection at its seating position.

(b) A multipurpose passenger vehicle, truck, or bus, with a GVWR of 4,536 kg (10,000 lb) or less, is loaded to its unloaded vehicle weight plus the necessary dummies, as specified in S9 of this standard, plus 136 kg or its rated GVWR, whichever is less, secured in the load carrying area and distributed as nearly as possible in proportion to its GVWR. For the purpose of this standard, unloaded vehicle weight does not include the weight of work-performing accessories. Each dummy is restrained only by means that are installed in the vehicle for protection at its seating position.

(c) A school bus with a GVWR greater than 4,536 kg is loaded to its unloaded vehicle weight, plus 54 kg of unsecured mass at each designated seating position.

S10.3 *Static rollover test conditions.* The vehicle is rotated about its longitudinal axis, with the axis kept horizontal, to each successive increment of 90°, 180°, and 270° at a uniform rate, with 90° of rotation taking place in any time interval from 1 to 3 minutes. After reaching each 90° increment the vehicle is held in that position for 5 minutes.

S10.4 *Rear moving barrier impact test conditions.* The conditions of S7.3(b) and S7.6 of § 571.301 apply to the conducting of the rear moving deformable barrier impact test specified in S9.2 of this standard.

S10.5 *Side moving deformable barrier impact test conditions.* The conditions of S8.9, S8.10, and S8.11 of § 571.214 apply

to the conduct of the side moving deformable barrier impact test specified in S9.3 of this standard.

S11. *Vehicle controls managing REESS safe operations.* Each vehicle to which the standard applies shall meet the requirements in S11.1, when tested according to S12 of this standard and the requirements in S11.2.

S11.1 When tested in accordance with the overcharge test in S12.1, the over-discharge test in S12.2, the overcurrent test in S12.3, the high-temperature test in S12.4, and the short circuit test in accordance with S12.5 of this standard, each vehicle shall meet the following:

(a) During the test, there shall be no evidence of electrolyte leakage, rupture, venting, fire, or explosion of the REESS as verified by visual inspection without disassembly of the vehicle.

(b) The isolation resistance of the high voltage sources measured after the test shall not be less than 100 ohms/volt when determined in accordance with S7.2 of this standard.

S11.2 In the event of operational failure of the vehicle controls that manage safe operation of the REESS, the vehicle must provide a visual warning while in active driving possible mode. The warning system shall monitor its own readiness and the visual warning must be provided to the driver. For a vehicle with automated driving systems and without manually operated driving controls, the visual warning must be provided to all the front row occupants.

S12. *Test methods for evaluating vehicle controls managing REESS safe operations.*

S12.1 Overcharge test. The overcharge test is conducted at ambient temperatures between 10 °C and 30 °C, with the vehicle REESS initially set between 90 to 95 percent SOC. The following steps are conducted to evaluate the vehicle's overcharge protection controls:

(a) A breakout harness is connected to the traction side of the REESS. The manufacturer must specify an appropriate location(s) and attachment point(s) to connect the breakout harness.

(b) Temperature probes are connected to the REESS outer casing to monitor changes in REESS temperature. Temperature measurements may also be obtained through communication with the REESS control module.

(c) The external charge/discharge equipment, with maximum voltage and current set at least 10 percent higher than the REESS voltage and current limits, is connected to the breakout harness.

(d) The vehicle switch or device that provides power to the vehicle controls that manage REESS operations is set to the activated position.

(e) The REESS is charged with the external charge/discharge equipment with the maximum charge current specified by the manufacturer. If the manufacturer does not specify an appropriate charge current, then a charge rate of ⅓C is used.

(f) Charging is continued until one of the following occurs:

(1) The overcharge protection control terminates the charge current;

(2) The REESS temperature is 10 °C above the manufacturer-specified maximum operating temperature of the REESS; or

(3) 12 hours have passed since the start of charging the vehicle.

(g) After the charge current is terminated, if charge and discharge are permitted by the vehicle controls, a standard cycle is performed in accordance with S12.6.

(h) After the completion of the standard cycle, or if the standard cycle was not performed, after charging is terminated, the vehicle is observed for 1 hour for evidence of electrolyte leakage, rupture, venting, fire, or explosion of the REESS.

(i) At the conclusion of the test, electrical isolation of the REESS is determined in accordance with S7.2 of this standard.

S12.2 *Over-discharge test.* The over-discharge test is conducted at ambient temperatures between 10 °C and 30 °C, with the vehicle REESS initially set between 10 and 15 percent SOC. For a vehicle with on-board energy conversion systems such as an internal combustion engine or a fuel cell, the fuel supply is set to the minimum level where active driving possible mode is permitted. The following steps are conducted to evaluate the vehicle's over-discharge protection controls:

(a) A breakout harness is connected to the traction side of the REESS. The manufacturer must specify an appropriate location(s) and attachment point(s) to connect the breakout harness.

(b) Temperature probes are connected to the REESS outer casing to monitor changes in REESS temperature. Temperature measurements may also be obtained through communication with the REESS control module.

(c) The external charge/discharge equipment, with maximum voltage and current set at least 10 percent higher than the REESS voltage and current limits, is connected to the breakout harness.

(d) The vehicle switch or device that provides power from the REESS to the electric power train is set to the activated position or the active driving possible mode.

(e) The REESS is discharged with the external charge/discharge equipment with the maximum discharge rate under normal operating conditions specified by the manufacturer. If the manufacturer does not specify an appropriate discharge rate, a power load of 1kW is used.

(f) Discharging is continued until one of the following occurs:

(1) The over-discharge protection control terminates the discharge current;

(2) The temperature gradient of the REESS is less than 4 °C through 2 hours from the start of discharge; or

(3) The vehicle is discharged to 25 percent of its working voltage level.

(g) After the discharge current is terminated, a standard cycle is performed in accordance with S12.6, if charge and discharge are permitted by the vehicle controls.

(h) After the completion of the standard cycle, or if the standard cycle was not performed, after discharging is terminated, the vehicle is observed for 1 hour for evidence of electrolyte leakage, rupture, venting, fire, or explosion of the REESS.

(i) At the conclusion of the test, electrical isolation of the REESS is determined in accordance with S7.2 of this standard.

S12.3 *Overcurrent test.* The overcurrent test is only conducted on vehicles that have the capability of charging by DC external electricity supply. The test is conducted at ambient temperatures between 10 °C and 30 °C, with the vehicle REESS initially set between 40 to 50 percent SOC. The following steps are conducted to evaluate the vehicle's over-current protection controls:

(a) A breakout harness is connected to the traction side of the REESS. The manufacturer must specify an appropriate location(s) and attachment point(s) to connect the breakout harness.

(b) Temperature probes are connected to the REESS outer casing to monitor changes in REESS temperature. Temperature measurements may also be obtained through communication with the REESS control module.

(c) The external charge/discharge equipment, with maximum voltage and current set at least 10 percent higher than the REESS voltage and current limits, is connected to the breakout harness.

(d) The vehicle switch or device that provides power to the vehicle controls that manage REESS operations is set to the activated position.

(e) The REESS is charged with the external charge/discharge equipment with the maximum charge current specified by the manufacturer. If the manufacturer does not specify an appropriate charge current, then a charge rate of ⅓C is used.

(f) After charging is initiated, the overcurrent specified by the manufacturer is supplied over the course of 5 seconds from the maximum charge current level to the over-current level. If the vehicle manufacturer does not supply an overcurrent level, a 10 Ampere over-current is supplied over 5 seconds. If charging is not terminated, the overcurrent supply is increased in steps of 10 Amperes.

(g) Charging at the over-current level is continued until one of the following occurs:

(1) The over-current protection control terminates the charge current; or

(2) The temperature gradient of the REESS is less than 4 °C through 2 hours from the first overcurrent input.

(h) After the charge current is terminated, if charge and discharge are permitted by the vehicle controls, a standard cycle is performed in accordance with S12.6.

(i) After the completion of the standard cycle or if the standard cycle was not performed, after charging is terminated, the vehicle is observed for 1 hour for evidence of electrolyte leakage, rupture, venting, fire, or explosion of the REESS.

(j) At the conclusion of the test, electrical isolation of the REESS is determined in accordance with S7.2 of this standard.

S12.4 *Over-temperature test.* The over-temperature test is conducted at ambient temperatures between 10 °C and 30 °C on a chassis-dynamometer with the vehicle REESS initially set between 90 to 95 percent SOC. For a vehicle with on-board energy conversion systems such as an internal combustion engine or a fuel cell, the fuel supply is set to allow operation for about one hour of driving. The following steps are conducted to evaluate the vehicle's high temperature protection controls:

(a) The cooling system of the REESS is disabled using manufacturer supplied information. For an REESS that will not operate if the cooling system is disabled, the cooling operation is significantly reduced. If manufacturer does not supply information to disable or significantly reduce the cooling system, methods such as crimping the liquid cooling hose, removing refrigerant fluid, or blocking cabin air intakes for air cooled REESS are applied.

(b) Temperature probes are connected to the REESS outer casing to monitor changes in REESS temperature. Temperature measurements may also be obtained through communication with the REESS control module.

(c) The vehicle is installed on a chassis dynamometer and the vehicle switch or device that provides power from the REESS to the electric power train is set to the activated position or the active driving possible mode.

(d) The vehicle is driven on the dynamometer using an appropriate vehicle manufacturer supplied drive profile and charging information for discharge and charge of the REESS to raise the REESS temperature to its upper boundary safe operating temperature within one hour. If an appropriate manufacturer-supplied drive profile is not available, the vehicle is repeatedly accelerated to 80 mph and then decelerated to 15 mph within 40 seconds. If the manufacturer does not supply a charge profile, then a charge rate greater than ⅓C current is used.

(e) The discharge/charge procedure on the chassis-dynamometer is continued until one of the following occurs:

(1) The vehicle terminates the discharge/charge cycle;

(2) The temperature gradient of the REESS is less than 4 °C through 2 hours from the start of the discharge/charge cycle; or

(3) Three (3) hours have passed since the start of discharge/charge cycles.

(f) After the discharge and charge procedure is terminated, if charge and discharge are permitted by the vehicle controls, a standard cycle is performed in accordance with S12.6.

(g) After the completion of the standard cycle, or if the standard cycle is not performed, after the discharge and charge procedure is terminated, the vehicle is observed for 1 hour for evidence of electrolyte leakage, rupture, venting, fire, or explosion of the REESS.

(h) At the conclusion of the test, electrical isolation of the REESS is determined in accordance with S7.2 of this standard.

S12.5 *External short circuit test.* The short circuit test is conducted at ambient conditions with the vehicle REESS initially set between 90 to 95 percent SOC. The following steps are conducted to evaluate the vehicle's external short circuit protection controls:

(a) A breakout harness is connected to the REESS. The manufacturer must specify an appropriate location(s) and attachment point(s) to connect the breakout harness.

(b) Temperature probes are connected to the REESS outer casing to monitor changes in REESS temperature. Temperature measurements may also be obtained through communication with the REESS control module.

(c) The vehicle switch or device that provides power to the vehicle controls that manage REESS operations is set to the activated position.

(d) The short circuit contactor (with the contactors in open position) is connected to the breakout harnesses. The total resistance of the equipment to create the external short circuit (short circuit contactor and breakout harnesses) is verified to be between 2 to 5 milliohms.

(e) The short circuit contactor is closed to initiate the short circuit.

(f) The short circuit condition is continued until one of the following occurs:

(1) Short circuit current is terminated; or

(2) The temperature gradient of the REESS is less than 4 °C through 2 hours from the start of initiating the short circuit condition.

(g) After the short circuit current is terminated, if charge and discharge are permitted by the vehicle controls, a standard cycle is performed in accordance with S12.6.

(h) After the completion of the standard cycle, or if the standard cycle was not performed, after short circuit current is terminated, the vehicle is observed for 1 hour for evidence of electrolyte leakage, rupture, venting, fire, or explosion of the REESS.

(i) At the conclusion of the test, electrical isolation of the REESS is determined in accordance with S7.2 of this standard.

S12.6 *Standard cycle.* The standard cycle is conducted at ambient temperatures between 10 °C and 30 °C and starts with a standard discharge followed by a standard charge. The discharge and charge procedures would follow manufacturer supplied information. The charge procedure is initiated 15 minutes after discharge is terminated.

(a) If the manufacturer does not provide a discharge procedure, the vehicle is discharged with 1C current until discharge is terminated by vehicle controls.

(b) If the manufacturer does not provide a charge procedure, the vehicle is charged with ⅓C current until terminated by vehicle controls.

S13. *Warning in the case of thermal event in REESS.* The vehicle shall provide a warning to the driver in the case of a thermal event in the REESS when the vehicle is in active driving possible mode. The thermal event warning system must monitor its own readiness. The warning shall activate within three minutes of the onset of the thermal event. The warning shall consist of auditory and visual signals that remain active for at least 5 minutes. For a vehicle with automated driving systems and without manually operated driving controls, the visual warning must be provided to all the front row occupants.

S14. *Water exposure safety.* Each vehicle to which the standard applies shall maintain electrical isolation as specified in S6.3.1 and S6.3.2 of this standard at these times:

(a) Just after exposure to water in each of the two tests specified below and with the vehicle still wet; and

(b) After a minimum of 24 hours after completing each of the tests specified in S14.1 and S14.2.

S14.1 *Vehicle washing test.* The vehicle is sprayed from any direction with a stream of freshwater from a standard test nozzle shown in figure 9 to this standard that has a nozzle internal diameter of 6.3 millimeters, delivery rate of 11.9 to 13.2 liters/minute, and water pressure at the nozzle between 30 kPa to 35 kPa.

(a) During the washing, the distance from the nozzle to the vehicle surface is 3.0 to 3.2 meters. The distance of the nozzle from the vehicle surface may be reduced, if necessary, to ensure the surface is wet when spraying upwards. The washing test duration per square meter of the vehicle surface area is 60 to 75 seconds, with a minimum total test duration of 3 minutes.

(b) The vehicle external surface, including the vehicle sides, front, rear, top, and bottom is exposed to the water stream. Border lines on the vehicle such glass seals, outline of opening parts (doors, windows, vehicle inlet cover), outline of front grille, and seals of vehicle lamps are exposed to the water stream from any direction.

(c) At the conclusion of the normal washing test, with the vehicle still wet, electrical isolation is determined in accordance with S7.2 of this standard.

S14.2 *Driving through standing water test.* The vehicle is driven through a wade pool of at least 10 centimeters but not more than 15 centimeters depth of freshwater for a distance of 500 meters

at a minimum speed of 12 mph (20 km/h) but not more than 15 mph (24 km/h).

(a) If the wade pool is less than 500 m in length, then the vehicle shall be driven through it several times for a total distance of 500 m. The total time, including the period outside of the wade pool, shall be less than 10 minutes.

(b) At the conclusion of the standing water test, with the vehicle still wet, electrical isolation is determined in accordance with S7.2 of this standard.

FIGURES TO FMVSS NO. 305A

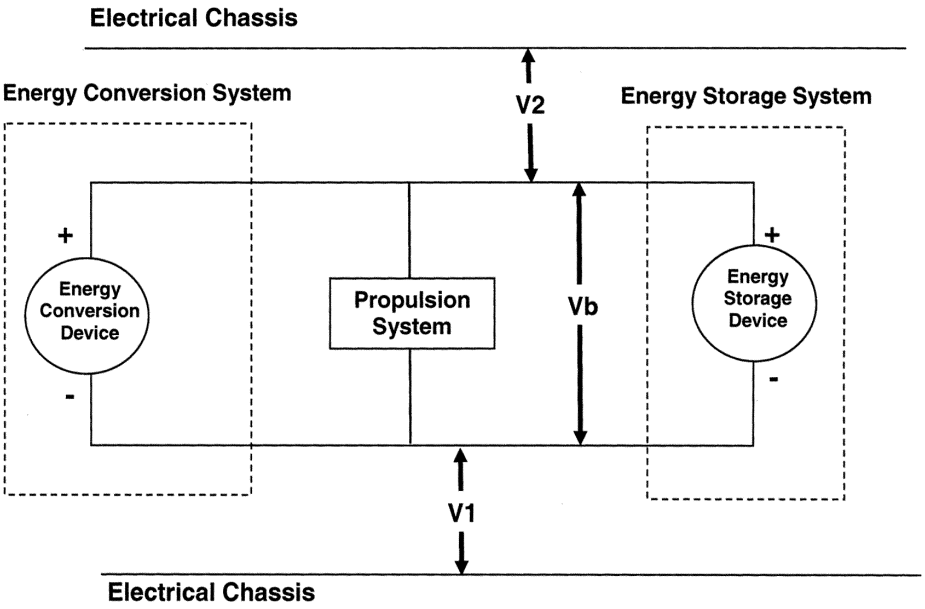


Figure 1. Voltage Measurements of the High Voltage Source

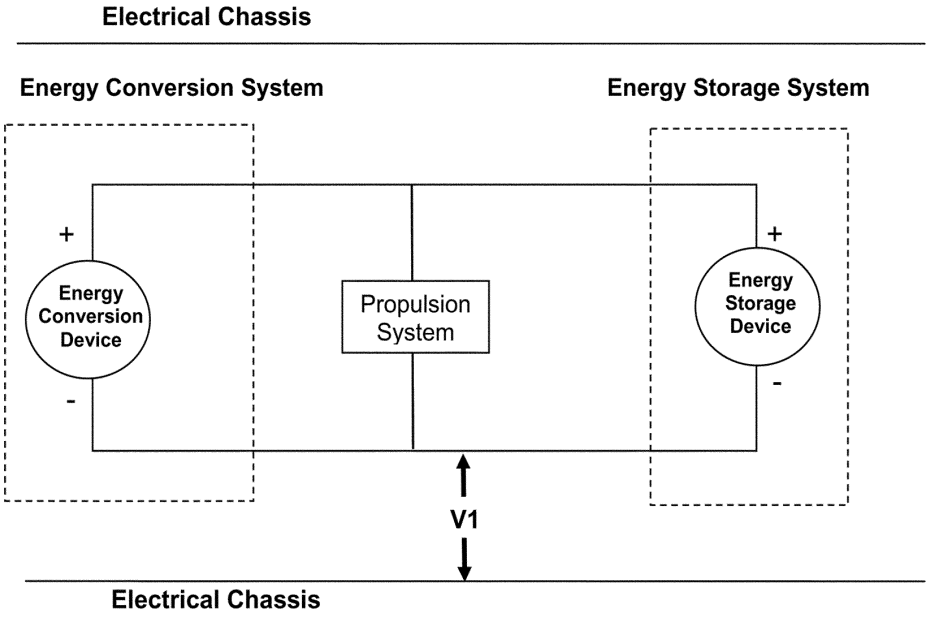


Figure 2. Measurement for V1 Voltage Between the Negative Side of the High Voltage Source and the Electrical Chassis

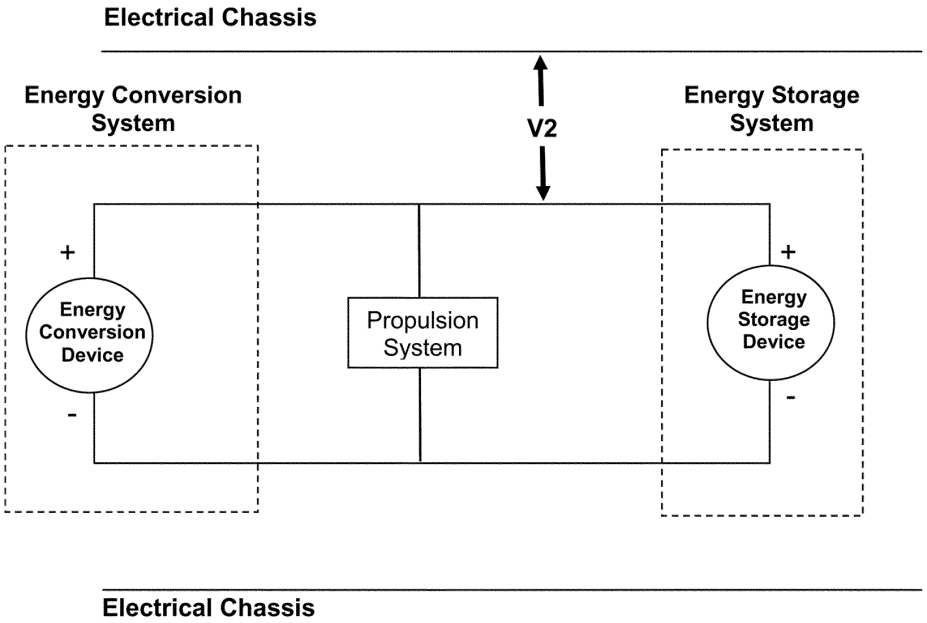


Figure 3. Measurement for V2 Voltage Between the Positive Side of the High Voltage Source and the Electrical Chassis

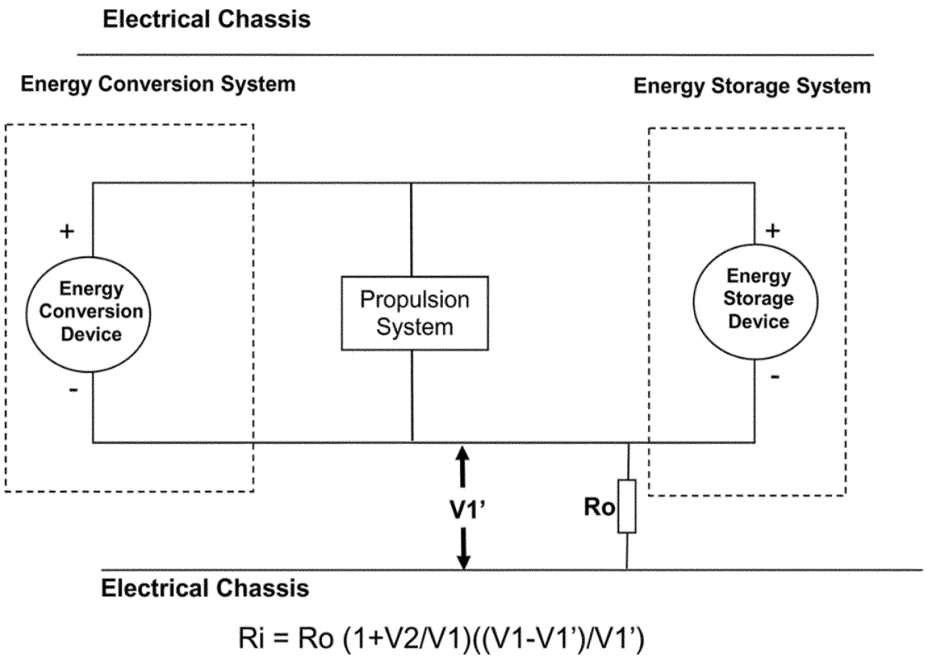


Figure 4. Measurement for V1' Voltage Across Resistor Between Negative Side of the High Voltage Source and Electrical Chassis

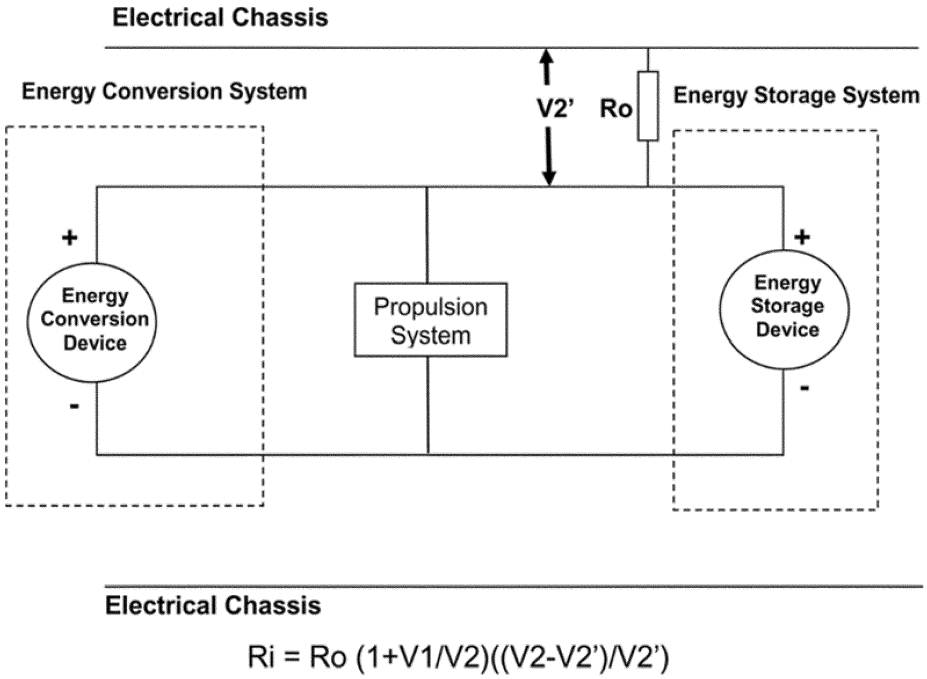


Figure 5. Measurement for V2' Voltage Across Resistor Between Positive Side of the High Voltage Source and Electrical Chassis

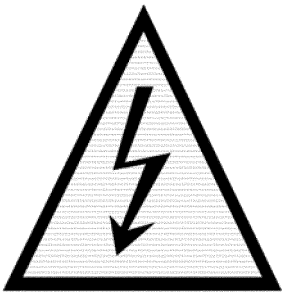


Figure 6. Marking of High Voltage Sources

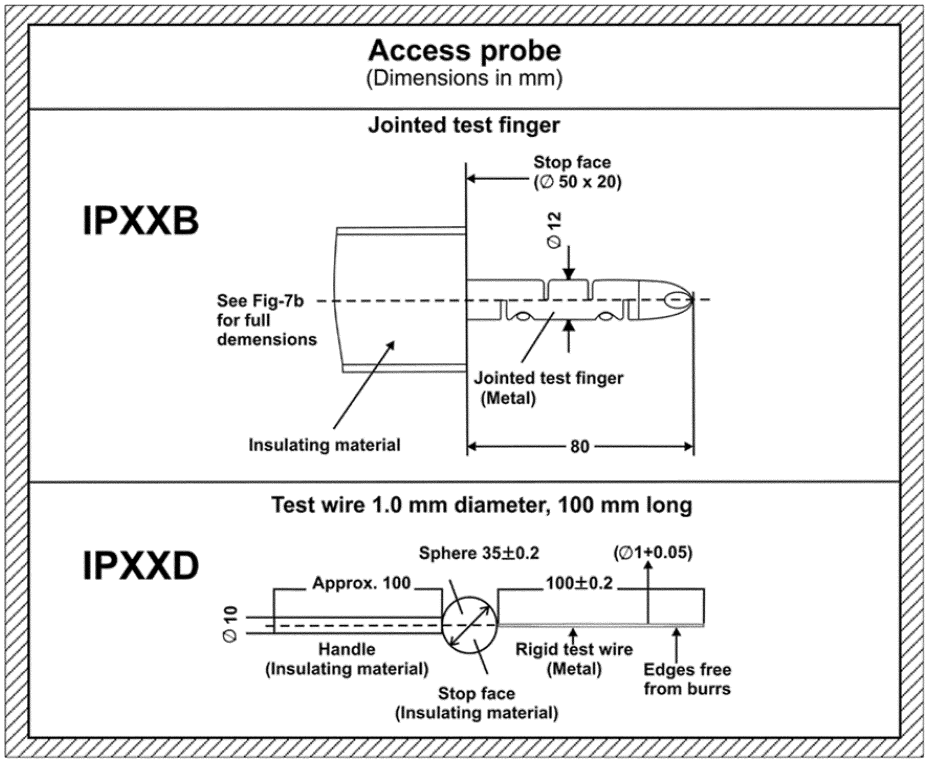
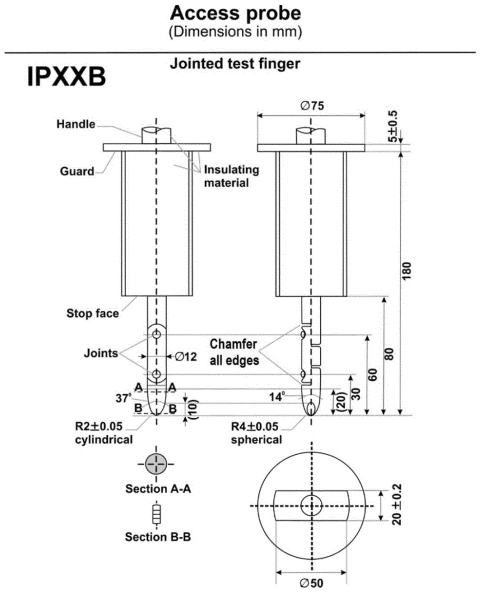


Figure 7a. Access Probes for the Tests of Direct Contact Protection. Access Probe IPXXB (Top) and Access Probe IPXXD (Bottom)



Material: metal, except where otherwise specified
Linear dimensions in millimeters
Tolerances on dimensions without specific tolerance:
on angles, 0/10 degrees
on linear dimensions:
up to 25 mm: 0/-0.05 mm
over 25 mm: ±0.2 mm
Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0° to +10° tolerance.

Figure 7b. Jointed Test Finger IPXXB

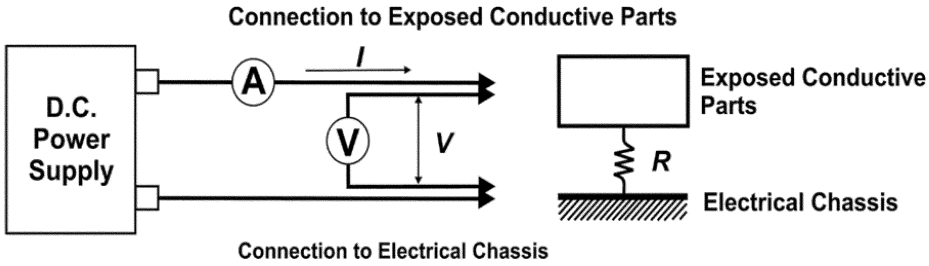


Figure 8. Connection To Determine Resistance Between Exposed Conductive Parts of Electrical Protection Barrier and Electrical Chassis

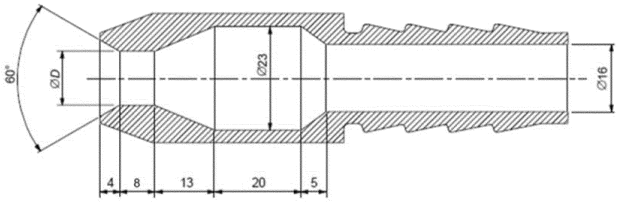


Figure 9. Standard Nozzle for IPX5 Water Exposure Test

[89 FR 104352, Dec. 20, 2024]

§571.307 Standard No. 307; Fuel system integrity of hydrogen vehicles.

S1. *Scope.* This standard specifies requirements for the integrity of motor vehicle hydrogen fuel systems.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries occurring from fires that result from hydrogen fuel leakage during vehicle operation and after motor vehicle crashes.

S3. *Application.* This standard applies to each motor vehicle manufactured on or after September 1, 2028, that uses compressed hydrogen gas as a fuel source to propel the vehicle.

S4. *Definitions.*

Check valve means a valve that prevents reverse flow.

Closure devices mean the check valve(s), shut-off valve(s), and thermally-activated pressure relief device(s) that control the flow of hydrogen into and/or out of a CHSS.

Container means a pressure-bearing component of a compressed hydrogen storage system that stores a continuous volume of hydrogen fuel in a single chamber or in multiple permanently interconnected chambers.

Container attachments mean non-pressure bearing parts attached to the container that provide additional support and/or protection to the container and that may be removed only with the use of tools for the specific purpose of maintenance and/or inspection.

Compressed hydrogen storage system (CHSS) means a system that stores compressed hydrogen fuel for a hydrogen-fueled vehicle, composed of a container, container attachments (if any), and all closure devices required to isolate the stored hydrogen from the remainder of the fuel system and the environment.

Enclosed or semi-enclosed spaces means the passenger compartment, luggage compartment, and space under the hood.

Fuel cell system means a system containing the fuel cell stack(s), air processing system, fuel flow control system, exhaust system, thermal management system, and water management system.

Fueling receptacle means the equipment to which a fueling station nozzle attaches to the vehicle and through which fuel is transferred to the vehicle.

Fuel lines means all piping, tubing, joints, and any components such as flow controllers, valves, heat exchangers, and pressure regulators.

Hydrogen concentration means the percentage of the hydrogen molecules within the mixture of hydrogen and air (equivalent to the partial volume of hydrogen gas).

Hydrogen fuel system means the fueling receptacle, CHSS, fuel cell system or internal combustion engine, fuel lines, and exhaust systems.

Luggage compartment means the space in the vehicle for luggage, cargo, and/or goods accommodation, bounded by a roof, hood, floor, side walls being separated from the passenger compartment by the front bulkhead or the rear bulkhead.

Maximum allowable working pressure (MAWP) means the highest gauge pressure to which a component or system is

permitted to operate under normal operating conditions.

Nominal working pressure (NWP) means the settled pressure of compressed gas in a container or CHSS fully fueled to 100 percent state of charge and at a uniform temperature of 15 °C.

Normal milliliter means a quantity of gas that occupies one milliliter of volume when its temperature is 0 °C and its pressure is 1 atmosphere.

Passenger compartment means the space for occupant accommodation that is bounded by the roof, floor, side walls, doors, outside glazing, front bulkhead, and rear bulkhead or rear gate.

Pressure relief device (PRD) means a device that, when activated under specified performance conditions, is used to release hydrogen from a pressurized system and thereby prevent failure of the system.

Rechargeable electrical energy storage system (REESS) means the rechargeable energy storage system that provides electric energy for electrical propulsion.

Service door means a door that allows for the entry and exit of vehicle occupants under normal operating conditions.

Shut-off valve means a valve between the container and the remainder of the hydrogen fuel system that must default to the ''closed'' position when unpowered.

State of charge (SOC) means the density ratio of hydrogen in the CHSS between the actual CHSS condition and that at NWP with the CHSS equilibrated to 15 °C, as expressed as a percentage using equation 1 to this section, where ρ is the density of hydrogen (g/L) at pressure (P) in MegaPascals (MPa) and temperature (T) in Celsius (°C) as listed in table 1 to S4 or linearly interpolated therein:

EQUATION 1 TO § 571.307 S4

$$SOC(\%) = \frac{\rho(P,T)}{\rho(NWP, 15°C)} x100$$

TABLE 1 TO §571.307 S4

Temperature (°C)	Pressure (MPa)												
	1	10	20	30	35	40	50	60	65	70	75	80	87.5
−40	1.0	9.7	18.1	25.4	28.6	31.7	37.2	42.1	44.3	46.4	48.4	50.3	53.0
−30	1.0	9.4	17.5	24.5	27.7	30.6	36.0	40.8	43.0	45.1	47.1	49.0	51.7
−20	1.0	9.0	16.8	23.7	26.8	29.7	35.0	39.7	41.9	43.9	45.9	47.8	50.4
−10	0.9	8.7	16.2	22.9	25.9	28.7	33.9	38.6	40.7	42.8	44.7	46.6	49.2
0	0.9	8.4	15.7	22.2	25.1	27.9	33.0	37.6	39.7	41.7	43.6	45.5	48.1
10	0.9	8.1	15.2	21.5	24.4	27.1	32.1	36.6	38.7	40.7	42.6	44.4	47.0
15	0.8	7.9	14.9	21.2	24.0	26.7	31.7	36.1	38.2	40.2	42.1	43.9	46.5
20	0.8	7.8	14.7	20.8	23.7	26.3	31.2	35.7	37.7	39.7	41.6	43.4	46.0
30	0.8	7.6	14.3	20.3	23.0	25.6	30.4	34.8	36.8	38.8	40.6	42.4	45.0
40	0.8	7.3	13.9	19.7	22.4	24.9	29.7	34.0	36.0	37.9	39.7	41.5	44.0
50	0.7	7.1	13.5	19.2	21.8	24.3	28.9	33.2	35.2	37.1	38.9	40.6	43.1
60	0.7	6.9	13.1	18.7	21.2	23.7	28.3	32.4	34.4	36.3	38.1	39.8	42.3
70	0.7	6.7	12.7	18.2	20.7	23.1	27.6	31.7	33.6	35.5	37.3	39.0	41.4
80	0.7	6.5	12.4	17.7	20.2	22.6	27.0	31.0	32.9	34.7	36.5	38.2	40.6
85	0.7	6.4	12.2	17.5	20.0	22.3	26.7	30.7	32.6	34.4	36.1	37.8	40.2

Thermally-activated pressure relief device (TPRD) means a non-reclosing PRD that is activated by temperature to open and release hydrogen gas.

S5. *Hydrogen fuel system.*

S5.1. *Fuel system integrity during normal vehicle operations.*

S5.1.1. *Fueling receptacle requirements.* (a) A compressed hydrogen fueling receptacle shall prevent reverse flow to the atmosphere.

(b) A label shall be affixed close to the fueling receptacle showing the following information:

(1) The statement, ''Compressed hydrogen gas only.''

(2) The statement, ''Service pressure _____MPa (_____psig).''

(3) The statement, ''See instructions on fuel container(s) for inspection and service life.''

(c) The fueling receptacle shall ensure positive locking of the fueling nozzle.

(d) The fueling receptacle shall be protected from the ingress of dirt and water.

(e) The fueling receptacle shall not be installed in enclosed or semi-enclosed spaces.

S5.1.2. *Hydrogen discharge systems.*

S5.1.2.1. *Pressure relief systems.* (a) If present, the outlet of the vent line for hydrogen gas discharge from the TPRD(s) of the CHSS shall be protected from ingress of dirt and water.

(b) The hydrogen gas discharge from TPRD(s) of the CHSS shall not impinge upon:

(1) Enclosed or semi-enclosed spaces;

(2) Any vehicle wheel housing;

(3) Container(s);

(4) REESS(s);

(5) Any emergency exit(s) as identified in § 571.217 (FMVSS No. 217); nor

(6) Any service door(s).

S5.1.2.2. *Vehicle exhaust system.* When tested in accordance with S6.5 of this standard, the hydrogen concentration at the vehicle exhaust system's point of discharge shall not:

(a) Exceed an average of 4.0 percent by volume during any moving three-second time interval; nor

(b) Exceed 8.0 percent by volume at any time.

S5.1.3. *Protection against flammable conditions.* (a) When tested in accordance with S6.4.1 of this standard, a warning in accordance with S5.1.6 shall be provided within 10 seconds of the application of the first test gas. When tested in accordance with S6.4.1, the main shut-off valve shall close within 10 seconds of the application of the second test gas.

(b) When tested in accordance with S6.4.2 of this standard, the hydrogen concentration in the enclosed or semi-enclosed spaces shall be less than 3.0 percent.

S5.1.4. *Fuel system leakage.* When tested in accordance with S6.6 of this standard, the hydrogen fuel system downstream of the shut-off valve(s) shall not exhibit observable leakage.

S5.1.5 *Tell-tale warning.* A warning shall be given to the driver, or to all front seat occupants for vehicles without a driver's designated seating position, by a visual signal or display text with the following properties:

(a) Visible to the driver while seated in the driver's designated seating position or visible to all front seat occupants of vehicles without a driver's designated seating position;

(b) Yellow in color if the warning system malfunctions;

(c) Red in color if hydrogen concentration in enclosed or semi-enclosed spaces exceeds 3.0 percent by volume;

(d) When illuminated, shall be visible to the driver (or to all front seat occupants in vehicles without a driver's designated seating position) under both daylight and nighttime driving conditions; and

(e) Remains illuminated when hydrogen concentration in any of the vehicle's enclosed or semi-enclosed spaces exceeds 3.0 percent by volume or when the warning system malfunctions, and the ignition locking system is in the ''On'' (''Run'') position or the propulsion system is activated.

S5.2. *Post-crash fuel system integrity.* Each vehicle with a gross vehicle weight rating (GVWR) of 4,536 kg or less to which this standard applies must meet the requirements in S5.2.1 through S5.2.4 when tested according to S6 under the conditions of S7. Each school bus with a GVWR greater than 4,536 kg to which this standard applies must meet the requirements in S5.2.1 through S5.2.4 when tested according

to S6 under the conditions of S7 of this standard.

S5.2.1. *Fuel leakage limit.* If hydrogen gas is used for testing, the volumetric flow of hydrogen gas leakage shall not exceed an average of 118 normal liters per minute for the time interval, Δt, as determined in accordance with S6.2.1 of this standard. If helium is used for testing, the volumetric flow of helium leakage shall not exceed an average of 88.5 normal litres per minute for the time interval, Δt, as determined in accordance with S6.2.2 of this standard.

S5.2.2. *Concentration limit in enclosed spaces.* The vehicle shall meet at least one of the requirements in S5.2.2(a), (b), or (c).

(a) Hydrogen gas leakage shall not result in a hydrogen concentration in the air greater than 4.0 percent by volume in enclosed or semi-enclosed spaces for 60 minutes after impact when tested in accordance with S6.3 of this standard.

(b) Helium gas leakage shall not result in a helium concentration in the air greater than 3.0 percent by volume in enclosed or semi-enclosed spaces for 60 minutes after impact when tested in accordance with S6.3 of this standard.

(c) The shut-off valve of the CHSS shall close within 5 seconds of the crash.

S5.2.3. *Container displacement.* The container(s) shall remain attached to the vehicle by at least one component anchorage, bracket, or any structure that transfers loads from the container to the vehicle structure.

S5.2.4. *Fire.* There shall be no fire in or around the vehicle for the duration of the test.

S6. *Test Requirements.*

S6.1. *Vehicle Crash Tests.* A test vehicle with a GVWR less than or equal to 4,536 kg, under the conditions of S7 of this standard, is subject to any one single barrier crash test of S6.1.1, S6.1.2, and S6.1.3. A school bus with a GVWR greater than 4,536 kg, under the conditions of S7, is subject to the contoured barrier crash test of S6.1.4. A particular vehicle need not meet further test requirements after having been subjected and evaluated to a single barrier crash test.

S6.1.1. *Frontal barrier crash.* The test vehicle, with test dummies in accordance with S6.1 of 571.301 of this chapter, traveling longitudinally forward at any speed up to and including 48.0 km/h, impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at an angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle.

S6.1.2. *Rear moving barrier impact.* The test vehicle, with test dummies in accordance with S6.1 of §571.301, is impacted from the rear by a barrier that conforms to S7.3(b) of §571.301 and that is moving at any speed up to and including 80.0 km/h.

S6.1.3. *Side moving deformable barrier impact.* The test vehicle, with the appropriate 49 CFR part 572 test dummies specified in §571.214 (FMVSS No. 214) at positions required for testing by S7.1.1, S7.2.1, or S7.2.2 of Standard 214, is impacted laterally on either side by a moving deformable barrier moving at any speed between 52.0 km/h and 54.0 km/h.

S6.1.4. *Moving contoured barrier crash.* The test vehicle is impacted at any point and at any angle by the moving contoured barrier assembly, specified in S7.5 and S7.6 in §571.301, traveling longitudinally forward at any speed up to and including 48.0 km/h.

S6.2. *Post-crash CHSS leak test.*

S6.2.1. *Post-crash leak test for CHSS filled with compressed hydrogen.* (a) The hydrogen gas pressure, P_0 (MPa), and temperature, T_0 (°C), shall be measured immediately before the impact. The hydrogen gas pressure P_f (MPa) and temperature, T_f (°C) shall also be measured immediately after a time interval Δt (in minutes) after impact. The time interval, Δt, starting from the time of impact, shall be the greater of S6.2.1(a)(1) or (2):

(1) 60 minutes; or

(2) The time interval calculated with equation 2 to this section, where $R_s = P_s/NWP$, P_s is the pressure range of the pressure sensor (MPa), NWP is the Nominal Working Pressure (MPa), and V_{CHSS} is the volume of the CHSS (L):

EQUATION 2 TO §571.307 S6.2.1(A)(2)

$$\Delta t = V_{CHSS} \times NWP/1000 \times ((-0.027 \times NWP + 4) \times R_s - 0.21) - 1.7 \times R_s$$

(b) The initial mass of hydrogen M_0 (g) in the CHSS shall be calculated

from equations 3 through 5 to this section:

EQUATION 3 TO § 571.307 S6.2.1(B)

$$P_0' = P_0 \times 288/(273 + T_0)$$

EQUATION 4 TO § 571.307 S6.2.1(B)

$$\rho_0' = -0.0027 \times (P_0')^2 + 0.75 \times P_0' + 1.07$$

EQUATION 5 TO § 571.307 S6.2.1(B)

$$M_0 = \rho_0' \times V_{CHSS}$$

(c) The final mass of hydrogen in the CHSS, M_f (in grams), at the end of the time interval, Δt, shall be calculated from equations 6 through 8 to this section, where P_f is the measured final pressure (MPa) at the end of the time interval, and T_f (°C) is the measured final temperature:

EQUATION 6 TO § 571.307 S6.2.1(C)

$$P_f' = P_f \times 288/(273 + T_f)$$

EQUATION 7 TO § 571.307 S6.2.1(C)

$$\rho_f' = -0.0027 \times (P_f')^2 + 0.75 \times P_f' + 1.07$$

EQUATION 8 TO § 571.307 S6.2.1(C)

$$M_f = \rho_f' \times V_{CHSS}$$

(d) The average hydrogen flow rate over the time interval shall be calculated from equation 9 to this section, where V_{H2} is the average volumetric flow rate (normal millilitres per min) over the time interval:

EQUATION 9 TO § 571.307 S6.2.1(D)

$$V_{H2} = (M_f - M_0)/\Delta t \times 22.41/2.016 \times (P_{target}/P_0)$$

S6.2.2 *Post-crash leak test for CHSS filled with compressed helium.*

(a) The helium pressure, P_0 (MPa), and temperature, T_0 (°C), shall be measured immediately before the impact and again immediately after a time interval starting from the time of impact. The time interval, Δt (min), shall be the greater of the values in S6.2.2(a)(1) or (2):

(1) 60 minutes; or

(2) The time interval calculated with equation 10 to this section, where $R_s = P_s/NWP$, P_s is the pressure range of the pressure sensor (MPa), NWP is the Nominal Working Pressure (MPa), and V_{CHSS} is the volume of the CHSS (L):

EQUATION 10 TO § 571.307 S6.2.2(A)(2)

$$\Delta t = V_{CHSS} \times NWP/1000 \times (-0.028 \times NWP + 5.5) \times R_s - 0.3) - 2.6 \times R_s$$

(b) The initial mass of helium M_0 (g) in the CHSS shall be calculated from equations 11 through 13 to this section:

EQUATION 11 TO § 571.307 S6.2.2(B)

$$P_0' = P_0 \times 288/(273 + T_0)$$

EQUATION 12 TO § 571.307 S6.2.2(B)

$$\rho_0' = -0.0043 \times (P_0')^2 + 1.53 \times P_0' + 1.49$$

EQUATION 13 TO § 571.307 S6.2.2(B)

$$M_0 = \rho_0' \times V_{CHSS}$$

(c) The final mass of helium M_f (g) in the CHSS at the end of the time interval, Δt (min), shall be calculated from equations 14 through 16 to this section, where P_f is the measured final pressure (MPa) at the end of the time interval, and T_f (°C) is the measured final temperature:

EQUATION 14 TO § 571.307 S6.2.2(C)

$$P_f' = P_f \times 288/(273 + T_f)$$

EQUATION 15 TO § 571.307 S6.2.2(C)

$$\rho_f' = -0.0043 \times (P_f')^2 + 1.53 \times P_f' + 1.49$$

EQUATION 16 TO § 571.307 S6.2.2(C)

$$M_f = \rho_f' \times V_{CHSS}$$

(d) The average helium flow rate over the time interval shall be calculated from equation 17 to this section, where V_{He} is the average volumetric flow rate (normal millilitres per min) of helium over the time interval:

EQUATION 17 TO § 571.307 S6.2.2(D)

$$V_{He} = (M_f - M_0)/\Delta t \times 22.41/4.003 \times (P_{target}/P_0)$$

S6.3. *Post-crash concentration test for enclosed spaces.* (a) Sensors shall measure either the accumulation of hydrogen or helium gas, as appropriate, or the reduction in oxygen.

(b) Sensors shall have an accuracy of at least 5 percent at 4.0 percent hydrogen or 3.0 percent helium by volume in air, and a full-scale measurement capability of at least 25 percent above these criteria. The sensor shall be capable of a 90 percent response to a full-scale change in concentration within 10 seconds.

(c) Prior to the crash impact, the sensors shall be located in the passenger and luggage compartments of the vehicle as follows:

(1) At any interior point at any distance between 240 mm and 260 mm of the headliner above the driver's seat or near the top center of the passenger compartment.

(2) At any interior point at any distance between 240 mm and 260 mm of the floor in front of the rear (or rear most) seat in the passenger compartment.

(3) At any interior point at any distance between 90 mm and 110 mm below the top of luggage compartment(s).

(d) The sensors shall be securely mounted on the vehicle structure or seats and protected from debris, air bag exhaust gas and projectiles.

(e) The vehicle shall be located either indoors or in an area outdoors protected from direct and indirect wind.

(f) Post-crash data collection in enclosed spaces shall commence from the time of impact. Data from the sensors shall be collected at least every 5 seconds and continue for a period of 60 minutes after the impact.

(g) The data shall be compiled into a three-data-point rolling average prior to evaluating the applicable concentration limit in accordance with S5.2.2(a) or (b) of this standard.

S6.4. *Test procedure for protection against flammable conditions.*

S6.4.1. *Test for hydrogen gas leakage detectors.* (a) The vehicle propulsion system shall be operated for at least five minutes prior to testing and shall continue to operate throughout the test.

(b) Two mixtures of air and hydrogen gas shall be used in the test: The first test gas has any hydrogen concentration between 3.0 and 4.0 percent by volume in air to verify function of the warning, and the second test gas has any hydrogen concentration between 4.0 and 6.0 percent by volume in air to verify function of the shut-down.

(c) The test shall be conducted without influence of wind.

(d) A vehicle hydrogen leakage detector located in the enclosed or semi-enclosed spaces is enclosed with a cover and a test gas induction hose is attached to the hydrogen gas leakage detector.

(e) The hydrogen gas leakage detector is exposed to continuous flow of the first test gas specified in S.6.4.1(b) until the warning turns on.

(f) Then the hydrogen gas leakage detector is exposed to continuous flow of the second test gas specified in S.6.4.1(b) until the main shut-off valve closes to isolate the CHSS. The test is completed when the shut-off valve closes.

S6.4.2. *Test for integrity of enclosed spaces and detection systems.* (a) The test shall be conducted without influence of wind.

(b) Prior to the test, the vehicle is prepared to simulate remotely controllable hydrogen releases from the fuel system or from an external fuel supply. The number, location, and flow capacity of the release points downstream of the shut-off valve are defined by the vehicle manufacturer.

(c) A hydrogen concentration detector shall be installed in any enclosed or semi-enclosed spaces where hydrogen may accumulate from the simulated hydrogen release.

(d) Vehicle doors, windows and other covers are closed.

(e) The vehicle propulsion system shall be operated for at least five minutes and shall continue to operate throughout the remainder of the test.

(f) A leak shall be simulated using the remote controllable function.

(g) The hydrogen concentration is measured continuously until the end of the test.

(h) The test is completed 5 minutes after initiating the simulated leak or when the hydrogen concentration does not change for 3 minutes, whichever is longer.

S6.5. *Test for the vehicle exhaust system.* (a) The vehicle propulsion system shall be operated for at least five minutes prior to testing and shall continue to operate throughout the test, except for times when the propulsion system becomes deactivated by the steps taken during S6.5(c).

(b) The measuring section of the measuring device shall be placed along the centerline of the exhaust gas flow within 100 mm of where the exhaust is released to the atmosphere.

(c) The exhaust hydrogen concentration shall be continuously measured during the following steps:

(1) The fuel cell system shall be shut down.

(2) The fuel cell system shall be immediately restarted.

(3) After one minute, the vehicle shall be set to the ''off'' position and measurement continues until the until the vehicle shutdown is complete.

(d) The measurement device shall have a resolution time of less than 300 milliseconds;

(e) The measurement device shall have a measurement response time ($t_0 - t_{90}$) of less than 2 seconds, where t_0 is the moment of hydrogen concentration switching, and t_{90} is the time when 90 percent of the final indication is reached and shall have a resolution time of less than 300 milliseconds (sampling rate of greater than 3.33 Hz).

S6.6. *Test for fuel system leakage.* The vehicle CHSS shall be filled with hydrogen to any pressure between 90 percent NWP and 100 percent NWP for the duration of the test for fuel system leakage.

(a) The vehicle propulsion system shall be operated for at least five minutes prior to testing and shall continue to operate throughout the test.

(b) Hydrogen leakage shall be evaluated at accessible sections of the hydrogen fuel system downstream of the shut-off valve(s) using a leak detecting liquid. Hydrogen gas leak detection shall be performed immediately after applying the liquid.

S7. *Test conditions.* The requirements of S5.2 shall be met under the following conditions. Where a range of conditions is specified, the vehicle must be capable of meeting the requirements at all points within the range.

(a) Prior to conducting the crash test, instrumentation is installed in the CHSS to perform the required pressure and temperature measurements if the vehicle does not already have instrumentation with the required accuracy.

(b) The CHSS is then purged, if necessary, following vehicle manufacturer directions before filling the CHSS with compressed hydrogen or helium gas, as specified by the vehicle manufacturer.

(c) The target fill pressure P_{target} shall be calculated from equation 18 to this section, where NWP is in MPa, T_o is the ambient temperature in °C to which the CHSS is expected to settle, and P_{target} is the target fill pressure in MPa after the temperature settles:

EQUATION 18 TO § 571.307 S7

$$P_{target} = NWP \times (273 + T_o)/288$$

(d) The container(s) shall be filled to any pressure between 95.0 percent and 100.0 percent of the calculated target fill pressure.

(e) After fueling, the vehicle shall be maintained at rest for any duration between 2.0 and 3.0 hours before conducting a crash test in accordance with S6.1 of this standard.

(f) The CHSS shut-off valve(s) and any other shut-off valves located in the fuel system downstream hydrogen gas piping shall be in normal driving condition immediately prior to the impact.

(g) The parking brake is disengaged and the transmission is in neutral prior to the crash test.

(h) Tires are inflated to manufacturer's specifications.

(i) The vehicle, including test devices and instrumentation, is loaded as follows:

(1) A passenger car, with its fuel system filled as specified in S7(d), is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the necessary test dummies as specified in S6, restrained only by means that are installed in the vehicle for protection at its seating position(s).

(2) A multipurpose passenger vehicle, truck, or bus with a GVWR of 10,000 pounds or less, whose fuel system is filled as specified in S7(d), is loaded to its unloaded vehicle weight, plus the necessary test dummies as specified in S6 of this standard, plus 136.1 kg, or its rated cargo and luggage capacity weight, whichever is less, secured to the vehicle and distributed so that the weight on each axle as measured at the tire-ground interface is in proportion to its gross axle weight rating (GAWR). Each dummy shall be restrained only by means that are installed in the vehicle for protection at its seating position(s).

(3) A school bus with a GVWR greater than 10,000 pounds, whose fuel system is filled as specified in S7(d), is loaded to its unloaded vehicle weight, plus 54.4 kg of unsecured weight at each designated seating position.

[90 FR 6277, Jan. 17, 2025]

§ 571.308 Standard No. 308; Compressed hydrogen storage system integrity.

S1. *Scope.* This standard specifies requirements for compressed hydrogen storage systems used in motor vehicles.

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries occurring from fires that result from hydrogen fuel leakage during vehicle operation and to reduce deaths and injuries occurring from explosions resulting from the burst of pressurized hydrogen containers.

S3. *Application.* This standard applies to each motor vehicle manufactured on or after September 1, 2028, that is equipped with compressed hydrogen gas as a fuel source to propel the vehicle. The standard does not apply to vehicles that are only equipped with cryo-compressed hydrogen storage systems and/or solid-state hydrogen storage system to propel the vehicle.

S4. *Definitions.*

BP_O means the vehicle manufacturer-supplied median burst pressure for a batch of new containers.

Burst means to break apart or to break open.

Burst pressure means the highest pressure achieved for a container tested in accordance with S6.2.2.1 of this standard.

Check valve means a valve that prevents reverse flow.

Closure devices mean the check valve(s), shut-off valve(s), and thermally-activated pressure relief device(s) that control the flow of hydrogen into and/or out of a CHSS.

Container means a pressure-bearing component of a compressed hydrogen storage system that stores a continuous volume of hydrogen fuel in a single chamber or in multiple permanently interconnected chambers.

Container attachments mean non-pressure bearing parts attached to the container that provide additional support and/or protection to the container and that may be removed only with the use of tools for the specific purpose of maintenance and/or inspection.

Compressed hydrogen storage system (CHSS) means a system that stores compressed hydrogen fuel for a hydrogen-fueled vehicle, composed of a container, container attachments (if any), and all closure devices required to isolate the stored hydrogen from the remainder of the fuel system and the environment.

Cryo-compressed hydrogen storage system means a system that stores hydrogen by compressing it to high pressure while simultaneously cooling it to very low temperatures, allowing for a higher density of hydrogen storage compared to standard compressed hydrogen systems.

Hydrogen fuel system means the fueling receptacle, CHSS, fuel cell system or internal combustion engine, fuel lines, and exhaust systems.

Nominal working pressure (NWP) means the settled pressure of compressed gas in a container or CHSS fully fueled to 100 percent state of charge and at a uniform temperature of 15 °C.

Normal milliliter means a quantity of gas that occupies one milliliter of volume when its temperature is 0 °C and its pressure is 1 atmosphere.

Pressure relief device (PRD) means a device that, when activated under specified performance conditions, is used to release hydrogen from a pressurized system and thereby prevent failure of the system.

Service life (of a container) means the time frame during which service (usage) is authorized by the vehicle manufacturer.

Shut-off valve means a valve between the container and the remainder of the hydrogen fuel system that must default to the ''closed'' position when unpowered.

Solid-state hydrogen storage system means a system that stores hydrogen at ambient temperatures and low pressures within solid materials that can either physically absorb the hydrogen gas or chemically combine with it.

State of charge (SOC) means the density ratio of hydrogen in the CHSS between the actual CHSS condition and

that at NWP with the CHSS equilibrated to 15 °C, as expressed as a percentage using the equation 1 to this section, where ρ is the density of hydrogen (g/L) at pressure (P) in MegaPascals (MPa) and temperature (T) in Celsius (°C) as listed below in Table 1 or linearly interpolated therein:

EQUATION 1 TO § 571.308 S4

$$SOC(\%) = \frac{\rho(P,T)}{\rho(NWP, 15°C)} x100$$

TABLE 1 TO §571.308 S4

Temperature (°C)	Pressure (MPa)												
	1	10	20	30	35	40	50	60	65	70	75	80	87.5
−40	1.0	9.7	18.1	25.4	28.6	31.7	37.2	42.1	44.3	46.4	48.4	50.3	53.0
−30	1.0	9.4	17.5	24.5	27.7	30.6	36.0	40.8	43.0	45.1	47.1	49.0	51.7
−20	1.0	9.0	16.8	23.7	26.8	29.7	35.0	39.7	41.9	43.9	45.9	47.8	50.4
−10	0.9	8.7	16.2	22.9	25.9	28.7	33.9	38.6	40.7	42.8	44.7	46.6	49.2
0	0.9	8.4	15.7	22.2	25.1	27.9	33.0	37.6	39.7	41.7	43.6	45.5	48.1
10	0.9	8.1	15.2	21.5	24.4	27.1	32.1	36.6	38.7	40.7	42.6	44.4	47.0
15	0.8	7.9	14.9	21.2	24.0	26.7	31.7	36.1	38.2	40.2	42.1	43.9	46.5
20	0.8	7.8	14.7	20.8	23.7	26.3	31.2	35.7	37.7	39.7	41.6	43.4	46.0
30	0.8	7.6	14.3	20.3	23.0	25.6	30.4	34.8	36.8	38.8	40.6	42.4	45.0
40	0.8	7.3	13.9	19.7	22.4	24.9	29.7	34.0	36.0	37.9	39.7	41.5	44.0
50	0.7	7.1	13.5	19.2	21.8	24.3	28.9	33.2	35.2	37.1	38.9	40.6	43.1
60	0.7	6.9	13.1	18.7	21.2	23.7	28.3	32.4	34.4	36.3	38.1	39.8	42.3
70	0.7	6.7	12.7	18.2	20.7	23.1	27.6	31.7	33.6	35.5	37.3	39.0	41.4
80	0.7	6.5	12.4	17.7	20.2	22.6	27.0	31.0	32.9	34.7	36.5	38.2	40.6
85	0.7	6.4	12.2	17.5	20.0	22.3	26.7	30.7	32.6	34.4	36.1	37.8	40.2

Thermally-activated pressure relief device (TPRD) means a non-reclosing PRD that is activated by temperature to open and release hydrogen gas.

TPRD sense point means instrumentation that detects elevated temperature for the purpose of activating a TPRD.

S5. *Requirements.*

S5.1. *Requirements for the CHSS.* Each vehicle CHSS shall include the following functions: shut-off valve, check valve, and TPRD. Each vehicle CHSS shall have a NWP of 70 MPa or less. Each vehicle container, closure device, and CHSS shall meet the applicable performance test requirements listed in table 2 to this section.

TABLE 2 TO § 571.308 S5.1

Requirement section	Test article
S5.1.1. *Tests for baseline metrics*	Container.
S5.1.2. *Test for performance durability*	Container.
S5.1.3. *Test for expected on-road performance*	CHSS.
S5.1.4. *Test for service terminating performance in fire*	CHSS.
S5.1.5. *Tests for performance durability of closure devices*	Closure devices.

S5.1.1. *Tests for baseline metrics.*

S5.1.1.1. *Baseline initial burst pressure.* The vehicle manufacturer shall immediately and irrevocably specify upon request, in writing and within 15 business days: whether the primary constituent of the container is glass fiber composite. When a new container with its container attachments (if any) is tested in accordance with S6.2.2.1 of this standard, both of the following requirements shall be met:

(a) The burst pressure of the container shall not be less than 2 times NWP.

(b) The burst pressure of the container having glass-fiber composite as a primary constituent shall not be less than 3.5 times NWP.

S5.1.1.2. *Baseline initial pressure cycle test.* When a new container with its container attachments (if any) is hydraulically pressure cycled in accordance with S6.2.2.2 of this standard to any pressure between 125.0 percent NWP and 130.0 percent NWP,

(a) Containers for vehicles with a GVWR of 10,000 pounds or less

(1) Shall not leak nor burst for at least 7,500 cycles, and

(2) Thereafter shall not burst for an additional 14,500 cycles. If a leak occurs while conducting the test as specified in S5.1.1.2(a)(2), the test is stopped and not considered a failure.

(b) Containers for vehicles with a GVWR of over 10,000 pounds

(1) Shall not leak nor burst for at least 11,000 cycles, and

(2) Thereafter shall not burst for an additional 11,000 cycles. If a leak occurs while conducting the test as specified in S5.1.1.2(b)(2), the test is stopped and not considered a failure.

S5.1.2. *Test for performance durability.* A new container shall not leak nor burst when subjected to the sequence of tests in S5.1.2.1 through S5.1.2.6. Immediately following S5.1.2.6, and without depressurizing the container, the container is subjected to a burst test in accordance with S6.2.2.1(c) and (d) of this standard. The burst pressure of the container at the end of the sequence of tests in this section shall not be less than 0.8 times the BP_O value specified by the vehicle manufacturer. The sequence of tests and the burst pressure test are illustrated in figure 1 to S5.1.2. The vehicle manufacturer shall immediately and irrevocably specify upon request, in writing and within 15 business days: the BP_O of the container.

S5.1.2.1. *Drop test.* The container with its container attachments (if any) is dropped once in accordance with S6.2.3.2 of this standard in any one of the four orientations specified in that section. Any container with damage from the drop test that prevents further testing of the container in accordance with S6.2.3.4 of this standard shall be considered to have failed to meet the test for performance durability requirements. In the case of an asymmetric container, the vehicle manufacturer shall immediately and irrevocably specify upon request, in writing,

and within 15 business days: the center of gravity of the container.

S5.1.2.2. *Surface damage test.* The container, except if an all-metal container, is subjected to the surface damage test in accordance with the S6.2.3.3 of this standard. Container attachments designed to be removed shall be removed and container attachments that are not designed to be removed shall remain in place. Container attachments that are removed shall not be reinstalled for the remainder of S5.1.2; container attachments that are not removed shall remain in place for the remainder of S5.1.2.

S5.1.2.3. *Chemical exposure and ambient-temperature pressure cycling test.* The container is exposed to chemicals in accordance with S6.2.3.4 and then hydraulically pressure cycled in accordance with S6.2.3.4 of this standard for 60 percent of the number of cycles as specified in S5.1.1.2(a)(1) or (b)(1) as applicable. For all but the last 10 of these cycles, the cycling pressure shall be any pressure between 125.0 percent NWP and 130.0 percent NWP. For the last 10 cycles, the pressure shall be any pressure between 150.0 percent NWP and 155.0 percent NWP.

S5.1.2.4. *High temperature static pressure test.* The container is pressurized to any pressure between (or equal to) 125 percent NWP and 130 percent NWP and held at that pressure no less than 1,000 and no more than 1,050 hours in accordance with S6.2.3.5 of this standard and with the temperature surrounding the container at any temperature between 85.0 °C and 90.0 °C.

S5.1.2.5. *Extreme temperature pressure cycling test.* The container is pressure cycled in accordance with S6.2.3.6 for 40 percent of the number of cycles specified in S5.1.1.2(a)(1) or (b)(1) as applicable. The pressure for the first half of these cycles equals any pressure between 80.0 percent NWP and 85.0 percent NWP with the temperature surrounding the container equal to any temperature between −45.0 °C and −40.0 °C. The pressure for the next half of these cycles equals any pressure between 125.0 percent NWP and 130.0 percent NWP and the temperature surrounding the container equal to any temperature between 85.0 °C and 90.0 °C and the relative humidity surrounding the container not less than 80 percent.

S5.1.2.6. *Residual pressure test.* The container is hydraulically pressurized in accordance with S6.2.3.1 of this standard to a pressure between 180.0 percent NWP and 185.0 percent NWP and held for any duration between 240 to 245 seconds.

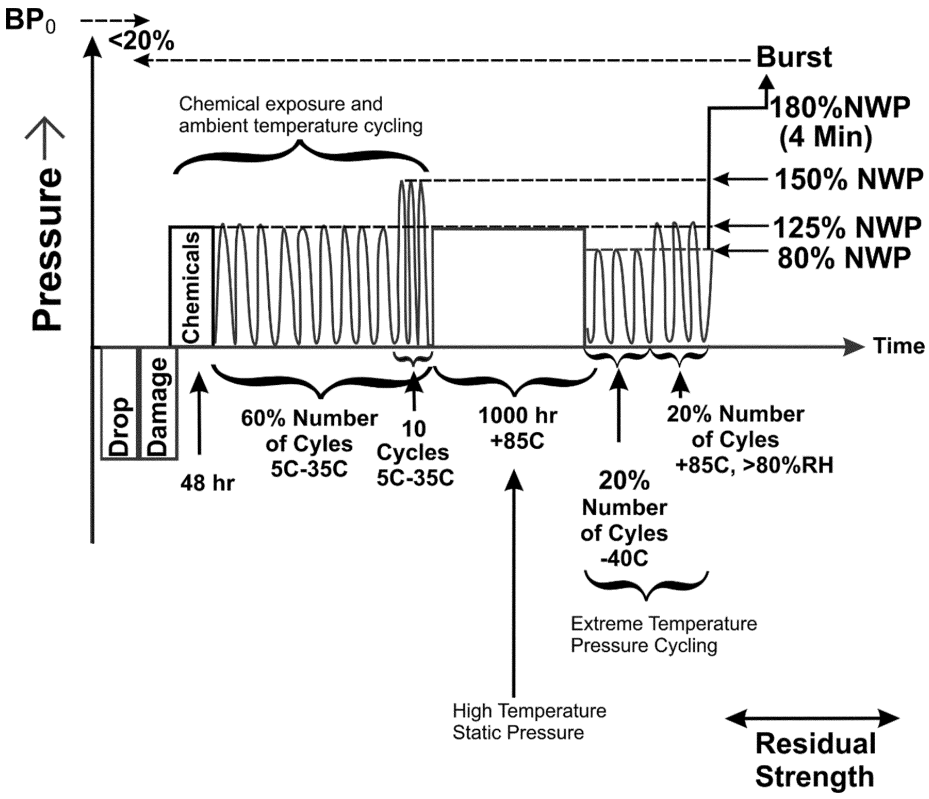


FIGURE 1 TO § 571.308 S5.1.2. PERFORMANCE DURABILITY TEST; (FOR ILLUSTRATION PURPOSES ONLY)

S5.1.3. *Test for expected on-road performance.* When subjected to the sequence of tests in S5.1.3.1, the CHSS shall meet the permeation and leak requirements specified in S5.1.3.2 and shall not burst. Thereafter, the container of the CHSS shall not burst when subjected to a residual pressure test in accordance with S5.1.3.3. Immediately following the test specified in S5.1.3.3, and without depressurizing the container, the container of the CHSS is subjected to a burst test in accordance with S6.2.2.1(c) and (d) of this standard. The burst pressure of the container at the end of the sequence of tests in this section shall not be less than 0.8 times the BP_O specified by the vehicle manufacturer under S5.1.2.

S5.1.3.1. *Ambient and extreme temperature gas pressure cycling test.* The CHSS is pressure cycled using hydrogen gas for 500 cycles under any temperature and pressure condition for the number of cycles as specified in table 3 to S5.1.3.1, and in accordance with the S6.2.4.1 of this standard test procedure. A static gas pressure leak/permeation test performed in accordance with S5.1.3.2 is conducted after the first 250 pressure cycles and after the remaining 250 pressure cycles.

TABLE 3 TO §571.308 S5.1.3.1

Number of cycles	*Ambient conditions*	*Initial system equilibration*	*Fuel delivery temperature*	*Cycle initial and final pressure*	*Cycle peak pressure*
5	−30.0 °C to −25.0 °C.	−30.0 °C to −25.0 °C.	15.0 °C to 25.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
5	−30.0 °C to −25.0 °C.	−30.0 °C to −25.0 °C.	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
15	−30.0 °C to −25.0 °C.	not appliable	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
5	50.0 °C to 55.0 °C, 80% to 100% relative humidity.	50 °C to 55 °C, 80% to 100% relative humidity.	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
20	50.0 °C to 55.0 °C, 80% to 100% relative humidity.	not appliable	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
200	5.0 °C to 35.0 °C.	not appliable	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
Extreme temperature static gas pressure leak/permeation test S5.1.3.2.	55.0 °C to 60.0 °C.	55.0 °C to 60.0 °C.	not appliable	not appliable	100.0% SOC to 105.0% SOC.
25	50.0 °C to 55.0 °C, 80% to 100% relative humidity.	not appliable	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
25	−30.0 °C to −25.0 °C.	not appliable	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
200	5.0 °C to 35.0 °C.	not appliable	−40.0 °C to −33.0 °C.	1.0 MPa to 2.0 MPa.	100.0% SOC to 105.0% SOC.
Extreme temperature static gas pressure leak/permeation test S5.1.3.2.	55.0 °C to 60.0 °C.	55.0 °C to 60.0 °C.	not appliable	not appliable	100.0% SOC to 105.0% SOC.

S5.1.3.2. *Extreme temperature static gas pressure leak/permeation test.* When tested in accordance with S6.2.4.2 of this standard after each group of 250 pneumatic pressure cycles in S5.1.3.1, the CHSS shall not discharge hydrogen more than 46 millilitres per hour (mL/h) for each litre of CHSS water capacity.

S5.1.3.3. *Residual pressure test.* The container of the CHSS is hydraulically pressurized in accordance with S6.2.3.1 to any pressure between 1.800 times NWP and 1.850 times NWP and held at that pressure for any duration between 240 to 245 seconds.

S5.1.4. *Test for service terminating performance in fire.* When the CHSS is exposed to the two-stage localized or engulfing fire test in accordance with S6.2.5 of this standard, the container shall not burst. The pressure inside the CHSS shall fall to 1 MPa or less within the test time limit specified in S6.2.5.3(o) of this standard. Any leakage or venting, other than that through TPRD outlet(s), shall not result in jet flames greater than 0.5 m in length. If venting occurs though the TPRD, the venting shall be continuous.

S5.1.5. *Tests for performance durability of closure devices.* All tests are performed at ambient temperature of 5 °C to 35 °C unless otherwise specified.

S5.1.5.1. *TPRD requirements.* The TPRD shall not activate at any point during the test procedures specified in S6.2.6.1.1, S6.2.6.1.3, S6.2.6.1.4, S6.2.6.1.5, S6.2.6.1.6, S6.2.6.1.7, and S6.2.6.1.8 of this standard.

(a) A TPRD subjected to pressure cycling in accordance with S6.2.6.1.1 of this standard shall be sequentially tested in accordance with S6.2.6.1.8, S6.2.6.1.9, and S6.2.6.1.10 of this standard;

(1) When tested in accordance with S6.2.6.1.8, the TPRD shall not exhibit leakage greater than 10 normal milliliters per minute (NmL/hour).

(2) When tested in accordance with S6.2.6.1.9 of this standard, the TPRD shall activate within no more than 2 minutes of the average activation time of three new TPRDs tested in accordance with S6.2.6.1.9;

(3) When tested in accordance with S6.2.6.1.10 of this standard, the TPRD shall have a flow rate of at least 90 percent of the highest baseline flow rate established in accordance with S6.2.6.1.10;

(b)(1) A TPRD shall activate in less than ten hours when tested at the vehicle manufacturer's specified activation temperature in accordance with S6.2.6.1.2 of this standard;

(2) When tested at the accelerated life temperature in accordance with S6.2.6.1.2 of this standard, a TPRD shall not activate in less than 500 hours and shall not exhibit leakage greater than 10 NmL/hour when tested in accordance with S6.2.6.1.8 of this standard;

(c) A TPRD subjected to temperature cycling testing in accordance with S6.2.6.1.3 of this standard shall be sequentially tested in accordance with S6.2.6.1.8(a)(3), S6.2.6.1.9, and S6.2.6.1.10 of this standard;

(1) When tested in accordance with S6.2.6.1.8(a)(3) of this standard, the TPRD shall not exhibit leakage greater than 10 NmL/hour;

(2) When tested in accordance with S6.2.6.1.9 of this standard, the TPRD shall activate within no more than 2 minutes of the average activation time of three new TPRDs tested in accordance with S6.2.6.1.9;

(3) When tested in accordance with S6.2.6.1.10 of this standard, the TPRD shall have a flow rate of at least 90 percent of the highest baseline flow rate established in accordance with S6.2.6.1.10;

(d) A TPRD subjected to salt corrosion resistance testing in accordance with S6.2.6.1.4 of this standard shall be sequentially tested in accordance with S6.2.6.1.8, S6.2.6.1.9, and S6.2.6.1.10 of this standard;

(1) When tested in accordance with S6.2.6.1.8 of this standard, the TPRD shall not exhibit leakage greater than 10 NmL/hour;

(2) When tested in accordance with S6.2.6.1.9 of this standard, the TPRD shall activate within no more than 2 minutes of the average activation time of three new TPRDs tested in accordance with S6.2.6.1.9;

(3) When tested in accordance with S6.2.6.1.10 of this standard, the TPRD shall have a flow rate of at least 90 percent of the highest baseline flow rate established in accordance with S6.2.6.1.10;

(e) A TPRD subjected to vehicle environment testing in accordance with S6.2.6.1.5 of this standard shall not show signs of cracking, softening, or swelling, and thereafter shall be sequentially tested in accordance with S6.2.6.1.8, S6.2.6.1.9, and S6.2.6.1.10 of this standard. Cosmetic changes such as pitting or staining are not considered failures.

(1) When tested in accordance with S6.2.6.1.8 of this standard, the TPRD shall not exhibit leakage greater than 10 NmL/hour.

(2) When tested in accordance with S6.2.6.1.9 of this standard, the TPRD shall activate within no more than 2 minutes of the average activation time of three new TPRDs tested in accordance with S6.2.6.1.9,

(3) When tested in accordance with S6.2.6.1.10 of this standard, the TPRD shall have a flow rate of at least 90 percent of the highest baseline flow rate established in accordance with S6.2.6.1.10;

(f) A TPRD subjected to stress corrosion cracking testing in accordance with S6.2.6.1.6 of this standard shall not exhibit visible cracking or delaminating;

(g) A TPRD shall be subjected to drop and vibration testing in accordance with S6.2.6.1.7 of this standard. If the TPRD progresses beyond S6.2.6.1.7(c) to complete testing under S6.2.6.1.7(d), it shall then be sequentially tested in accordance with S6.2.6.1.8, S6.2.6.1.9, and S6.2.6.1.10 of this standard.

(1) When tested in accordance with S6.2.6.1.8 of this standard, the TPRD shall not exhibit leakage greater than 10 NmL/hour.

(2) When tested in accordance with S6.2.6.1.9 of this standard, the TPRD shall activate within no more than 2 minutes of the average activation time of three new TPRDs tested in accordance with S6.2.6.1.9,

(3) When tested in accordance with S6.2.6.1.10 of this standard, the TPRD shall have a flow rate of at least 90 percent of the highest baseline flow rate established in accordance with S6.2.6.1.10;

(h) One new TPRD subjected to leak testing in accordance with S6.2.6.1.8 of this standard shall not exhibit leakage greater than 10 NmL/hour;

(i) Three new TPRDs are subjected to a bench top activation test in accordance with S6.2.6.1.9 of this standard. The maximum difference in the activation time between any two of the three TPRDs shall be 2 minutes or less.

S5.1.5.2. *Check valve and shut-off valve requirements.* This section applies to both check valves and shut-off valves.

(a) A valve subjected to hydrostatic strength testing in accordance with S6.2.6.2.1 of this standard shall not leak to an extent that prevents continued pressurization in accordance with S6.2.6.2.1(c) nor burst at less than 250 percent NWP;

(b) A valve subjected to leak testing in accordance with S6.2.6.2.2 of this standard shall not exhibit leakage greater than 10 NmL/hour;

(c)(1) A check valve shall meet the requirements when tested sequentially as follows:

(i) The check valve shall reseat and prevent reverse flow after each cycle when subjected to 13,500 pressure cycles in accordance with S6.2.6.2.3 of this standard to any pressure between 100.0 and 105.0 percent NWP and at any temperature between 5.0 °C and 35.0 °C;

(ii) The same check valve shall reseat and prevent reverse flow after each cycle when subjected to 750 pressure cycles in accordance with S6.2.6.2.3 of this standard to any pressure between 125.0 and 130.0 percent NWP and at any temperature between 85.0 °C and 90.0 °C;

(iii) The same check valve shall reseat and prevent reverse flow after each cycle when subjected to 750 pressure cycles in accordance with S6.2.6.2.3 of this standard to any pressure between 80.0 and 85.0 percent NWP and at any temperature between −45.0 °C and −40.0 °C;

(iv) The same check valve shall be subjected to chatter flow testing in accordance with S6.2.6.2.4 of this standard;

(v) When tested in accordance with S6.2.6.2.2 of this standard, the same check valve shall not exhibit leakage greater than 10 NmL/hour;

(vi) When tested in accordance with S6.2.6.2.1 of this standard, the same check valve shall not leak to an extent that prevents continued pressurization in accordance with S6.2.6.2.1(c), nor burst at less than 250 percent NWP, nor burst at less than 80 percent of the burst pressure of the new unit tested in accordance with S5.1.5.2(a) unless the burst pressure of the valve exceeds 400 percent NWP.

(2) A shut-off valve shall meet the requirements when tested sequentially as follows:

(i) The shut-off valve shall be subjected to 45,000 pressure cycles in accordance with S6.2.6.2.3 to any pressure between 100.0 and 105.0 percent NWP and at any temperature between 5.0 °C and 35.0 °C;

(ii) The same shut-off valve shall be subjected to 2,500 pressure cycles in accordance with S6.2.6.2.3 of this standard to any pressure between 125.0 and 130.0 percent NWP and at any temperature between 85.0 °C and 90.0 °C;

(iii) The same shut-off valve shall be subjected to 2,500 pressure cycles in accordance with S6.2.6.2.3 of this standard to any pressure between 80.0 and 85.0 percent NWP and at any temperature between −45.0 °C and −40.0 °C;

(iv) The same shut-off valve shall be subjected to chatter flow testing in accordance with S6.2.6.2.4 of this standard;

(v) When tested in accordance with S6.2.6.2.2 of this standard, the same shut-off valve shall not exhibit leakage greater than 10 NmL/hour;

(vi) When tested in accordance with S6.2.6.2.1 of this standard, the same

shut-off valve shall not leak to an extent that prevents continued pressurization in accordance with S6.2.6.2.1(c), nor burst at less than 250 percent NWP, nor burst at less than 80 percent of the burst pressure of the new unit tested in accordance with S5.1.5.2(a) unless the burst pressure of the valve exceeds 400 percent NWP.

(d) A valve subjected to salt corrosion resistance testing in accordance with S6.2.6.1.4 of this standard shall be tested sequentially in accordance with S6.2.6.2.2 followed by S6.2.6.2.1 of this standard.

(1) When tested in accordance with S6.2.6.2.2 of this standard, the valve shall not exhibit leakage greater than 10 NmL/hour;

(2) When tested in accordance with S6.2.6.2.1 of this standard, the valve shall not leak to an extent that prevents continued pressurization in accordance with S6.2.6.2.1(c), nor burst at less than 250 percent NWP, nor burst at less than 80 percent of the burst pressure of the new unit tested in accordance with S5.1.5.2(a) unless the burst pressure of the valve exceeds 400 percent NWP.

(e) A valve subjected to vehicle environment testing in accordance with S6.2.6.1.5 of this standard shall not show signs of cracking, softening, or swelling and shall be tested sequentially in accordance with S6.2.6.2.2 followed by S6.2.6.2.1 of this standard. Cosmetic changes such as pitting or staining are not considered failures.

(1) When tested in accordance with S6.2.6.2.2 of this standard, the valve shall not exhibit leakage greater than 10 NmL/hour;

(2) When tested in accordance with S6.2.6.2.1 of this standard, the valve shall not leak to an extent that prevents continued pressurization in accordance with S6.2.6.2.1(c), nor burst at less than 250 percent NWP, nor burst at less than 80 percent of the burst pressure of the new unit tested in accordance with S5.1.5.2(a) unless the burst pressure of the valve exceeds 400 percent NWP;

(f) A shut-off valve shall have a minimum resistance of 240 kΩ between the power conductor and the valve casing, and shall not exhibit open valve, smoke, fire, melting, or leakage greater than 10 NmL/hour when subjected to electrical testing in accordance with S6.2.6.2.5 followed by leak testing in accordance with S6.2.6.2.2 of this standard;

(g) A valve subjected to vibration testing in accordance with S6.2.6.2.6 of this standard shall be tested sequentially in accordance with S6.2.6.2.2 followed by S6.2.6.2.1 of this standard.

(1) When tested in accordance with S6.2.6.2.2 of this standard, the valve shall not exhibit leakage greater than 10 NmL/hour;

(2) When tested in accordance with S6.2.6.2.1 of this standard, the valve shall not leak to an extent that prevents continued pressurization in accordance with S6.2.6.2.1(c), nor burst at less than 250 percent NWP, nor burst at less than 80 percent of the burst pressure of the new unit tested in accordance with S5.1.5.2(a) unless the burst pressure of the valve exceeds 400 percent NWP.

(h) A valve shall not exhibit visible cracking or delaminating when subjected to stress corrosion cracking testing in accordance with S6.2.6.1.6 of this standard.

S5.1.6. *Labeling.* Each vehicle container shall be permanently labeled with the information specified in paragraphs S5.1.6(a) through (g). Any label affixed to the container in compliance with this section shall remain in place and be legible for the vehicle manufacturer's recommended service life of the container. The information shall be in English and in letters and numbers that are at least 6.35 millimeters (¼ inch) high.

(a) The statement: ''If there is a question about the proper use, installation, or maintenance of this compressed hydrogen storage system, contact _____,'' inserting the vehicle manufacturer's name, address, and telephone number. The name provided shall be consistent with the vehicle manufacturer's filing in accordance with 49 CFR part 566.

(b) The container serial number.

(c) The statement: ''Manufactured in _____,'' inserting the month and year of manufacture of the container.

(d) The statement ''Nominal Working Pressure _____MPa (_____psig),'' Inserting the nominal

working pressure which shall be no greater than 70 MPa.

(e) The statement ''Compressed Hydrogen Gas Only.''

(f) The statement: ''Do Not Use After _____,'' inserting the month and year that mark the end of the vehicle manufacturer's recommended service life for the container.

(g) The statement: ''This container should be visually inspected for damage and deterioration after a motor vehicle accident or fire, and either: (i) at least every 12 months when installed on a vehicle with a GVWR greater than 4,536 kg, or (ii) at least every 36 months or 36,000 miles, whichever comes first, when installed on a vehicle with a GVWR less than or equal to 4,536 kg.''

S6. *Test procedures.*

S6.1. [Reserved]

S6.2. *Test procedures for compressed hydrogen storage.*

S6.2.1. Unless otherwise specified, data sampling for pressure cycling under S6.2 shall be at least 1 Hz.

S6.2.2. *Test procedures for baseline performance metrics.*

S6.2.2.1. *Burst test.* (a) The container is filled with a hydraulic fluid.

(b) The container, the surrounding environment, and the hydraulic fluid are at any temperature between 5.0 °C and 35.0 °C.

(c) The rate of pressurization shall be less than or equal to 1.4 MPa per second for pressures higher than 1.50 times NWP. If the rate exceeds 0.35 MPa per second at pressures higher than 1.50 times NWP, then the container is placed in series between the pressure source and the pressure measurement device.

(d) The container is hydraulically pressurized until burst and the burst pressure of the container is recorded.

S6.2.2.2. *Pressure cycling test.* (a) The container is filled with a hydraulic fluid.

(b) The container surface, or the surface of the container attachments if present, the environment surrounding the container, and the hydraulic fluid are at any temperature between 5.0 °C and 35.0 °C at the start of testing and maintained at the specified temperature for the duration of the testing.

(c) The container is pressure cycled at any pressure between 1.0 MPa and 2.0 MPa up to the pressure specified in the respective section of S5. The cycling rate shall be any rate up to 10 cycles per minute.

(d) The temperature of the hydraulic fluid entering the container is maintained and monitored at any temperature between 5.0 °C and 35.0 °C.

(e) The vehicle manufacturer may specify a hydraulic pressure cycle profile within the specifications of S6.2.2.2(c). Vehicle manufacturers shall submit this profile to NHTSA immediately and irrevocably, upon request, in writing, and within 15 business days; otherwise, NHTSA shall determine the profile. At NHTSA's option, NHTSA shall cycle the container within 10 percent of the vehicle manufacturer's specified cycling profile.

S6.2.3. *Performance durability test.*

S6.2.3.1. *Residual pressure test.* The container is pressurized smoothly and continually with hydraulic fluid or hydrogen gas as specified until the pressure level is reached and held for the specified time.

S6.2.3.2. *Drop impact test.* The container is drop tested without internal pressurization or attached valves. The surface onto which the container is dropped shall be a smooth, horizontal, uniform, dry, concrete pad or other flooring type with equivalent hardness. No attempt shall be made to prevent the container from bouncing or falling over during a drop test, except for the vertical drop test, during which the test article shall be prevented from falling over. The container shall be dropped in any one of the following four orientations described below and illustrated in figure 2 to S6.2.3.2.

(a) From a position within 5° of horizontal with the lowest point of the container at any height between 1.800 meters and 1.820 meters above the surface onto which it is dropped. In the case of a non-axisymmetric container, the largest projection area of the container shall be oriented downward and aligned horizontally;

(b) From a position within 5° of vertical with the center of any shut-off valve interface location upward and with any potential energy of between 488 Joules and 538 Joules. If a drop energy of between 488 Joules and 538 Joules would result in the height of the

lower end being more than 1.820 meters above the surface onto which it is dropped, the container shall be dropped from any height with the lower end between 1.800 meters and 1.820 meters above the surface onto which it is dropped. If a drop energy of between 488 Joules and 538 Joules would result in the height of the lower end being less than 0.100 meters above the surface onto which it is dropped, the container shall be dropped from any height with the lower end between 0.100 meters and 0.120 meters above the surface onto which it is dropped. In the case of a non-axisymmetric container, the center of any shut-off valve interface location and the container's center of gravity shall be aligned vertically, with the center of that shut-off valve interface location upward;

(c) From a position within 5° of vertical with the center of any shut-off valve interface location downward with any potential energy of between 488 Joules and 538 Joules. If a potential energy of between 488 Joules and 538 Joules would result in the height of the lower end being more than 1.820 meters above the surface onto which it is dropped, the container shall be dropped from any height with the lower end between 1.800 meters and 1.820 meters above the surface onto which it is dropped. If a drop energy of between 488 Joules and 538 Joules would result in the height of the lower end being less than 0.100 meters above the surface onto which it is dropped, the container shall be dropped from any height with the lower end between 0.100 meters and 0.120 meters above the surface onto which it is dropped. In the case of a non-axisymmetric container, the center of any shut-off valve interface location and the container's center of gravity shall be aligned vertically, with the center of that shut-off valve interface location downward;

(d) From any angle between 40° and 50° from the vertical orientation with the center of any shut-off valve interface location downward, and with the container center of gravity between 1.800 meters and 1.820 meters above the surface onto which it is dropped. However, if the lowest point of the container is closer to the ground than 0.60 meters, the drop angle shall be changed so that the lowest point of the container is between 0.60 meters and 0.62 meters above the ground and the center of gravity is between 1.800 meters and 1.820 meters above the surface onto which it is dropped. In the case of a non-axisymmetric container, the line passing through the center of any shut-off valve interface location and the container's center of gravity shall be at any angle between 40° and 50° from the vertical orientation. If this specification results in more than one possible container orientation, the drop shall be conducted from the orientation that results in the lowest positioning of the center of the shut-off valve interface location.

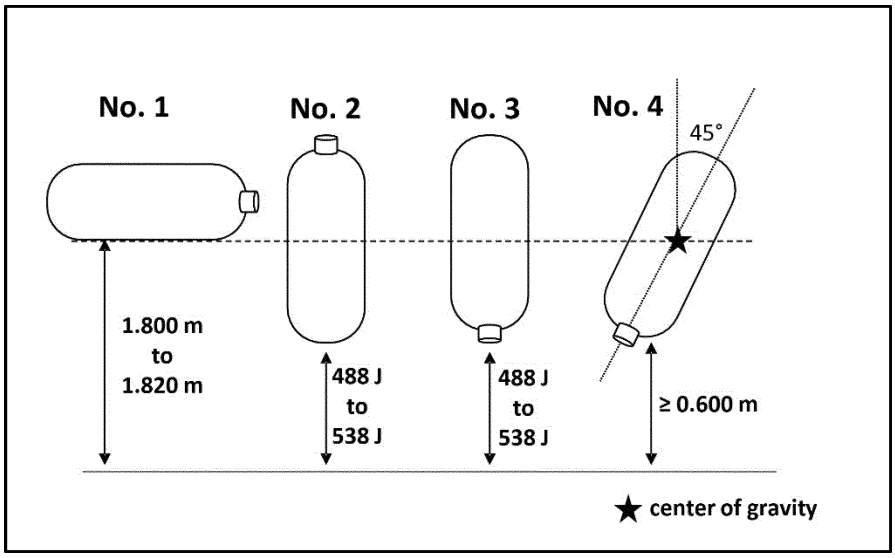


FIGURE 2 TO §571.308 S6.2.3.2. THE FOUR DROP ORIENTATIONS; (FOR ILLUSTRATION PURPOSES ONLY)

S6.2.3.3. *Surface damage test.* The surface damage test consists of surface cut generation and pendulum impacts as described below.

(a) Surface cut generation: Two longitudinal saw cuts are made at any location on the same side of the outer surface of the unpressurized container, as shown in Figure 3, or on the container attachments if present. The first cut is 0.75 millimeters to 1.25 millimeters deep and 200 millimeters to 205 millimeters long; the second cut, which is only required for containers affixed to the vehicle by compressing its composite surface, is 1.25 millimeters to 1.75 millimeters deep and 25 millimeters to 28 millimeters long.

(b) Pendulum impacts: Mark the outer surface of the container, or the container attachments if present, with five separate, non-overlapping circles each having any linear diameter between 100.0 millimeters and 105.0 millimeters, as shown in Figure 3. The marks shall be located on the side opposite from the saw cuts, or located on a different chamber in the case of a container with more than one chamber. Within 30 minutes following preconditioning for any duration from 12 hours to 24 hours in an environmental chamber at any temperature between −45.0 °C and −40.0 °C, impact the center of each of the five areas with a pendulum having a pyramid with equilateral faces and square base, and the tip and edges being rounded to a radius of between 2.0 millimeters and 4.0 millimeters. The center of impact of the pendulum shall coincide with the center of gravity of the pyramid. The energy of the pendulum at the moment of impact with each of the five marked areas on the container is any energy between 30.0 Joules and 35.0 Joules. The container is secured in place during pendulum impacts and is not pressurized above 1 MPa.

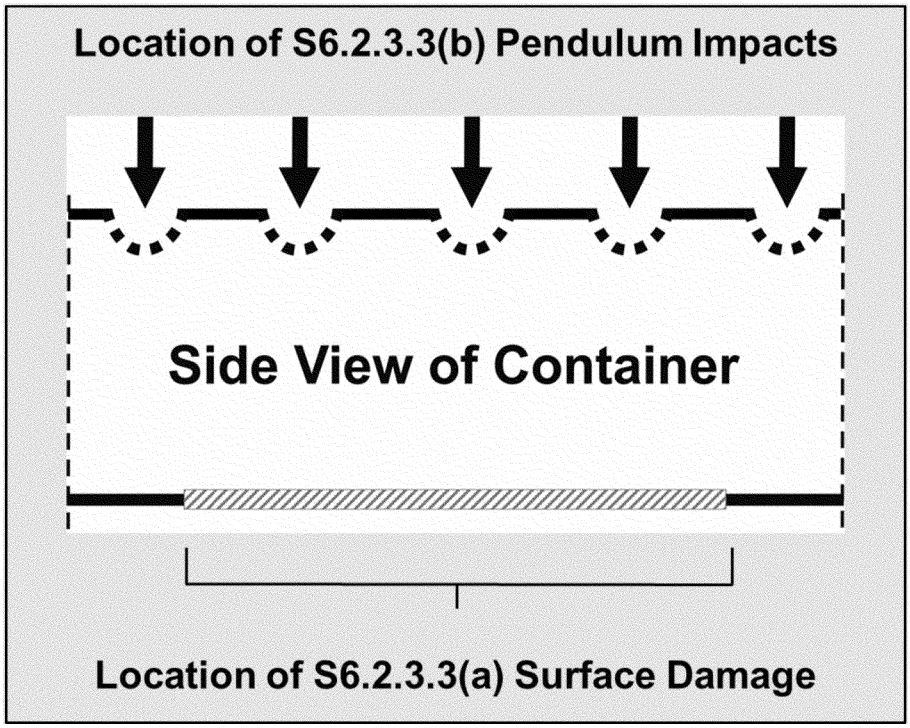


FIGURE 3 TO § 571.308 S6.2.3.3. LOCATIONS OF SURFACE DAMAGE FOR S6.2.3.3(A) AND PENDULUM IMPACTS FOR S6.2.3.3(B); (FOR ILLUSTRATION PURPOSES ONLY)

S6.2.3.4. *Chemical exposure and ambient temperature pressure cycling test.* (a) Each of the 5 areas preconditioned by pendulum impact in S6.2.3.3(b) is exposed to any one of five solutions:

(1) 19 to 21 percent by volume sulfuric acid in water;

(2) 25 to 27 percent by weight sodium hydroxide in water;

(3) 5 to 7 percent by volume methanol in gasoline;

(4) 28 to 30 percent by weight ammonium nitrate in water; and

(5) 50 to 52 percent by volume methyl alcohol in water.

(b) The container is oriented with the fluid exposure areas on top. A pad of glass wool approximately 0.5 centimeters thick and 100 millimeters in diameter is placed on each of the five preconditioned areas. A sufficient amount of the test fluid is applied to the glass wool to ensure that the pad is wetted across its surface and through its thickness for the duration of the test. A plastic covering shall be applied over the glass wool to prevent evaporation.

(c) The exposure of the container with the glass wool is maintained for at least 48 hours and no more than 60 hours with the container hydraulically pressurized to any pressure between 125.0 percent NWP and 130.0 percent NWP. During exposure, the temperature surrounding the container is maintained at any temperature between 5.0 °C and 35.0 °C.

(d) Hydraulic pressure cycling is performed in accordance with S6.2.2.2 at any pressure within the specified ranges according to S5.1.2.3 for the specified number of cycles. The glass wool pads are removed and the container surface is rinsed with water after the cycles are complete.

S6.2.3.5. *Static pressure test.* The container is hydraulically pressurized to the specified pressure in a temperature-controlled chamber. The temperature of the chamber and the container surface, or the surface of the container attachments if present, are held at the specified temperature for the specified duration.

S6.2.3.6. *Extreme temperature pressure cycling test.* (a) The container is filled with hydraulic fluid for each test;

(b) At the start of each test, the container surface, or the surface of the container attachments if present, the hydraulic fluid, and the environment surrounding the container are at any temperature and relative humidity (if applicable) within the ranges specified in S5.1.2.5 of this standard and maintained for the duration of the testing.

(c) The container is pressure cycled from any pressure between 1.0 MPa and 2.0 MPa up to the specified pressure at a rate not exceeding 10 cycles per minute for the specified number of cycles;

(d) The temperature of the hydraulic fluid entering the container shall be measured as close as possible to the container inlet.

S6.2.4. *Test procedures for expected on-road performance.*

S6.2.4.1. *Ambient and extreme temperature gas pressure cycling test.* (a) In accordance with table 3 to S5.1.3.1 of this standard, the specified ambient conditions of temperature and relative humidity, if applicable, are maintained within the test environment throughout each pressure cycle. When required in accordance with table 3 to S5.1.3.1, the CHSS temperature shall be in the specified initial system equilibration temperature range between pressure cycles.

(b) The CHSS is pressure cycled from any pressure between 1.0 MPa and 2.0 MPa up to any pressure within the specified peak pressure range in accordance with table 3 to this section. The temperature of the hydrogen fuel dispensed to the container is controlled to within the specified temperature range within 30 seconds of fueling initiation. The specified number of pressure cycles are conducted.

(c) The ramp rate for pressurization shall be greater than or equal to the ramp rate given in table 4 to S6.2.4.1(c) according to the CHSS volume, the ambient conditions, and the fuel delivery temperature. If the required ambient temperature is not available in table 4 to this section, the closest ramp rate value or a linearly interpolated value shall be used. The pressure ramp rate shall be decreased if the gas temperature in the container exceeds 85 °C.

TABLE 4 TO §571.308 S6.2.4.1(c)

CHSS volume (L)	CHSS pressurization rate (MPa/min)			
	50.0 °C to 55.0 °C ambient conditions −33.0 °C to −40.0 °C fuel delivery temperature	5.0 °C to 35.0 °C ambient conditions −33.0 °C to −40.0 °C fuel delivery temperature	−30.0 °C to −25.0 °C ambient conditions −33.0 °C to −40.0 °C fuel delivery temperature	−30.0 °C to −25.0 °C ambient conditions 15.0 °C to 25.0 °C fuel delivery temperature
50	7.6	19.9	28.5	13.1
100	7.6	19.9	28.5	7.7
174	7.6	19.9	19.9	5.2
250	7.6	19.9	19.9	4.1
300	7.6	16.5	16.5	3.6
400	7.6	12.4	12.4	2.9
500	7.6	9.9	9.9	2.3
600	7.6	8.3	8.3	2.1
700	7.1	7.1	7.1	1.9
1,000	5.0	5.0	5.0	1.4
1,500	3.3	3.3	3.3	1.0
2,000	2.5	2.5	2.5	0.7
2,500	2.0	2.0	2.0	0.5

(d) The de-fueling rate shall be any rate greater than or equal to the intended vehicle's maximum fuel-demand rate. Out of the 500 pressure cycles, any 50 pressure cycles are performed using a de-fueling rate greater than or equal to the maintenance de-fueling rate.

S6.2.4.2. *Gas permeation test.* (a) A CHSS is filled with hydrogen gas to any SOC between 100.0 percent and 105.0 percent and placed in a sealed container. The CHSS is held for any duration between 12 hours and 24 hours at any temperature between 55.0 °C and 60.0 °C prior to the start of the test.

(b) The permeation from the CHSS shall be determined hourly throughout the test.

(c) The test shall continue for 500 hours or until the permeation rate reaches a steady state. Steady state is achieved when at least 3 consecutive leak rates separated by any duration between 12 hours and 48 hours are within 10 percent of the previous rate.

S6.2.5. *Test procedures for service terminating performance in fire.* The fire test consists of two stages: a localized fire stage followed by an engulfing fire stage. The burner configuration for the fire test is specified in S6.2.5.1. The overall test configuration of the fire test is verified using a pre-test checkout in accordance with S6.2.5.2 prior to the fire test of the CHSS. The fire test of the CHSS is conducted in accordance with S6.2.5.3.

S6.2.5.1. *Burner configuration.* (a) The fuel for the burner shall be liquefied petroleum gas (LPG).

(b) The width of the burner shall be between 450 millimeters and 550 millimeters.

(c) The length of the burner used for the localized fire stage shall be between 200 millimeters and 300 millimeters.

(d) The length of the burner used for the engulfing fire stage shall be in accordance with S6.2.5.3(m).

(e) The burner nozzle configuration and installation shall be in accordance with table 5 to S6.2.5.1. The nozzles shall be installed uniformly on six rails.

TABLE 5 TO § 571.308 S6.2.5.1

Item	Description
Nozzle type	Liquefied petroleum gas fuel nozzle with air pre-mix.
LPG orifice in nozzle	0.9 to 1.1 millimeter inner diameter.
Air ports in nozzle	Four (4) holes, 5.8 to 7.0 millimeter inner diameter.
Fuel/Air mixing tube in nozzle	9 to 11 millimeter inner diameter.
Number of rails	6.
Center-to-center spacing of rails	100 to 110 millimeter.
Center-to-center nozzle spacing along the rails	45 to 55 millimeter.

S6.2.5.2. *Pre-test checkout.* (a) The pre-test checkout procedure in this section shall be performed to verify the fire test configuration for the CHSS tested in accordance with S6.2.5.3.

(b) A pre-test container is a 12-inch Schedule 40 Nominal Pipe Size steel pipe with end caps. The cylindrical length of the pre-test container shall be equal to or longer than the overall length of the CHSS to be tested in S6.2.5.3, but no shorter than 0.80 m and no longer than 1.75 m.

(c) The pre-test container shall be mounted over the burner:

(1) At any height between 95 millimeters and 105 millimeters above the burner;

(2) Such that the nozzles from the two center rails are pointing toward the bottom center of the pre-test container; and

(3) Such that the container's position relative to the localized and engulfing zones of the burner is consistent with the positioning of the CHSS over the burner in S6.2.5.3.

(d) For outdoor test sites, wind shielding shall be used. The separation between the pre-test container and the walls of the wind shields shall be at least 0.5 meters.

(e) Temperatures during the pre-test check-out shall be measured at least once per second using 3.2 millimeter diameter or less K-type sheath thermocouples.

(f) The thermocouples shall be located in sets to measure temperatures along the cylindrical section of the pre-test container. These thermocouples are secured by straps or other mechanical attachments within 5

millimeters from the pre-test container surface. One set of thermocouples consists of:

(1) One thermocouple located at the bottom surface exposed to the burner flame,

(2) One thermocouple located mid-height along the left side of the cylindrical surface,

(3) One thermocouple located mid-height along the right side of the cylindrical surface, and

(4) One thermocouple located at the top surface opposite to the burner flame.

(g) One set of thermocouples shall be centrally located at the localized fire zone of the CHSS to be tested as determined in S6.2.5.3. Two additional sets of thermocouples shall be spread out over the remaining length of the engulfing fire zone of the CHSS to be tested that is not part of the localized fire zone of the CHSS to be tested.

(h) Burner monitor thermocouples shall be located between 20 millimeters and 30 millimeters below the bottom surface of the pre-test container in the same three horizontal locations described in S6.2.5.2(g). These thermocouples shall be mechanically supported to prevent movement.

(i) With the localized burner ignited, the LPG flow rate to the burner shall be set such that the 60-second rolling averages of individual temperature readings in the localized fire zone shall be in accordance with the localized stage row in the table below.

(j) With the entire burner ignited, the LPG flow rate to the burner shall be set such that the 60-second rolling averages of individual temperature readings shall be in accordance with the engulfing stage row in table 6 to S6.2.5.2.

TABLE 6 TO §571.308 S6.2.5.2

Fire stage	Temperature range on bottom of pre-test container	Temperature range on sides of pre-test container	Temperature range on top of pre-test container
Localized	450 °C to 700 °C	less than 750 °C.	less than 300 °C.
Engulfing	Average temperatures of the pre-test container surface measured at the three bottom locations shall be greater than 600 °C.	Not applicable.	Average temperatures of the pre-test container surface measured at the three top locations shall be at least 100 °C, and when greater than 750 °C, shall also be less than the average temperatures of the pre-test container surface measured at the three bottom locations.

S6.2.5.3. *CHSS fire test*. (a) The CHSS to be fire tested shall include TPRD vent lines.

(b) The CHSS to be fire tested shall be mounted at any height between 95 millimeters and 105 millimeters above the burner.

(c) CHSS shall be positioned for the localized fire test by orienting the CHSS such that the distance from the center of the localized fire exposure to the TPRD(s) and TPRD sense point(s) is at or near maximum.

(d) When the container is longer than the localized burner, the localized burner shall not extend beyond either end of the container in the CHSS.

(e) The CHSS shall be filled with compressed hydrogen gas to any SOC between 100.0 percent and 105.0 percent.

(f) For outdoor test sites, the same wind shielding shall be used as was used for S6.2.5.2. The separation between the CHSS and the walls of the wind shields shall be at least 0.5 meters.

(g) Burner monitor temperatures shall be measured below the bottom surface of the CHSS in the same positions as specified in S6.2.5.2(h).

(h) The allowable limits for the burner monitor temperatures during the CHSS fire test shall be established based on the results of the pre-test checkout as follows:

(1) The minimum value for the burner monitor temperature during the localized fire stage ($Tmin_{LOC}$) shall be calculated by subtracting 50 °C from the 60-second rolling average of the burner monitor temperature in the localized fire zone of the pre-test checkout. If the resultant $Tmin_{LOC}$ exceeds 600 °C, $Tmin_{LOC}$ shall be 600 °C.

(2) The minimum value for the burner monitor temperature during the engulfing fire stage ($Tmin_{ENG}$) shall be calculated by subtracting 50 °C from the 60-second rolling average of the average of the three burner monitor temperatures during the engulfing fire stage of the pre-test checkout. If the resultant $Tmin_{ENG}$ exceeds 800 °C, $Tmin_{ENG}$ shall be 800 °C.

(i) The localized fire stage is initiated by starting the fuel flow to the localized burner and igniting the burner.

(j) The 10-second rolling average of the burner monitor temperature in the localized fire zone shall be at least 300 °C within 1 minute of ignition and for the next 2 minutes.

(k) Within 3 minutes of the igniting the burner, using the same LPG flow rate as S6.2.5.2(i), the 60-second rolling average of the localized zone burner monitor temperature shall be greater than $Tmin_{LOC}$ as determined in S6.2.5.3(h)(1).

(l) After 10 minutes from igniting the burner, the engulfing fire stage is initiated.

(m) The engulfing fire zone includes the localized fire zone and extends in one direction towards the nearest TPRD or TPRD sense point along the complete length of the container up to a maximum burner length of 1.65 m.

(n) Within 2 minutes of the initiation of the engulfing fire stage, using the same LPG flow rate as S6.2.5.2(j), the 60-second rolling average of the engulfing burner monitor temperature shall be equal or greater than $Tmin_{ENG}$ as determined in S6.2.5.3(h)(2).

(o) The fire testing continues until the pressure inside the CHSS is less than or equal to 1.0 MPa or until:

(1) A total test time of 60 minutes for CHSS on vehicles with a GVWR of 10,000 pounds or less or;

(2) A total test time of 120 minutes for CHSS on vehicles with a GVWR over 10,000 pounds.

S6.2.6. *Test procedures for performance durability of closure devices.*

S6.2.6.1. *TPRD performance tests.* Unless otherwise specified, testing is performed with either hydrogen gas with a purity of at least 99.97 percent, less than or equal to 5 parts per million of water, and less or equal to 1 part per million particulate, or with an inert gas. All tests are performed at any temperature between 5.0 °C and 35.0 °C unless otherwise specified.

S6.2.6.1.1. *Pressure cycling test.* A TPRD undergoes 15,000 internal pressure cycles at a rate not exceeding 10 cycles per minute. The table below summarizes the pressure cycles. Any condition within the ranges specified in table 7 to this section may be selected for testing.

(a) The first 10 pressure cycles shall be from any low pressure of between 1.0 MPa and 2.0 MPa to any high pressure between 150.0 percent NWP and 155.0 percent NWP. These cycles are conducted at any sample temperature between 85.0 °C to 90.0 °C.

(b) The next 2,240 pressure cycles shall be from any low pressure between 1.0 MPa and 2.0 MPa to any high pressure of between 125.0 percent NWP and 130.0 percent NWP. These cycles are conducted at any sample temperature between 85.0 °C to 90.0 °C.

(c) The next 10,000 pressure cycles shall be from any low pressure of between 1.0 MPa and 2.0 MPa to any high pressure between 125.0 percent NWP and 130.0 percent NWP. These cycles are conducted at a sample temperature between 5.0 °C to 35.0 °C.

(d) The final 2,750 pressure cycles shall be from any low pressure between 1.0 MPa and 2.0 MPa to any high pressure between 80.0 percent NWP and 85.0 percent NWP. These cycles are conducted at any sample temperature between −45.0 °C to −40.0 °C.

TABLE 7 TO §571.308 S6.2.6.1.1

Number of cycles	Low pressure	High pressure	Sample temperature for cycles
First 10	1.0 MPa to 2.0 MPa	150.0% NWP to 155.0% NWP	85.0 °C to 90.0 °C.
Next 2,240	1.0 MPa to 2.0 MPa	125.0% NWP to 130.0% NWP	85.0 °C to 90.0 °C.
Next 10,000	1.0 MPa to 2.0 MPa	125.0% NWP to 130.0% NWP	5.0 °C to 35.0 °C.
Final 2,750	1.0 MPa to 2.0 MPa	80.0% NWP to 85.0% NWP	−45.0 °C to −40.0 °C.

S6.2.6.1.2. *Accelerated life test.* (a) Two TPRDs undergo testing; one at the vehicle manufacturer's specified activation temperature, and one at an accelerated life temperature, T_L, given in °C using equation 2 to this section, where β = 273.15 °C, T_{ME} is 85 °C, and T_f is the vehicle manufacturer's specified activation temperature in °C.:

EQUATION 2 TO §571.308 S6.2.6.1.2

$$T_L = \left(\frac{0.502}{\beta + T_f} + \frac{0.498}{\beta + T_{ME}}\right)^{-1} - \beta$$

(b) The TPRDs are placed in an oven or liquid bath maintained within 5.0 °C of the specified temperature per S6.2.6.1.2(a). The TPRD inlets are pressurized with hydrogen to any pressure between 125.0 percent NWP and 130.0 percent NWP and time until activation is measured.

S6.2.6.1.3. *Temperature cycling test.* (a) An unpressurized TPRD is placed in a cold liquid bath maintained at any temperature between −45.0 °C and −40.0 °C. The TPRD shall remain in the cold bath for any duration not less than 2 hours and not more than 24 hours. The TPRD is removed from the cold bath and transferred, within five minutes of removal, to a hot liquid bath maintained at any temperature between 85.0 °C and 90.0 °C. The TPRD shall remain in the hot bath for any duration not less than 2 hours and not more than 24 hours. The TPRD is removed from the hot bath and, within five minutes of removal, transferred back into the cold bath maintained at any temperature between −45.0 °C and −40.0 °C.

(b) Step (a) is repeated until 15 thermal cycles have been achieved.

(c) The TPRD remains in the cold liquid bath for any duration not less than 2 and not more than 24 additional hours, then the internal pressure of the TPRD is cycled with hydrogen gas from any pressure between 1.0 MPa and 2.0 MPa to any pressure between 80.0 percent NWP and 85.0 percent NWP for 100 cycles. During cycling, the TPRD remains in the cold bath and the cold bath is maintained at any temperature between −45.0 °C and −40.0 °C.

S6.2.6.1.4. *Salt corrosion resistance test.* (a) Each closure device is exposed to a combination of cyclic conditions of salt solution, temperatures, and humidity. One test cycle is equal to any duration not less than 22 and not more than 26 hours, and is in accordance with table 8 to S6.2.6.1.4.

TABLE 8 TO §571.308 S6.2.6.1.4

Accelerated cyclic corrosion conditions (1 cycle = 22 hours to 26 hours)			
Cycle condition	Temperature	Relative humidity	Cycle duration
Ambient stage	22.0 °C to 28.0 °C	35 percent to 55 percent	470 minutes to 490 minutes
Transition 55 min to 60 min			
Humid stage	47.0 °C to 51.0 °C	95 percent to 100 percent	410 minutes to 430 minutes

TABLE 8 TO § 571.308 S6.2.6.1.4—Continued

Accelerated cyclic corrosion conditions (1 cycle = 22 hours to 26 hours)			
Cycle condition	Temperature	Relative humidity	Cycle duration
Transition 170 minutes to 190 minutes			
Dry stage	55.0 °C to 65.0 °C	less than 30 percent	290 minutes to 310 minutes

(b) The apparatus used for this test shall consist of a fog/environmental chamber as defined in ISO 6270–2:2017(E) (incorporated by reference, see § 571.5), with a suitable water supply conforming to Type IV requirements in ASTM D1193–06 (Reapproved 2018) (incorporated by reference, see § 571.5). The chamber shall include a supply of compressed air and one or more nozzles for fog generation. The nozzle or nozzles used for the generation of the fog shall be directed or baffled to minimize any direct impingement on the closure devices.

(c) During ''wet-bottom'' generated humidity cycles, water droplets shall be visible on the samples.

(d) Steam generated humidity may be used provided the source of water used in generating the steam is free of corrosion inhibitors and visible water droplets are formed on the samples to achieve proper wetness.

(e) The drying stage shall occur in the following environmental conditions: any temperature not less than 60 °C and not greater than 65 °C and relative humidity no more than 30 percent with air circulation.

(f) The impingement force from the salt solution application shall not remove corrosion and/or damage the coatings of the closure devices.

(g) The complex salt solution in percent by mass shall be as specified in S6.2.6.1.4(g)(1) through (5):

(1) Sodium Chloride: not less than 0.08 and not more than 0.10 percent.

(2) Calcium Chloride: not less than 0.095 and not more than 0.105 percent.

(3) Sodium Bicarbonate: not less than 0.07 and not more than 0.08 percent.

(4) Sodium Chloride must be reagent grade or food grade. Calcium Chloride must be reagent grade. Sodium Bicarbonate must be reagent grade. For the purposes of S6.2.6.1.4, water must meet ASTM D1193–06 (Reapproved 2018) Type IV requirements (incorporated by reference, see § 571.5).

(5) Either calcium chloride or sodium bicarbonate material must be dissolved separately in water and added to the solution of the other materials.

(h) The closure devices shall be installed in accordance with the vehicle manufacturer's recommended procedure and exposed to the 100 daily corrosion cycles, with each corrosion cycle in accordance with table 8 to S6.2.6.1.4.

(i) For each salt mist application, the solution shall be sprayed as an atomized mist, using the spray apparatus to mist the components until all areas are thoroughly wet and dripping. Suitable application techniques include using a plastic bottle, or a siphon spray powered by oil-free regulated air to spray the test samples. The quantity of spray applied should be sufficient to visibly rinse away salt accumulation left from previous sprays. Four salt mist applications shall be applied during the ambient stage. The first salt mist application occurs at the beginning of the ambient stage. Each subsequent salt mist application should be applied not less than 90 and not more than 95 minutes after the previous application.

(j) The time from ambient to the wet condition shall be any duration not less than 60 and not more than 65 minutes and the transition time between wet and dry conditions shall be any duration not less than 180 and not more than 190 minutes.

S6.2.6.1.5. *Vehicle environment test.* (a) The inlet and outlet connections of the closure device are connected or capped in accordance with the vehicle manufacturer's installation instructions. All external surfaces of the closure device are exposed to each of the following fluids for any duration between 24 hours and 26 hours. The temperature

during exposure shall be any temperature between 5.0 °C and 35.0 °C. A separate test is performed with each of the fluids sequentially on a single closure device.

(1) Sulfuric acid: not less than 19 and not more than 21 percent by volume in water;

(2) Ethanol/gasoline: not less than 10 and not more than 12 percent by volume ethanol and not less than 88 and not more than 90 percent by volume gasoline; and

(3) Windshield washer fluid: not less than 50 and not more than 52 percent by volume methanol in water.

(b) The fluids are replenished as needed to ensure complete exposure for the duration of the test.

(c) After exposure to each fluid, the closure device is wiped off and rinsed with water.

S6.2.6.1.6. *Stress corrosion cracking test.* (a) All components exposed to the atmosphere shall be degreased. For check valves and shut-off valves, the closure device shall be disassembled, all components degreased, and then reassembled.

(b) The closure device is continuously exposed to a moist ammonia air mixture maintained in a glass chamber having a glass cover. The exposure lasts any duration not less than 240 hours and not more than 242 hours. The aqueous ammonia shall have a composition of between 19 weight percent and 21 weight percent ammonium hydroxide in water. Aqueous ammonia shall be located at the bottom of the glass chamber below the sample at any volume not less than 20 mL and not more than 22 mL of aqueous ammonia per liter of chamber volume. The bottom of the sample is positioned any distance not less than 30 and not more than 40 millimeters above the aqueous ammonia and supported in an inert tray.

(c) The moist ammonia-air mixture is maintained at atmospheric pressure and any temperature not less than 35 °C and not more than 40 °C.

S6.2.6.1.7. *Drop and vibration test.* (a) The TPRD is aligned vertically to any one of the six orientations covering the opposing directions of three orthogonal axes: vertical, lateral and longitudinal.

(b) A TPRD is dropped in free fall from any height between 2.00 meters and 2.02 meters onto a smooth concrete surface. The TPRD is allowed to bounce on the concrete surface after the initial impact.

(c) Any sample with damage from the drop that results in the TPRD not being able to be tested in accordance with S6.2.6.1.7(d) shall not proceed to S6.2.6.1.7(d) and shall not be considered a failure of this test.

(d) Each TPRD dropped in S6.2.6.1.7(a) that did not have damage that results in the TPRD not being able to be tested is mounted in a test fixture in accordance with vehicle manufacturer's installation instructions and vibrated for any duration between 30.0 minutes and 35.0 minutes along each of the three orthogonal axes (vertical, lateral and longitudinal) at the most severe resonant frequency for each axis.

(1) The most severe resonant frequency for each axis is determined using any acceleration between 1.50 g and 1.60 g and sweeping through a sinusoidal frequency range from 10 Hz to 500 Hz with any sweep time between 10.0 minutes and 20.0 minutes. The most severe resonant frequency is identified by a pronounced increase in vibration amplitude.

(2) If the resonance frequency is not found, the test shall be conducted at any frequency between 35 Hz and 45 Hz.

S6.2.6.1.8. *Leak test.* Unless otherwise specified, the TPRD shall be thermally conditioned to the ambient temperature condition, then checked for leakage, then conditioned to the high temperature condition, then checked for leakage, then conditioned to low temperature, then checked for leakage.

(a) The TPRD shall be thermally conditioned at test temperatures in each of the test conditions and held for any duration between 1.0 hour and 24.0 hours. The TPRD is pressurized with hydrogen at the inlet. The required test conditions are:

(1) Ambient temperature: condition the TPRD at any temperature between 5.0 °C and 35.0 °C; test in accordance with S6.2.6.1.8(b) at any pressure between 1.5 MPa and 2.5 MPa and then at any pressure between 125.0 percent NWP and 130.0 percent NWP.

(2) High temperature: condition the TPRD at any temperature between 85.0 °C and 90.0 °C; test in accordance with S6.2.6.1.8(b) at any pressure between 1.5 MPa and 2.5 MPa and then at any pressure between 125.0 percent NWP and 130.0 percent NWP.

(3) Low temperature: condition the TPRD at any temperature between −45.0 °C and −40.0 °C; test in accordance with S6.2.6.1.8(b) at any pressure between 1.5 MPa and 2.5 MPa and then at any pressure between 100.0 percent NWP and 105.0 percent NWP.

(b) Following conditioning at each of the specified test temperature ranges, the TPRD is observed for leakage while immersed in a temperature-controlled liquid at the same specified temperature range for any duration between 1.0 minutes and 2.0 minutes at each of the pressure ranges listed above. If no bubbles are observed for the specified time period, it is not considered a failure. If bubbles are detected, the leak rate is measured.

S6.2.6.1.9. *Bench top activation test.* (a) The test apparatus consists of either a forced air oven or chimney with air flow. The TPRD is not exposed directly to flame. The TPRD is mounted in the test apparatus according to the vehicle manufacturer's installation instructions.

(b) The temperature of the oven or chimney is at any temperature between 600.0 °C and 605.0 °C for any duration between 2 minutes and 62 minutes prior to inserting the TPRD.

(c) Prior to inserting the TPRD, pressurize the TPRD to any pressure between 1.5 MPa and 2.5 MPa.

(d) The pressurized TPRD is inserted into the oven or chimney, the temperature within the oven or chimney is maintained at any temperature between 600.0 °C and 605.0 °C, and the time for the TPRD to activate is recorded. If the TPRD does not activate within 120 minutes from the time of insertion into the oven or chimney, the TPRD shall be considered to have failed the test.

S6.2.6.1.10. *Flow rate test.* (a) At least one new TPRD is tested to establish a baseline flow rate.

(b) After activation in accordance with S6.2.6.1.9, and without cleaning, removal of parts, or reconditioning, the TPRD is subjected to flow testing using hydrogen, air or an inert gas;

(c) Flow rate testing is conducted with any inlet pressure between 1.5 MPa and 2.5 MPa. The outlet is at atmospheric pressure.

(d) Flow rate is measured in units of kilograms per minute with a precision of at least 2 significant digits.

S6.2.6.2. *Check valve and shut-off valve performance tests.* Unless otherwise specified, testing shall be performed with either hydrogen gas with a purity of at least 99.97 percent, less than or equal to 5 parts per million of water, and less than or equal to 1 part per million particulate, or with an inert gas. All tests are performed at any temperature between 5.0 °C and 35.0 °C unless otherwise specified.

S6.2.6.2.1. *Hydrostatic strength test.* (a) The outlet opening is plugged and valve seats or internal blocks are made to assume the open position.

(b) Any hydrostatic pressure between 250.0 percent NWP and 255.0 percent NWP is applied using water to the valve inlet for any duration between 180.0 seconds and 185.0 seconds. The unit is examined to ensure that burst has not occurred.

(c) The hydrostatic pressure is then increased at a rate of less than or equal to 1.4 MPa/sec until component failure. The hydrostatic pressure at failure is recorded.

S6.2.6.2.2. *Leak test.* Each unit shall be thermally conditioned to the ambient temperature condition, then checked for leakage, then conditioned to the high temperature condition, then checked for leakage, then conditioned to low temperature, then checked for leakage.

(a) Each unit shall be pressurized to any pressure between 2.0 MPa and 3.0 MPa and held for any duration between 1.0 hours and 24.0 hours in the specified temperature range before testing. The outlet opening is plugged. The test conditions are:

(1) Ambient temperature: condition the unit at any temperature between 5.0 °C and 35.0 °C; test at any pressure between 1.5 MPa and 2.5 MPa and at any pressure between 125.0 percent NWP and 130.0 percent NWP.

(2) High temperature: condition the unit at any temperature between 85.0

°C and 90.0 °C; test at any pressure between 1.5 MPa and 2.5 MPa and at any pressure between 125.0 percent NWP and 130.0 percent NWP.

(3) Low temperature: condition the unit at any temperature between −45.0 °C and −40.0 °C; test at any pressure between 1.5 MPa and 2.5 MPa and at any pressure between 100.0 percent NWP and 105.0 percent NWP.

(b) While within the specified temperature and pressure range, the unit is observed for leakage while immersed in a temperature-controlled liquid held within the same specified temperature range as the test condition for any duration between 1.0 minutes and 2.0 minutes at each of the test pressures. If no bubbles are observed for the specified time period, the sample passes the leak test. If bubbles are detected, the leak rate is measured.

S6.2.6.2.3. *Extreme temperature pressure cycling test.* (a) The valve unit is connected to a test fixture.

(b) For a check valve, the pressure is applied in six incremental pulses to the check valve inlet with the outlet closed. The pressure is then vented from the check valve inlet. The pressure is lowered on the check valve outlet side to any pressure between 55.0 percent NWP and 60.0 percent NWP prior to the next cycle.

(c) For a shut-off valve, the specified pressure is applied through the inlet port. The shut-off valve is then energized to open the valve and the pressure is reduced to any pressure less than 50 percent of the specified pressure range. The shut-off valve shall then be de-energized to close the valve prior to the next cycle.

S6.2.6.2.4. *Chatter flow test.* The valve is subjected to between 24.0 hours and 26.0 hours of chatter flow at a flow rate that causes the most valve flutter.

S6.2.6.2.5. *Electrical Tests.* This section applies to shut-off valves only.

(a) The solenoid valve is connected to a variable DC voltage source, and the solenoid valve is operated as follows:

(1) Held for any duration between 60.0 and 65.0 minutes at any voltage between 0.50 V and 1.5 times the rated voltage.

(2) The voltage is increased to any voltage between 0.5 V to two times the rated voltage, or between 60.0 V and 60.5 V, whichever is less, and held for any duration between 60.0 seconds and 70.0 seconds.

(b) Any voltage between 1,000.0 V DC and 1,010.0 V DC is applied between the power conductor and the component casing for any duration between 2.0 seconds to 4.0 seconds.

S6.2.6.2.6. *Vibration test.* (a) The valve is pressurized with hydrogen to any pressure between 100.0 percent NWP and 105.0 percent NWP, sealed at both ends, and vibrated for any duration between 30.0 and 35.0 minutes along each of the three orthogonal axes (vertical, lateral and longitudinal) at the most severe resonant frequencies.

(b) The most severe resonant frequencies are determined using any acceleration between 1.50 g and 1.60 g and sweeping through a sinusoidal frequency range from 10 Hz to 500 Hz with any sweep time between 10.0 minutes and 20.0 minutes. The resonance frequency is identified by a pronounced increase in vibration amplitude.

(c) If the resonance frequency is not found, the test shall be conducted at any frequency between 35 Hz and 45 Hz.

[90 FR 6281, Jan. 17, 2025]

§571.401 Standard No. 401; Interior trunk release.

S1. *Purpose and scope.* This standard establishes the requirement for providing a trunk release mechanism that makes it possible for a person trapped inside the trunk compartment of a passenger car to escape from the compartment.

S2. *Application.* This standard applies to passenger cars that have a trunk compartment. This standard does not apply to passenger cars with a back door.

S3. *Definitions.*

Back door means a door or door system on the back end of a passenger car through which cargo can be loaded or unloaded. The term includes the hinged back door on a hatchback or a station wagon.

Trunk compartment. (a) Means a space that:

(1) Is intended to be used for carrying luggage or cargo,

(2) Is wholly separated from the occupant compartment of a passenger car by a permanently attached partition or

by a fixed or fold-down seat back and/or partition,

(3) Has a trunk lid, and

(4) Is large enough so that the three-year-old child dummy described in Subpart C of Part 572 can be placed inside the trunk compartment, and the trunk lid can be closed and latched with all removable equipment furnished by the passenger car manufacturer stowed in accordance with label(s) on the passenger car or information in the passenger car owner's manual, or, if no information is provided, as located when the passenger car is delivered. (Note: For purposes of this standard, the Part 572 Subpart C test dummy need not be equipped with the accelerometers specified in § 572.21.)

(b) Does not include a sub-compartment within the trunk compartment.

Trunk lid means a moveable body panel that is not designed or intended as a passenger car entry point for passengers and that provides access from outside a passenger car to a trunk compartment. The term does not include a back door or the lid of a storage compartment located inside the passenger compartment of a passenger car.

S4. *Requirements.*

S4.1 Each passenger car with a trunk compartment must have an automatic or manual release mechanism inside the trunk compartment that unlatches the trunk lid. Each trunk release shall conform, at the manufacturer's option, to either S4.2(a) and S4.3, or S4.2(b) and S4.3. The manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle.

S4.2(a) Each manual release mechanism installed pursuant to S4.1 of this standard must include a feature, like lighting or phosphorescence, that allows the release mechanism to be easily seen inside the closed trunk compartment.

(b) Each automatic release mechanism installed pursuant to S4.1 of this section must unlatch the trunk lid within 5 minutes of when the trunk lid is closed with a person inside the trunk compartment.

S4.3(a) Except as provided in paragraph S4.3(b), actuation of the release mechanism required by S4.1 of this standard must completely release the trunk lid from all latching positions of the trunk lid latch.

(b)(1) For passenger cars with a front trunk compartment that has a front opening trunk lid required to have a secondary latching position or latch system, actuation of the release mechanism required by paragraph S4.1 of this standard must result in the following:

(i) When the passenger car is stationary, the release mechanism must release the trunk lid from all latching positions or latch systems;

(ii) When the passenger car is moving forward at a speed less than 5 km/h, the release mechanism must release the trunk lid from the primary latching position or latch system, and may release the trunk lid from all latching positions or latch systems;

(iii) When the passenger car is moving forward at a speed of 5 km/h or greater, the release mechanism must release the trunk lid from the primary latching position or latch system, but must not release the trunk lid from the secondary latching position or latch system.

(2) The passenger cars described in paragraph S4.3(b)(1) are excluded from the requirements of this standard until September 1, 2002.

[66 FR 43121, Aug. 17, 2001, as amended at 67 FR 19523, Apr. 22, 2002]

§ 571.403 Standard No. 403; Platform lift systems for motor vehicles.

S1. *Scope.* This standard specifies requirements for platform lifts used to assist persons with limited mobility in entering or leaving a vehicle.

S2. *Purpose.* The purpose of this standard is to prevent injuries and fatalities to passengers and bystanders during the operation of platform lifts installed in motor vehicles.

S3 *Application.* This standard applies to platform lifts manufactured on and after April 1, 2005, that are designed to carry standing passengers, who may be aided by canes or walkers, as well as persons seated in wheelchairs, scooters, and other mobility aids, into and out of motor vehicles.

S4. *Definitions.*

Bridging device means that portion of a platform lift that provides a transitional surface between the platform

surface and the surface of the vehicle floor within the platform threshold area.

Cycle means deploying a platform lift from a stowed position, lowering the lift to the ground level loading position, raising the lift to the vehicle floor loading position, and stowing the lift. The term includes operation of any wheelchair retention device, bridging device, and inner roll stop.

Deploy means with respect to a platform, its movement from a stowed position to an extended position or, one of the two loading positions. With respect to a wheelchair retention device or inner roll stop, the term means the movement of the device or stop to a fully functional position intended to prevent a passenger from disembarking the platform or being pinched between the platform and vehicle.

Floor reference plane means the plane perpendicular to the longitudinal vehicle reference plane for platform lifts that deploy from the side of the vehicle or perpendicular to the transverse vehicle reference plane for platform lifts that deploy from the rear of the vehicle, and tangent to the outermost edge of the vehicle floor surface adjacent to the lift platform. (See figure 1.)

Gap means a discontinuity in a plane surface, or between two adjacent surfaces.

Inner roll-stop means a device that is located at the edge of the platform that a passenger or mobility aid must traverse when entering and exiting the platform from the vehicle floor loading position and that is designed to retain mobility aids on the platform surface during the range of passenger operation.

Lift reference plane means the plane that is defined by two orthogonal axes passing through the geometric center of the platform surface of a platform lift. One axis is perpendicular to the platform reference plane and the other is parallel to the direction of wheelchair travel during loading of the lift. (*See* figure 1.)

Loading position means, with respect to a platform lift, a position at which a passenger can either embark or disembark the lift. The two loading positions are at vehicle floor and ground level.

Longitudinal vehicle reference plane means the plane that is perpendicular to the floor reference plane and contains the longitudinal axis of the vehicle when the vehicle body is level and moves along with the vehicle body in response to the loading of the vehicle suspension. (*See* figure 1.)

Outer barrier is a particular wheelchair retention device that is located on the edge of the platform, is traversed during ground level loading and unloading, and is designed to retain wheelchairs on the platform surface during the range of passenger operation.

Platform means that portion of a platform lift on which the mobility aid or passenger rests while being raised or lowered.

Platform lift means a level change device, including any integration of existing vehicle components, and excluding a ramp, used to assist persons with limited mobility in entering or leaving a vehicle.

Platform reference plane means a plane tangent to the platform surface at its geometric center. (*See* figure 1.)

Platform surface means the passenger-carrying surface of the lift platform.

Platform threshold area means the rectangular area of the vehicle floor defined by moving a line that lies on the portion of the edge of the vehicle floor directly adjacent to the platform, through a distance of 457 mm (18 inches) across the vehicle floor in a direction perpendicular to the edge. Any portion of a bridging device that lies on this area must be considered part of that area.

Private use lift means a platform lift certified to the requirements for private use lifts and requirements in this standard for all lifts.

Public use lift means a platform lift certified to the requirements for public use lifts and requirements in this standard for all lifts.

Range of passenger operation means the portion of the lift cycle during which the platform is at or between the vehicle floor and ground level loading positions excluding any stow and deploy operations.

Standard test load means a static load or mass centered on the test pallet such that the total combined mass for

public-use lifts shall be 272 kg (600 lb), and the total combined mass for private-use lifts shall be the lift manufacturer's stated rated load or 181 kg (400 lb), whichever is greater.

Stow means with respect to a platform, its movement from a position within the range of passenger operation to the position maintained during normal vehicle travel; and, with respect to a wheelchair retention device, bridging device, or inner-roll stop, its movement from a fully functional position to a position maintained during normal vehicle travel.

Test pallet means a platform on which required test loads are placed for handling and moving.

Transverse vehicle reference plane means the plane that is perpendicular to the floor reference plane and contains the transverse axis of the vehicle when the vehicle body is level and that moves along with the vehicle body in response to the loading of the vehicle suspension. (*See* figure 1.)

Wheelchair retention device means a device designed to prevent wheelchairs from leaving the edge of the platform used for ground level loading and unloading during the range of passenger operation.

S5. [Reserved]

S6. Requirements.

(a) Each platform lift must comply with the requirements for private use lifts or public use lifts and with the requirements for all lifts.

(b) Each public use lift must

(1) Comply with the requirements for public use lifts and with the requirements for all lifts.

(2) Bear a label with the words ''DOT—Public Use Lift'' as certification of compliance with the requirements specified in paragraph S6(b)(1).

(c) Each private use lift must

(1) Comply with the requirements for private use lifts and with the requirements for all lifts.

(2) Bear a label with the words ''DOT—Private Use Lift'' as certification of compliance with the requirements specified in S6(c)(1).

(d) Platform lifts suitable for installation on buses, school buses, and MPVs other than motor homes with a GVWR greater than 4,536 kg (10,000 lb.), except motor homes, must be certified by the manufacturer as meeting the requirements for public use lifts. For platform lifts suitable for installation on all other vehicles, the manufacturer may select the option of certifying compliance with either the public use lift requirements or the private use lift requirements of this standard at the time it certifies the vehicle and may not thereafter select a different option for the vehicle.

(e) For all lifts, where a range of values is specified, the equipment must meet the requirements at all points within the range.

(f) The test procedures in S7 are used to determine compliance with all requirements, except S6.6, S6.7.5, S6.12 and S6.13.

S6.1 *Threshold warning signal.*

S6.1.1 Except when the platform lift is operated manually in backup mode as required by S6.9, the lift must meet the requirements of S6.1.2 and S6.1.3. The lift is tested in accordance with S7.4 to determine compliance with this section.

S6.1.2. Private-use lifts: Except for platform lifts where platform loading takes place wholly over the vehicle floor, a visual or audible warning must activate if the platform is more than 25 mm (1 inch) below the platform threshold area and portions of a passenger's body or mobility aid is on the platform threshold area defined in S4 when tested in accordance with S7.4.

S6.1.3 Public-use lifts: A visual and audible warning must activate if the platform is more than 25 mm (1 inch) below the platform threshold area and portions of a passenger's body or mobility aid is on the platform threshold area defined in S4 when tested in accordance with S7.4.

S6.1.4 The visual warning required by S6.1.2 and S6.1.3 must be a flashing red beacon as defined in SAE Recommended Practice J578 (1995) (incorporated by reference, see § 571.5), must have a minimum intensity of 20 candela, a frequency from 1 to 2 Hz, and must be located within the interior of the vehicle such that it is visible from a point 914 mm (3 ft) above the center of the threshold area (see Figure 2) wherever the lift is installed and with any configuration of the vehicle interior.

S6.1.5 The audible warning required by S6.1.2 and S6.1.3 must be a minimum of 85 dBA between 500 and 3000 Hz.

S6.1.6 The intensity of the audible warning and visibility of the visual warning required by S6.1.2 and S6.1.3 is measured/observed at a location 914 mm (3 ft) above the center of the platform threshold area. (See Figure 2).

S6.2 *Platform lift operational requirements.*

S6.2.1 *General.* Throughout the range of passenger operation and during the lift operations specified in S7.9.3 through S7.9.8, the platform lift must meet the requirements of S6.2.2 through S6.2.4. These requirements must be satisfied both with and without a standard load on the lift platform, except for S6.2.2.2, which must be satisfied without any load.

S6.2.2 *Maximum platform velocity.*

S6.2.2.1 Throughout the range of passenger operation specified in S7.9.4 through S7.9.7, both the vertical and horizontal velocity of the platform must be less than or equal to 152 mm (6 inches) per second when measured at the geometric center of the platform when the platform is unloaded and at the geometric center of the top, horizontal surface of the standard load specified in S7.1.1 when the platform is loaded.

S6.2.2.2 Except for platform lifts that manually stow (fold) and deploy (unfold), during the stow and deploy operations specified in S7.9.3 through S7.9.8, both the vertical and horizontal velocity of any portion of the platform must be less than or equal to 305 mm (12 inches) per second.

S6.2.3 *Maximum platform acceleration.* Throughout the range of passenger operation specified in S7.9.4 through S7.9.7, both the horizontal and vertical acceleration of the platform must be less than or equal to 0.3 g after the accelerometer output is filtered with a channel frequency class (CFC) 3 filter. The filter must meet the requirements of SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5), with F_H = 3 Hz and F_N = 5 Hz. The accelerometer is located at the geometric center of the platform and is mounted directly on the platform when it is unloaded and on the geometric center of the top, horizontal surface of the standard load specified in S7.1.1 when the platform is loaded.

S6.2.4 *Maximum noise level of public use lifts.* Except as provided in S6.1.5, throughout the range of passenger operation specified in S7.9.4 through S7.9.7, the noise level of a public use lift may not exceed 80 dBa as measured at any lift operator's position designated by the platform lift manufacturer for the intended vehicle and in the area on the lift defined in S6.4.2.1. Lift operator position measurements are taken at the vertical centerline of the control panel 30.5 cm (12 in) out from the face of the control panel. In the case of a lift with a pendant control (*i.e.*, a control tethered to the vehicle by connective wiring), measurement is taken at the vertical centerline of the control panel 30.5 cm (12 in) out from the face of the control panel while the control panel is in its stowed or stored position. For the lift operator positions outside of the vehicle, measurements are taken at the intersection of a horizontal plane 157 cm (62 in) above the ground and the vertical centerline of the face of the control panel after it has been extended 30.5 cm (12 in) out from the face of the control panel.

S6.3 *Environmental resistance.*

S6.3.1 *Internally mounted platform lifts.* On platform lifts and their components internal to the occupant compartment of the vehicle or internal to other compartments that provide protection from the elements when stowed, attachment hardware must be free of ferrous corrosion on significant surfaces except for permissible ferrous corrosion, as defined in §571.209, at peripheral surface edges or edges of holes on under-floor reinforcing plates and washers after being subjected to the conditions specified in S7.3. Alternatively, such hardware must be made from corrosion-resistant steel containing at least 11.5 percent chromium per §571.209, S5.2(a) or must be protected against corrosion by an electrodeposited coating of nickel, or copper and nickel with at least a service condition number of SC2, and other attachment hardware must be protected by an electrodeposited coating of nickel, or copper and nickel with a

service condition number of SC1, in accordance with ASTM B456–95 (incorporated by reference, see § 571.5), but such hardware may not be racked for electroplating in locations subjected to maximum stress. The manufacturer shall select the option by the time it certifies the lift and may not thereafter select a different option for the lift. The lift must be accompanied by all attachment hardware necessary for its installation on a vehicle.

S6.3.2 *Externally mounted platform lifts.* On platform lifts and their components external to the occupant compartment of the vehicle and external to other compartments that provide protection from the elements when stowed, the lift and its components must be free of ferrous corrosion on significant surfaces except for permissible ferrous corrosion, as defined in FMVSS No. 209, at peripheral surface edges and edges of holes and continue to function properly after being subjected to the conditions specified in S7.3. Alternatively, such lifts and all associated hardware and components must be completely made from corrosion-resistant steel containing at least 11.5 percent chromium per FMVSS 571.209, S5.2(a). The manufacturer shall select the option by the time it certifies the lift and may not thereafter select a different option for the lift. The lift must be accompanied by all attachment hardware necessary for its installation on a vehicle.

S6.4 *Platform requirements.*

S6.4.1 *General.* Throughout the range of passenger operations and during the platform lift operations specified in S7.9.4 through S7.9.7, the platform lift must meet the requirements of S6.4.2 through S6.4.12. The requirements of S6.4.2 through S6.4.6, S6.4.7.4, S6.4.9.4, S6.4.9.5, S6.4.9.6, and S6.4.9.8 must be satisfied both with and without a standard load on the lift platform

S6.4.2 *Unobstructed platform operating volume.*

S6.4.2.1 *Public use lifts.* For public use lifts, the minimum platform operating volume is the sum of an upper part and a lower part (see Figure 3). The lower part is a rectangular solid whose base is 725 mm (28.5 in) wide by the length of the platform surface, whose height is 50 mm (2 in), and which is resting on the platform surface with each side of the base parallel with the nearest side of the platform surface. The width is perpendicular to the lift reference plane and the length is parallel to the lift reference plane (See Figure 1). The upper part is a rectangular solid whose base is 760 mm (30 in) by 1,220 mm (48 in) long, whose height is 711 mm (28 in), and whose base is tangent to the top surface of the lower rectangular solid (see Figure 3). The centroids of both the upper and lower parts coincide with the vertical centroidal axis of the platform reference plane (see Figure 1).

S6.4.2.2 *Private use lifts.* For private use lifts, the platform operating volume is as specified by the lift manufacturer and identified in the lift insert to the vehicle owner's manual.

S6.4.3 *Platform surface protrusions.*

S6.4.3.1 *Public use lifts.* For public use lifts, except as required for deployment of the wheelchair retention device and inner roll stop, throughout the range of passenger operation, the platform surface may not have protrusions which rise more than 6.5 mm (0.25 in) above the platform surface, measured perpendicular to the platform surface by a device with its base centered between 50–100 mm (2–4 in) from the protrusion. Any cross-sectional dimension of the base of the protrusion measurement device must be greater than or equal to 25mm (1 in) and less than or equal to 50 mm (2 in).

S6.4.3.2 *Private use lifts.* For private use lifts, except as required for deployment of the wheelchair retention device and inner roll stop, the platform surface may not have protrusions which rise more than 13 mm (0.5 in) above the platform surface, measured perpendicular to the platform surface by a device with its base centered between 50–100 mm (2–4 in) from the protrusion. All portions of the sides of a protrusion that are between 6.5 mm (0.25 in) and 13 mm (0.5 in) above the platform must have a slope not greater than 1:2, measured with respect to the platform surface at the location of the protrusion. Any cross-sectional dimension of the base of the protrusion measurement device must be greater than or equal to 25mm (1 in) and less than or equal to 50 mm (2 in).

S6.4.4 *Gaps, transitions and openings.*

S6.4.4.1 When the platform lift is at the ground level loading position, any vertical surface transition measured perpendicular to the ground over which a passenger may traverse to enter or exit the platform, may not be greater than 6.5 mm (0.25 in). When the lift is at the vehicle level loading position, any vertical surface transition measured perpendicular to the platform threshold area over which a passenger may traverse to enter or exit the platform, may not be greater than 6.5 mm (0.25 in).

S6.4.4.2 When the platform lift is at the ground or vehicle level loading position, the slope of any surface over which a passenger may traverse to enter or exit the platform must have a rise to run not greater than 1:2 on the portion of the rise between 6.5 mm (0.25 in) and 13 mm (0.5 in), and 1:8 on the portion of the rise between 13 mm (0.5 in) and 75 mm (3 in). The rise of any sloped surface may not be greater than 75 mm (3 inches). When the lift is at the ground level loading position, measurements are made perpendicular to the ground. When the lift is at the vehicle level loading position, measurements are made perpendicular to the platform threshold area.

S6.4.4.3 When the inner roll stop or any outer barrier is deployed, any gap between the inner roll stop and lift platform and any gap between the outer barrier and lift platform must prevent passage of the clearance test block specified in S7.1.3 when its long axis is held perpendicular to the platform reference plane.

S6.4.4.4 When the platform is at the vehicle floor or ground level loading position, any horizontal gap over which a passenger may traverse to enter or exit the platform must prevent passage of a 13 mm (0.5 inch) diameter sphere.

S6.4.4.5 Any opening in that portion of the platform surface that coincides with the unobstructed platform operating volume described in S6.4.2 must prevent passage of a 19 mm (0.75 inch) diameter sphere.

S6.4.4.6 Any gap between the platform sides and edge guards which move with the platform must prevent passage of a 13 mm (0.5 inch) diameter sphere. Where structures fixed to the vehicle are used as edge guards, the horizontal gap between the platform side and vehicle structure must prevent passage of a 6.5 mm (0.25 inch) diameter sphere.

S6.4.5 *Platform deflection.* The angle of the deployed platform, when stationary, and loaded with a standard load, must not exceed 4.8 degrees with respect to the vehicle floor and must not exceed 3 degrees with respect to the platform's unloaded position. The angles are measured between a vertical axis from the vehicle floor and an axis normal to the platform center as shown in Figure 1.

S6.4.6 *Edge guards.*

S6.4.6.1 The platform lift must have edge guards that extend continuously along each side of the lift platform to within 75 mm (3 inches) of the edges of the platform that are traversed while entering and exiting the platform at both the ground and vehicle floor level loading positions. The edge guards must be parallel to the direction of wheelchair movement during loading and unloading. Alternatively, when tested in accordance with S7.7.4, all portions of the wheels of the wheelchair test device must remain above the platform surface and after the control is released to Neutral, at the end of each attempt to steer the test device off the platform, all wheels of the wheelchair test device must be in contact with the platform surface. The manufacturer shall select the option by the time it certifies the lift and may not thereafter select a different option for the lift.

S6.4.6.2 Edge guards that move with the platform must have vertical sides facing the platform surface and a minimum height of 38 mm (1.5 inches), measured vertically from the platform surface.

S6.4.6.3 Except whenever any part of the platform surface is below a horizontal plane 75 mm (3 inches) above the ground, edge guards must be deployed throughout the range of passenger operation.

S6.4.7 *Wheelchair retention.*

S6.4.7.1 *Impact I.* Except for platform lifts designed so that platform loading takes place wholly over the vehicle floor, the lift must have a means of retaining the test device specified in

S7.1.2. After impact, the test device must remain supported by the platform surface with none of the axles of its wheels extending beyond a plane that is perpendicular to the platform reference plane (Figure 1) and that is tangent to the edge of the platform that is traversed when entering or exiting the platform from the ground level loading position throughout its range of passenger operation, except as provided in S6.4.7.4. The lift is tested in accordance with S7.7 to determine compliance with this section.

S6.4.7.2 *Impact II.* For platform lifts designed so that platform loading takes place wholly over the vehicle floor, the lift must have a means of retaining the test device specified in S7.1.2. After impact, the test device must remain upright with all of its wheels on the platform surface, throughout the range of passenger operation, except as provided in S6.4.7.4. The lift is tested in accordance with S7.7 to determine compliance with this section.

S6.4.7.3 *Overload.* The deployed wheelchair retention device(s) must be capable of sustaining 7,117 N (1,600 lb force) when tested in accordance with S7.13. No separation, fracture, or breakage of the wheelchair retention device may occur as a result of conducting the test in S7.13.

S6.4.7.4 *Deployment.* Except whenever any part of the platform surface is below a horizontal plane 75 mm (3 in) above the ground, the wheelchair retention device(s) must be deployed throughout the range of passenger operation.

S6.4.8 *Inner roll stop.*

S6.4.8.1 *Public use lifts.* Public use lifts must have an inner roll stop that meets the requirements of S6.4.8.3.

S6.4.8.2 *Private use lifts.* Private use lifts must:

(a) Have an inner roll stop that meets the requirements of S6.4.8.3; or

(b) Have operating instructions near the lift controls and in the vehicle owner's manual, as specified in S6.7.8 and S6.12.4.3, that contain a warning that wheelchairs should back onto the platform when entering from the ground.

S6.4.8.3 *Requirements.* When tested in accordance with S7.8, platform lifts must have an inner roll stop that provides a means that prevents:

(a) The front wheels of the test device specified in S7.1.2 from extending beyond a plane that is perpendicular to the platform reference plane (Figure 1) and that is tangent to the edge of the platform where the roll stop is located when the lift is at ground level loading position; and

(b) Any portion of the test device specified in S7.1.2 from being contacted simultaneously with a portion of the lift platform and any other structure, throughout the lift's range of passenger operation.

S6.4.9 *Handrails.*

S6.4.9.1 *Public use lifts:* Public use lifts must have a handrail located on each side of the lift that meets the requirements of S6.4.9.3 through S6.4.9.9.

S6.4.9.2 *Private use lifts:* Private use lifts are not required to be equipped with handrails. Private use lifts that are equipped with handrails must meet the requirement of S6.4.9.3 through S6.4.9.9.

S6.4.9.3 The graspable portion of each handrail may not be less than 760 mm (30 inches) and more than 965 mm (38 inches) above the platform surface, measured vertically.

S6.4.9.4 The cross section of the graspable portion of each handrail may not be less than 31.5 mm (1.25 inches) and more than 38 mm (1.5 inches) in diameter or width, and may not have less than a 3.2 mm (0.125 inch) radii on any corner.

S6.4.9.5 The vertical projection of the graspable portion of each handrail must intersect two planes that are perpendicular to the platform reference plane and to the direction of travel of a wheelchair on the lift when entering or exiting the platform, and are 203 mm (8 inches) apart.

S6.4.9.6 The handrails must move such that the position of the handrails relative to the platform surface does not change.

S6.4.9.7 When tested in accordance with S7.12.1, each handrail must withstand 445 N (100 pounds force) applied at any point and in any direction on the handrail without more than 25 mm (1 inch) of displacement relative to the platform surface. After removal of the

load, the handrail must exhibit no permanent deformation.

S6.4.9.8 When tested in accordance with S7.12.1, there must be at least 38 mm (1.5 inches) of clearance between each handrail and any portion of the vehicle, throughout the range of passenger operation.

S6.4.9.9 When tested in accordance with S7.12.2, each handrail must withstand 1,112 N (250 lb/f) applied at any point and in any direction on the handrail without sustaining any failure, such as cracking, separation, fracture, or more than 100 mm (4 inches) of displacement of any point on the handrails relative to the platform surface.

S6.4.10 *Platform markings on public use lifts.* Throughout the range of passenger operation, all edges of the platform surface, the visible edge of the vehicle floor or bridging device adjacent to the platform lift, and any designated standing area on a public use lift must be outlined. The outlines must be at least 25 mm (1 in) wide and of a color that contrasts with its background by 60 percent, determined according to the following equation:

$$\text{Contrast} = 100 \times [(L1 - L2)/L1]$$

Where:

L1 = luminance of the lighter color or shade, and

L2 = luminance of the darker color or shade.

L1 and L2 are measured perpendicular to the platform surface with illumination provided by a diffuse light and a resulting luminance of the platform surface of 323 lm/m^2 (30 lumen/sqft).

S6.4.11 *Platform slip resistance.* When tested in accordance with S7.2, the coefficient of friction, in any direction, of any part of a wet platform surface may not be less than 0.65.

S6.5 *Structural integrity.*

S6.5.1 *Fatigue endurance.*

S6.5.1.1 *Public use lifts.* Except for lifts that manually stow (fold) and deploy (unfold), public use lifts must remain operable when operated through a total of 15,600 cycles: 7,800 unloaded Raise/Lower and Stow/Deploy operations and 7,800 loaded Raise/Lower operations as specified in S7.10. Public use lifts that manually stow (fold) and deploy (unfold) must remain operable when operated through a total of 15,600 cycles: 7,800 unloaded Raise/Lower operations and 7,800 loaded Raise/Lower operations. No separation, fracture, or breakage of any vehicle or lift component may occur as a result of conducting the fatigue test in S7.10.

S6.5.1.2 *Private use lifts.* Except for lifts that manually stow (fold) and deploy (unfold), private use lifts must remain operable when operated through a total of 4,400 cycles: 2,200 unloaded Raise/Lower and Stow/Deploy operations and 2,200 loaded Raise/Lower operations as specified in S7.10. Private use lifts that manually stow (fold) and deploy (unfold) must remain operable when operated through a total of 4,400 cycles: 2,200 unloaded Raise/Lower operations and 2,200 loaded Raise/Lower operations. No separation, fracture, or breakage of any vehicle or lift component may occur as a result of conducting the fatigue test in S7.10.

S6.5.2 *Proof load.* The platform lift must be capable of holding three times the standard load, as specified in S7.11, without separation, fracture, or breakage of any vehicle or lift component. After the test, the lift must pass Static Load Test I as specified in S7.9.

S6.5.3 *Ultimate load.* The platform lift must be capable of holding four times the standard load, as specified in S7.14, without separation, fracture, or breakage of the platform, supporting structure, or lifting mechanism.

S6.6 *Platform free fall limits.* In the event of any single-point failure of systems for raising, lowering or supporting the platform, any portion of the platform, loaded as specified in S7.1.1, may not fall vertically faster than 305 mm (12 in) per second or change angular orientation more than 2 degrees from the orientation prior to the failure. This requirement applies whenever the lift is under primary power source operation or manual backup operation.

S6.7 *Control panel switches.*

S6.7.1 The platform lift must meet the requirements of S6.7.2 through S6.7.8 and, when operated by means of the control panel switches specified in S6.7.2, must perform the lift operations specified in S7.9.

S6.7.2 The platform lift system must have control panel switches that perform not less than the following functions: (platform lifts that manually

stow (fold) and deploy (unfold) are exempt from S6.7.2.2 and S6.7.2.5).

S6.7.2.1 Enables and disables the lift control panel switches. This function must be identified as ''POWER'' if located on the control. The POWER function must have two states: ''ON'' and ''OFF''. The ''ON'' state must allow platform lift operation. When the POWER function is in the ''ON'' state, an indicator light on the controls must illuminate. The ''OFF'' state must prevent lift operation and must turn off the indicator light. Verification with this requirement is made throughout the lift operations specified in S7.9.3 through S7.9.8.

S6.7.2.2 Moves the lift from a stowed position to an extended position or, to one of the two loading positions. This function must be identified as ''DEPLOY'' or ''UNFOLD'' on the control.

S6.7.2.3 Lowers the lift platform. This function must be identified as ''Down'' or ''Lower'' on the control.

S6.7.2.4 Raises the lift platform. This function must be identified as ''Up'' or ''Raise'' on the control.

S6.7.2.5 Moves the lift from a position within the range of passenger operation to a stowed position. This function must be identified as ''Stow'' or ''Fold'' on the control.

S6.7.3 Except for the Power function described in S6.7.2.1, the functions specified in S6.7.2 must activate in a momentary fashion, by one switch or by a combination of switches. Verification with this requirement is made throughout the lift operations specified in S7.9.3 through S7.9.8.

S6.7.4 Except for the POWER function described in S6.7.2.1, the control system specified in S6.7.2 must prevent the simultaneous performance of more than one function. If an initial function is actuated, then one or more other functions are actuated while the initial function remains actuated, the platform must either continue in the direction dictated by the initial function or stop. Verification of this requirement is made throughout the lift operations specified in S7.9.3 through S7.9.8.

S6.7.5 Any single-point failure in the control panel switches may not prevent the operation of any of the interlocks as specified in S6.10.

S6.7.6 *Identification of operating functions.*

S6.7.6.1 Each operating function of each platform lift control must be identified with characters that are at least 2.5 mm (0.1 in) in height.

S6.7.6.2 *Public use lifts.* Public-use lift controls located within the portion of the passenger compartment specified in S5.3.4(a) of Standard No. 101 (§ 571.101) must have characters that are illuminated in accordance with S5.3 of Standard No. 101 when the vehicle's headlights are illuminated. Public-use lift controls located outside the portion of the passenger compartment specified in S5.3.4(a) of Standard No. 101 (§ 571.101) must have means for illuminating the characters to make them visible under daylight and nighttime conditions.

S6.7.7 Control location for public use lifts: In public use lifts, except for the backup operation specified in S6.9, all control panel switches must be positioned together and in a location such that the lift operator has a direct, unobstructed view of the platform lift passenger and the passenger's mobility aid, if applicable. Verification with this requirement is made throughout the lift operations specified in S7.9.3 through S7.9.8. Additional controls may be positioned in other locations.

S6.7.8 *Operating instructions:* Simple instructions regarding the platform lift operating procedures, including backup operations as specified by S6.9, must:

S6.7.8.1 Be located near the controls.

S6.7.8.2 Have characters with a minimum height of 2.5 mm (0.1 in) and written in English.

S6.7.8.3 *Public use lifts:* Include the statement ''DOT—Public Use Lift''.

S6.7.8.4 *Private use lifts:* Include the statement ''DOT—Private Use Lift'', the manufacturer's rated load for the lift, and, if applicable, instructions indicating that the wheelchair occupant must back onto the lift when loading from the ground.

S6.8 *Jacking prevention.*

S6.8.1 Except when the platform lift is operated in backup mode as required by S6.9, throughout the lift operations specified in S7.9.4 and S7.9.7, the lift system must meet the requirements of

S6.8.2, both with and without a standard load on the lift.

S6.8.2 The control system or platform lift design must prevent the raising of any portion of the vehicle by the lift system when lowering the lift is attempted while the lift is at the ground level loading position.

S6.9 *Backup operation.*

S6.9.1 The platform lift must be equipped with a manual backup operating mode that can, in the event there is a loss of the primary power source for lift operation or a lift malfunction, deploy the lift, lower the loaded platform to the ground level loading position, raise the unloaded platform to the vehicle floor loading position, and stow the lift. During backup operation of the lift, the wheelchair retention device and inner roll stop must be manually deployable and stowable. The operating instructions near the lift controls and in the vehicle owner's manual insert, as specified in S6.7.8 and S6.12.2, must contain information on manual backup operation which must include manual operation of the wheelchair retention device and inner roll stop during backup operation of the lift.

S6.10 *Interlocks.*

S6.10.1 Except when the platform lift is operated in backup mode as required by S6.9, the requirements of S6.10.2 must be met, both with and without a standard load on the lift.

S6.10.2 The platform lift system must have interlocks or operate in such a manner when installed according to the installation instructions, as to prevent:

S6.10.2.1 Forward or rearward mobility of the vehicle unless the platform lift is stowed. The design of this system must be such that it discourages accidental release and does not affect vehicle movement when the lift is stowed until the vehicle is stopped and the lift deployed. Verification with this requirement is made throughout the lift operations specified in S7.9.2 and S7.9.3.

S6.10.2.2 Operation of the platform lift from the stowed position until forward and rearward mobility of the vehicle is inhibited, by means of placing the transmission in park or placing the transmission in neutral and actuating the parking brake or the vehicle service brakes by means other than the operator depressing the vehicle's service brake pedal. Verification with this requirement is made throughout the lift operations specified in S7.9.2 and S7.9.3.

S6.10.2.3 Stowing of the platform lift when occupied by portions of a passenger's body, and/or a mobility aid. Platform lifts designed to be occupied while stowed and platform lifts that manually stow (fold) are excluded from this requirement. Verification with this requirement is made using the test device specified in S7.1.4. Move the deployed platform lift to a position within the range of passenger operation where it will stow if the control specified in S6.7.2.5 is actuated. Place the test device specified in S7.1.4 on its narrowest side on any portion of the platform surface that coincides with the unobstructed platform operating volume described in S6.4.2. Using the operator control specified in S7.7.2.5, attempt to stow the lift. The interlock must prevent the lift from stowing.

S6.10.2.4 Movement of the platform up or down, throughout the range of passenger operation, unless the inner roll stop required to comply with S6.4.8 is deployed. When the platform reaches a level where the inner roll stop is designed to fully deploy, the platform must stop unless the inner roll stop has fully deployed. Verification with this requirement is made by performing the test procedure specified in S7.6.1.

S6.10.2.5 Movement of the platform up or down, throughout the range of passenger operation, when the highest point of the platform surface at the outer most platform edge is above a horizontal plane 75 mm (3 in) above the ground level loading position, unless the wheelchair retention device required to comply with S6.4.7 is deployed throughout the range of passenger operations. Verification of compliance is made using the test procedure specified in S7.5.1.

S6.10.2.6 In the case of a platform lift that is equipped with an outer barrier, vertical deployment of the outer barrier when it is occupied by portions of the passenger's body or mobility aid throughout the lift operation. When the platform stops, the vertical change in distance of the horizontal plane (passing through the point of contact

between the wheelchair test device wheel(s) and the upper surface of the outer barrier) must not be greater than 13 mm (0.5 in). Verification of compliance with this requirement is made using the test procedure specified in S7.5.1.

S6.10.2.7 Vertical deployment of the inner roll stop required to comply with S6.4.8 when it is occupied by portions of a passenger's body or mobility aid throughout the lift operations. When the platform stops, the vertical change in distance of the horizontal plane (passing through the point of contact between the wheelchair test device wheel(s) and the upper surface of the inner roll stop or platform edge) must not be greater than 13 mm (0.5 in). Verification of compliance with this requirement is made using the test procedure specified in S7.6.1.

S6.11 *Operations counter*. The platform lift must have an operation or cycle counter that records each complete Up/Down (Raise/Lower) operation throughout the range of passenger operation. Determination of compliance with this requirement is made during the lift operations specified in S7.9.4 and S7.9.5.

S6.12 *Vehicle owner's manual insert*. The lift manufacturer must provide with the lift, inserts for the vehicle owner's manual that provide specific information about the platform lift. The vehicle owner's manual insert must be written in English and must include:

S6.12.1 A maintenance schedule that includes maintenance requirements that have, at a minimum, some dependency on the number of cycles on the operations counter specified in S6.11.

S6.12.2 Instructions regarding the platform lift operating procedures, including backup operations, as specified by S6.9.

S6.12.3 *Public use lifts:* In addition to meeting the requirements of S6.12.1 and S6.12.2, the owner's manual insert for public use lifts must also include:

S6.12.3.1 The statement ''DOT—Public Use Lift'' on the front cover of the vehicle owner's manual insert; and

S6.12.3.2 The statement ''*DOT—Public Use Lift*'' verifies that this platform lift meets the ''public use lift '' requirements of FMVSS No. 403. This lift may be installed on all vehicles appropriate for the size and weight of the lift, but must be installed on buses, school buses, and multi-purpose passenger vehicles other than motor homes with a gross vehicle weight rating (GVWR) that exceeds 4,536 kg (10,000 lb).''

S6.12.4 Private use lifts: In addition to meeting the requirements of S6.12.1 and S6.12.2, the owner's manual insert for private use lifts must also include:

S6.12.4.1 The dimensions that constitute the unobstructed platform operating volume;

S6.12.4.2 The manufacturer's rated load for the lift;

S6.12.4.3 Information on whether a wheelchair user must back onto the platform from the ground level loading position due to the absence of an inner roll stop;

S6.12.4.4 The statement ''DOT-Private Use Lift'' on the front cover of the vehicle owner's manual insert; and

S6.12.4.5 The statement ''*DOT-Private Use Lift* verifies that this platform lift meets only the ''private use lift'' requirements of FMVSS No. 403. This lift may be installed on all vehicles appropriate for the size and weight of the lift, except for buses, school buses, and multi-purpose passenger vehicles other than motor homes with a gross vehicle weight rating (GVWR) that exceeds (4,536 kg) 10,000 lb.''

S6.13 *Installation instructions.* The manufacturer of a platform lift must include installation instructions with each lift. Information must be included in the installation instructions that identifies:

S6.13.1 The vehicles on which the lift is designed to be installed. Vehicles may be identified by listing the make, model, and year of the vehicles for which the lift is suitable, or by specifying the design elements that would make a vehicle an appropriate host for the particular lift, and for which the platform lift manufacturer has certified compliance.

S6.13.2 Procedures for operational checks that the vehicle manufacturer must perform to verify that the lift is fully operational. Such checks include, but are not limited to, platform lighting, the threshold-warning signal, and

interlocks, including those that interface with vehicle systems.

S6.13.3 Any informational material or labels that must be placed on or in the vehicle in order to comply with the requirements of this standard. Labels must be of a permanent nature that can withstand the elements of the outside environment.

S6.13.4 Public use lifts: In addition to meeting the requirements of S6.13.1 through S6.13.3, the installation instructions for public use lifts must also include, on the front cover of the instructions, the statement ''DOT-Public Use Lift''.

S6.13.4.1 Installation instructions for public use lifts must contain the statement ''Public use vehicle manufacturers are responsible for complying with the lift lighting requirements in Federal Motor Vehicle Safety Standard No. 404, Platform Lift Installations in Motor Vehicles (49 CFR 571.404).''

S6.13.5 Private use lifts: In addition to meeting the requirements of S6.13.1 through S6.13.3, the installation instructions for private use lifts must also include, on the front cover of the instructions, the manufacturer's rated load for the lift and the statement ''DOT-Private Use Lift''.

S7 *Test conditions and procedures.* Each platform lift must be capable of meeting all of the tests specified in this standard, both separately, and in the sequence specified in this section. The tests specified in S7.4, S7.7.4 and S7.8 through S7.12 are performed on a single lift and vehicle combination. The tests specified in S7.2, S7.3, S7.5, S7.6, S7.7.1, S7.13, and S7.14 may be performed with the lift installed on a test jig rather than on a vehicle. Tests of requirements in S6.1 through S6.11 may be performed on a single lift and vehicle combination, except for the requirements of S6.5.3. Attachment hardware may be replaced if damaged by removal and reinstallation of the lift between a test jig and vehicle.

S7.1 *Test devices.*

S7.1.1 *Test pallet and load.* The surface of the test pallet that rests on the platform used for the tests specified in S7.9 through S7.11 and S7.14 has sides that measure between 660 mm (26 in) and 686 mm (27 in). For the tests specified in S7.9 and S7.10, the test pallet is made of a rectangular steel plate of uniform thickness and the load that rests on the test pallet is made of rectangular steel plate(s) of uniform thickness and sides that measure between 533 mm (21 in) and 686 mm (27 in). The standard test load that rests on the pallet is defined in S4.

S7.1.2 *Wheelchair test device.* The test device is an unloaded power wheelchair whose size is appropriate for a 95th percentile male and that has the dimensions, configuration and components described in S7.1.2.1 through S7.1.2.11. If the dimension in S7.1.2.9 is measured for a particular wheelchair by determining its tipping angle, the batteries are prevented from moving from their original position.

S7.1.2.1 a cross-braced steel frame;

S7.1.2.2 a sling seat integrated in the frame;

S7.1.2.3 a belt drive;

S7.1.2.4 detachable footrests, with the lowest point of the footrest adjustable in a range not less than 25 mm (1 in) to 123 mm (5 in) from the ground;

S7.1.2.5 Two pneumatic rear tires with a diameter not less than 495 mm (19.5 in) and not more than 521 mm (20.5 in) inflated to the wheelchair manufacturer's recommended pressure or if no recommendation exists, to the maximum pressure that appears on the sidewall of the tire;

S7.1.2.6 Two pneumatic front tires with a diameter not less than 190 mm (7.5 in) and not more than 216 mm (8.5 in) inflated to the wheelchair manufacturer's recommended pressure or if no recommendation exists, to the maximum pressure that appears on the sidewall of the tire;

S7.1.2.7 a distance between front and rear axles not less than 457 mm (18 in) and not more than 533 mm (21 in);

S7.1.2.8 a horizontal distance between rear axle and center of gravity not less than 114 mm (4.5 in) and not more than 152 mm (6.0 in);

S7.1.2.9 a vertical distance between ground and center of gravity not less than 260 mm (10.25 in) and not more than 298 mm (11.75 in);

S7.1.2.10 a mass of not less than 72.5 kg (160 lb) and not more than 86.0 kg (190 lb).

S7.1.2.11 Batteries with a charge not less than 75 percent of their rated

nominal capacity (for tests that require use of the wheelchair's propulsion system).

S7.1.3 *Clearance test block for gaps, transitions, and openings.* The clearance test block is made of a rigid material and is 16 × 16 × 100 mm (0.625 × 0.625 × 4.0 in) with all corners having a 1.6 mm (0.0625 inch) radius.

S7.1.4 *Test Device for detecting platform occupancy.* Occupancy of the platform is detected using a 152 × 152 × 305 mm (6 × 6 × 12 inches) rigid box having a total weight of 22.7 kg (50 lb).

S7.2 *Slip resistance test.*

S7.2.1 To determine compliance with S6.4.12, clean any 450mm × 100mm (17.5 in × 3.94 in) section of the platform with household glass cleaner (ammonia hydroxide solution). Wet the cleaned section of the platform by evenly spraying 3 ml (0.10 oz) of distilled water per 100 cm^2 (15.5 in^2) of surface area. Begin the test specified in S7.2.2 within 30 seconds of completion of the wetting process.

S7.2.2 Use the test procedure defined in ANSI/RESNA Standard WC/Vol. 1–1998, Section 13 (incorporated by reference, see §571.5), except for clauses 5.3, Force Gage and 6, Test Procedure, on the wet section of platform. In lieu of clauses 5.3 and 6, implement the requirements of S7.2.2.1 and S7.2.2.2.

S7.2.2.1 *Force gage.* The pulling force is measured, at a frequency of at least 10 Hz, by a force gauge that has been calibrated to an accuracy of ±2 percent of the reading in the range of 25N to 100N.

S7.2.2.2 *Test procedure.* Before the test, prepare the surface of the test rubber by lightly abrading with waterproof silicon carbide paper, grade P120, weight D (120 wet and dry). Then wipe the surface clean with a dry cloth or brush. No solvents or other cleaning materials are used. To determine the coefficient of friction for the wet platform section pull the test block, with the test rubber attached, by machine at a rate of 20 ±2mm/s. The machine and test block are rigidly linked by a device that exhibits a stiffness greater than or equal to 1×10^5 N/m. Pull the test block for a minimum of 13 seconds. Record the pulling force over the final 10 seconds of the test at a minimum frequency of 10 Hz. Repeat the test at least 5 times on any one area of the platform surface, in a single direction. Calculate the average pulling force for each trial, F_1 through F_n, where n is the number of trials. Measure the weight of the test block with the force gauge and call it F_b. Calculate the coefficient of friction, μ_p, from the following equation:

$$\mu_p = \frac{F_1 + F_2 + F_3 + \ldots F_n}{n \times F_b}$$

S7.3 *Environmental resistance test.*

S7.3.1 Perform the procedures specified in S7.3.2 through S7.3.5 to determine compliance with S6.3.

S7.3.2 Attachment hardware, as specified in S6.3.1, and externally mounted platform lifts or components, as specified in S6.3.2, are tested in accordance with ASTM B117–97 (incorporated by reference, see §571.5). Any surface coating or material not intended for permanent retention on the metal parts during service life are removed prior to testing. Except as specified in S7.3.3, the period of the test is 50 hours, consisting of two periods of 24 hours exposure to salt spray followed by one hour drying.

S7.3.3 For attachment hardware located within the occupant compartment of the motor vehicle or internal to other compartments that provide protection from the elements and not at or near the floor of the compartment, the period of the test is 25 hours, consisting of one period of 24 hours exposure to salt spray followed by one hour drying.

S7.3.4 For performance of this test, externally mounted platform lifts or components may be installed on test jigs rather than on the vehicle. The lift is in a stowed position. The configuration of the test setup is such that areas of the lift that would be exposed to the outside environment during actual use are not protected from the salt spray by the test jig.

S7.3.5 At the end of the test, any surface exposed to the salt spray is washed thoroughly with water to remove the salt. After drying for at least 24 hours under laboratory conditions, the platform lift and components are examined for ferrous corrosion on significant surfaces, *i.e.*, all surfaces that

can be contacted by a sphere 2 cm (0.79 in) in diameter.

S7.4 *Threshold warning signal test.*

S7.4.1 Determine compliance with S6.1.2 and S6.1.3 using the test procedure specified in S7.4.2.

S7.4.2 During the threshold warning test, the wheelchair test device may be occupied by a human representative of a 5th percentile female meeting the requirements of FMVSS 208, S29.1(f) and S29.2. If present, the human subject is seated in the wheelchair test device with his or her feet supported by the wheelchair foot rests which are adjusted properly for length and in the down position (not elevated). The manufacturer shall select the option by the time it certifies the lift and may not thereafter select a different test option for the lift. Maneuver the lift platform to the vehicle floor level loading position. Using the wheelchair test device specified in S7.1.2, place one front wheel of the wheelchair test device on any portion of the threshold area defined in S4. Move the platform down until the alarm is actuated. Remove the test wheelchair wheel from the threshold area to deactivate the alarm. Measure the vertical distance between the platform and the threshold area and determine whether that distance is greater than 25 mm (1 in).

S7.5 *Outer barrier non-deployment interlock and occupied outer barrier interlock test.*

S7.5.1 Determine compliance with both S6.10.2.5 and S6.10.2.6 by using the following single test procedure.

S7.5.1.1 Place the test jig or vehicle on which the lift is installed on a flat, level, horizontal surface. Maneuver the platform to the ground level loading position. Using the lift control, move the lift upward until the point where the outer barrier fully deploys. Stop the platform at that point and measure the vertical distance between the highest point on the platform surface at the outer most edge and the ground to determine whether the distance is greater than 75 mm (3 in). Reposition the platform in the ground level loading position. Locate the wheelchair test device specified in S7.1.2 on the platform. If other wheelchair retention devices (e.g., a belt retention device) prevent the front wheel of the wheelchair test device from accessing the outer barrier when on the platform, the wheelchair test device may be placed on the ground facing the entrance to the lift, with other retention devices configured so that they do not prevent lift operation (e.g., with any belt retention device fastened or buckled).

S7.5.1.2 Place one front wheel of the wheelchair test device on any portion of the outer barrier. If the platform is too small to maneuver one front wheel on the outer barrier, two front wheels may be placed on the outer barrier. Note the distance between a horizontal plane (passing through the point of contact between the wheelchair test device wheel(s) and the upper surface of the outer barrier) and the ground. Using the lift control, move the platform up until it stops. Measure the vertical distance between the highest point of the platform surface at the outer most edge and the ground to determine compliance with S6.10.2.5. Measure the vertical change in distance of the horizontal plane (passing through the point of contact between the wheelchair test device wheel(s) and the upper surface of the outer barrier) to determine compliance with S6.10.2.6.

S7.6 *Inner roll stop non-deployment interlock and occupied inner roll stop interlock test.*

S7.6.1 Determine compliance with both S6.10.2.4 and S6.10.2.7 by using the single test procedure in S7.6.2 and S7.6.3.

S7.6.2 Maneuver the platform to the vehicle floor level loading position, and position the wheelchair test device specified in S7.1.2 on the platform with the front of the wheelchair test device facing the vehicle. Using the lift control, move the platform down until the inner roll stop fully deploys. Stop the lift and note that location.

S7.6.3 Reposition the platform at the vehicle floor level loading position. Place one front wheel of the wheelchair test device on the inner roll stop. If the platform is too small to maneuver one front wheel on the inner roll stop, two front wheels may be placed on the inner roll stop. Note the vertical distance between a horizontal plane (passing through the point of contact between the wheelchair test device wheel(s) and the upper surface of the

inner roll stop) and the ground. Using the lift control, move the platform down until it stops. Compare the location of the platform relative to the location noted in S7.6.2 to determine compliance with S6.10.2.4. Measure the vertical change in distance of the horizontal plane (passing through the point of contact between the wheelchair test device wheel(s) and the upper surface of the inner roll stop) to determine compliance with S6.10.2.7.

S7.7 *Wheelchair retention device impact test and edge guard test.*

S7.7.1 Determine compliance with S6.4.7.1 and S6.4.7.2 using the test device specified in S7.1.2, under the procedures specified in S7.7.2 and S7.7.3.

S7.7.2 Conduct the test in accordance with the procedures in S7.7.2.1 through S7.7.2.5 to determine compliance with S6.4.7.1. In the case of private use lifts, perform both S7.7.2.5(a) and (b), unless the operating directions specify a required direction of wheelchair movement onto the platform. When a direction is indicated in the operating instructions, perform the procedure specified in S7.7.2.5(a) or (b) with the test device oriented as required by the operating instructions.

S7.7.2.1 Place the lift platform at the vehicle floor loading position.

S7.7.2.2 If the wheelchair retention device is an outer barrier, the footrests are adjusted such that at their lowest point they have a height 25 mm ±2 mm (1 in ±0.08 in) less than the outer barrier. If the wheelchair retention device is not an outer barrier, the footrests are adjusted such that at their lowest point they have a height 50 mm ±2 mm (2 in ±0.08 in) above the platform.

S7.7.2.3 Position the test device with its plane of symmetry coincident with the lift reference plane and at a distance from the platform sufficient to achieve the impact velocities required by S7.7.2.5.

S7.7.2.4 An optional 50 kg (110 pounds) of weight may be centered, evenly distributed, and secured in the seat of the wheelchair test device to assist in stabilizing the wheelchair test device during testing. The manufacturer shall select the option by the time it certifies the lift and may not thereafter select a different test option for the lift. Accelerate the test device onto the platform under its own power such that the test device impacts the wheelchair retention device at each speed and direction combination specified in S7.7.2.5. Terminate power to the wheelchair test device by means of the wheelchair controller after completion of the initial impact of any portion of the wheelchair test device with the wheelchair retention device. Note the position of the wheelchair test device following each impact to determine compliance with S6.4.7. If necessary, after each impact, adjust or replace the footrests to restore them to their original condition.

S7.7.2.5 The test device is operated at the following speeds, in the following directions—

(a) At a speed of not less than 2.0 m/s (4.4 mph) and not more than 2.1 m/s (4.7 mph) in the forward direction.

(b) At a speed of not less than 1.75 m/s (3.9 mph) and not more than 1.85 m/s (4.1 mph) in the rearward direction.

S7.7.3 *Rotary platform lifts:* For rotary platform lifts, conduct the test under the procedures in S7.7.3.3 through S7.7.3.7 to determine compliance with S6.4.7.2.

S7.7.3.1 *Public use lifts:* For public use lifts, perform the test in both possible test device orientations.

S7.7.3.2 *Private use lifts:* For private use lifts, perform the test in both possible test device orientations unless a required direction of wheelchair movement onto the platform is indicated in the operating instructions. If a required direction is indicated in the operating instructions, perform the test with the test device oriented as required by the operating instructions.

S7.7.3.3 Adjust the footrests of the test device to the shortest length. Place the test device on the platform with its plane of symmetry coincident with the lift reference plane.

S7.7.3.4 Position the platform surface 90 mm ±10 mm (3.5 inches ±0.4 inches) above the ground level position.

S7.7.3.5 Slowly move the test device in the forward direction until it contacts a wheelchair retention device. Activate the controller of the test device such that, if the test device were unloaded and unrestrained on a flat, level surface, it would achieve a maximum forward velocity of not less than

2.0 m/s (4.4 mph) and not more than 2.1 m/s (4.7 mph).

S7.7.3.6 Realign the test device on the platform so that its plane of symmetry is coincident with the lift reference plane. Slowly move the test device in the rearward direction until it contacts a wheelchair retention device. Activate the controller of the test device such that, if the test device were unloaded and unrestrained on a flat, level surface, it would achieve a maximum rearward velocity of not less than 1.75 m/s (3.9 mph) and not more than 1.85 m/s (4.1 mph).

S7.7.3.7 During the impacts specified in S7.7.3.5 and S7.7.3.6, maintain power to the drive motors until all test device motion has ceased except rotation of the drive wheels. Note the position of the test device after its motion has ceased following each impact to determine compliance with S6.4.7.2.

S7.7.4 Edge Guard Test. Determine compliance with S6.4.6 using the test device specified in S7.1.2 by performing the test procedure specified in S7.7.4.1 through S7.7.4.6. During the edge guard tests, remove the footrests from the wheelchair test device.

S7.7.4.1 Position the platform surface 90 mm ±10 mm (3.5 in ±0.4 in) above the ground level loading position.

S7.7.4.2 Place the test device on the platform surface with its plane of symmetry coincident with the lift reference plane within ±10 mm (±0.4 in), its forward direction of travel inboard toward the vehicle, and its position on the platform as far rearward as the wheelchair retention device or outer barrier will allow it to be placed.

S7.7.4.3 Adjust the control of the test device to a setting that provides maximum acceleration and steer the test device from side-to-side and corner-to-corner of the lift platform, attempting to steer the test device off the platform. After each attempt, when the wheelchair test device stalls due to contact with a barrier, release the control to Neutral and realign the test device to the starting position. Repeat this sequence at any level that is more than 90 mm ±10 mm (3.5 in ±0.4 in) above the ground level loading position and more than 38 mm ±10 mm (1.5 in ±0.4 in) below the vehicle floor level loading position. Repeat this sequence at 38 mm ±10 mm (1.5 in ±0.4 in) below the vehicle floor level loading position.

S7.7.4.4 Next position the platform surface 38 mm ±10 mm (1.5 in ±0.4 in) below the vehicle floor level loading position.

S7.7.4.5 Reposition the test device on the platform surface with its plane of symmetry coincident with the lift reference plane within ±10 mm (±0.4 in), its forward direction of travel outboard away from the vehicle, and its position on the platform as far rearward as the wheelchair inner roll-stop or vehicle body will allow it to be placed.

S7.7.4.6 Adjust the control of the test device to a setting that provides maximum acceleration and steer the test device from side-to-side and corner-to-corner of the lift platform, attempting to steer the test device off the platform. After each attempt, when the wheelchair test device stalls due to contact with a barrier, release the control to Neutral and realign the test device to the starting position. Repeat this sequence at any level that is more than 90 mm ±10 mm (3.5 in ±0.4 in) above the ground level loading position and more than 38 mm ±10 mm (1.5 in ±0.4 in) below the vehicle floor loading position. Repeat this sequence at 38 mm ±10 mm (1.5 in ±0.4 in) below the vehicle floor level loading position.

S7.8 *Inner roll stop test.* Determine compliance with S6.4.8 using the test device specified in S7.1.2 in accordance with the procedures specified in S7.8.1 through S7.8.6.

S7.8.1 Place the platform at the ground level loading position, such that the platform is level.

S7.8.2 Adjust the footrests of the test device to the shortest length. Position the test device on the ground at a distance from the platform sufficient to achieve the impact velocity required by S7.8.3. The plane of symmetry of the test device is coincident with the lift reference plane and the forward direction of travel is onto the platform.

S7.8.3 An optional 50 kg (110 pounds) of weight may be centered, evenly distributed, and secured in the seat of the wheelchair test device to assist in stabilizing the wheelchair test device during testing. The manufacturer shall select the option by the time it certifies the lift and may not thereafter select a

different test option for the lift. Accelerate the test device onto the platform such that it impacts the inner roll stop at a speed of not less than 1.5 m/s (3.4 mph) and not more than 1.6 m/s (3.6 mph). Terminate power to the wheelchair test device by means of the wheelchair controller after completion of the initial impact of any portion of the wheelchair test device with the inner roll stop. Determine compliance with S6.4.8.3(a).

S7.8.4 If necessary, adjust or replace the footrests to restore them to the condition they were in prior to the impact. Reposition the test device on the platform with its plane of symmetry coincident with the lift reference plane. Slowly move the test device in the forward direction until it contacts the inner roll stop.

S7.8.5 Apply a static load to the inner roll stop by activating the controller of the test device such that, with the test device were unrestrained on a flat and level surface, it achieves a maximum forward velocity of not less than 2.0 m/s and not more than 2.1 m/s.

S7.8.6 Maintain control activation and raise the platform to the vehicle loading position. Determine compliance with S6.4.8.3(b).

S7.9 *Static load test I—working load.*

S7.9.1 By use of the lift controls specified in S6.7.2, perform the operations specified in S7.9.2 through S7.9.8 in the order they are specified.

S7.9.2 Place the platform in the stowed position.

S7.9.3 Deploy the platform to the vehicle floor loading position. Center a standard load, including the test pallet, on the platform surface.

S7.9.4 Lower the lift platform from the vehicle floor loading position to the ground level loading position, stopping once between the two positions. Remove the test pallet from the lift platform.

S7.9.5 Raise the lift platform from the ground level loading position to the vehicle floor level loading position, stopping once between the two positions.

S7.9.6 Lower the lift platform from the vehicle floor level loading position to the ground level loading position, stopping once between the two positions.

S7.9.7 Center the loaded test pallet on the platform surface. Raise the lift platform from the ground level loading position to the vehicle floor loading position, stopping once between the two positions.

S7.9.8 Remove the pallet from the lift platform. Stow the lift.

S7.9.9 Turn power off to the lift and repeat S7.9.3 through S7.9.5 and stow the lift using the backup operating mode as specified by S6.9 in accordance with the manufacturer's backup operating instructions.

S7.10 *Fatigue endurance test.*

S7.10.1 Perform the test procedure specified in S7.10.2 through S7.10.6 and determine compliance with S6.5.1.

S7.10.2 Put the unloaded lift platform at the ground level loading position. Center a standard load, including the test pallet, on the platform surface.

S7.10.3 Each sequence of lift operations specified in S7.10.5.1, S7.10.5.2, S7.10.6.1 and S7.10.6.2 are done in blocks of 10 cycles with a 1 minute maximum rest period between each cycle in any block. The minimum rest period between each block of 10 cycles is such that the temperature of the lift components is maintained below the values specified by the manufacturer or that degrade the lift function.

S7.10.4 During the test sequence specified in S7.10.2 through S7.10.6, perform any lift maintenance as specified in the vehicle owner's manual.

S7.10.5 Public use lifts: Using the lift controls specified in S6.7.2, perform the operations specified in S7.10.5.1 through S7.10.5.3 in the order they are given. Public use lifts that manually stow (fold) and deploy (unfold) are not required to perform the stow and deploy portions of the tests.

S7.10.5.1 Raise and lower the platform through the range of passenger operation 3,900 times.

S7.10.5.2 Remove the test pallet from the platform. Raise the platform to the vehicle floor loading position, stow the lift, deploy the lift and lower the platform to the ground level loading position 3,900 times.

S7.10.5.3 Perform the test sequence specified in S7.10.5.1 and S7.10.5.2 two times.

S7.10.6 *Private use lifts:* Using the lift controls specified in S6.7.2, perform the operation specified in S7.10.6.1 through S7.10.6.3 in the order they are given. Private use lifts that manually stow (fold) and deploy (unfold) are not required to perform the stow and deploy portions of the tests.

S7.10.6.1 Raise and lower the platform through the range of passenger operation 1,100 times.

S7.10.6.2 Remove the test pallet from the platform. Raise the platform to the vehicle floor loading position, stow the lift, deploy the lift and lower the platform to the ground level loading position 1,100 times.

S7.10.6.3 Perform the test sequence specified in S7.10.6.1 and S7.10.6.2 two times.

S7.11 *Static load test II—proof load.*

S7.11.1 Perform the test procedures specified in S7.11.2 through S7.11.5 and determine compliance with S6.5.2.

S7.11.2 Place the platform at the vehicle floor level loading position, center three times the standard load, including the test pallet, on the platform surface. Fully place the pallet on the platform within 1 minute of beginning to place it.

S7.11.3 Two minutes after fully placing the loaded test pallet on the platform surface, remove the loaded test pallet and examine the platform lift and vehicle for separation, fracture or breakage.

S7.11.4 After completing the static load test specified in S7.11.2 through S7.11.4, repeat Static Load Test I specified in S7.9.

S7.12 *Handrail test.*

S7.12.1 To determine compliance with S6.4.9.7, apply 4.4 N (1 lbf) through an area of 1290 mm^2 (2 in^2) in any direction at any point on the handrail in order to remove any looseness or slack from the handrail structure. Use this position of the handrail relative to the platform as the reference point for the measurement of handrail displacement. Apply 445 N (100 lbf) through an area of 1290 mm^2 (2 in^2) in a direction and location opposite to that of the 4.4 N (1 lbf). Attain the force within 1 minute after beginning to apply it. Five seconds after attaining the force, measure the amount of displacement of the handrail relative to the reference point, and measure the distance between the outside of the handrail and the nearest portion of the vehicle. Release the 445 N (100 lbf) and reapply the 4.4 N (1 lbf) in the direction and location that it was first applied. Five seconds after attaining the force, measure the position of the handrail with respect to the reference point to determine if there is any permanent deformation of the handrail relative to the platform.

S7.12.2 To determine compliance with S6.4.9.8, apply 4.4 N (1 lbf) through an area of 1,290 mm^2 (2 in^2) in any direction at any point on the handrail in order to remove any looseness or slack from the handrail structure. Use this position of the handrail relative to the platform as the reference point for the measurement of handrail displacement. Apply 1,112 N (250 lbf) through an area of 1,290 mm^2 (2 in^2) in a direction and location opposite to that of the 1 4.4 N (1 lbf). Attain the force within 1 minute after beginning to apply it. Five seconds after attaining the force, measure the amount of displacement of the handrail relative to the reference point. Maintain the force for two minutes. Release the force and inspect the handrail for cracking, separations or fractures.

S7.13 *Wheelchair retention device overload test.*

S7.13.1 Perform the test procedures as specified in S7.13.2 through S7.13.5 to determine compliance with S6.4.7.3.

S7.13.2 Position the platform surface 90 mm ±10 mm (3.5 in ±0.4 in) above the ground level loading position. Apply 7,117 N (1,600 lbf) to the wheelchair retention device in a direction parallel to both the platform lift and platform reference planes. Attain the force within 1 minute after beginning to apply it.

S7.13.3 For a wheelchair retention device that is in the form of an outer barrier, apply the force through a rectangular area with a height of 25 mm (1 in) and a width spanning the entire barrier. Distribute the force evenly about an axis 64 mm (2.5 in) above the platform reference plane. If the bottom edge of the outer barrier falls 50 mm (2 in) or more above the platform reference plane, distribute the force about an axis 13 mm (0.5 in) above the bottom edge of the barrier.

S7.13.4 For a wheelchair retention device other than an outer barrier, place the test device specified in S7.1.2 on the lift platform with its plane of symmetry coincident with the lift reference plane and directed such that forward motion is impeded by the wheelchair retention device. Move the test device forward until it contacts the wheelchair retention device. Remove the test device from the platform. Apply the force specified in S7.13.2 distributed evenly at all areas of the wheelchair retention device that made contact with the test device when it was moved forward. Attain the force within 1 minute after beginning to apply it.

S7.13.5 After maintaining the force for two minutes, remove it and examine the wheelchair retention device for separation, fracture or breakage.

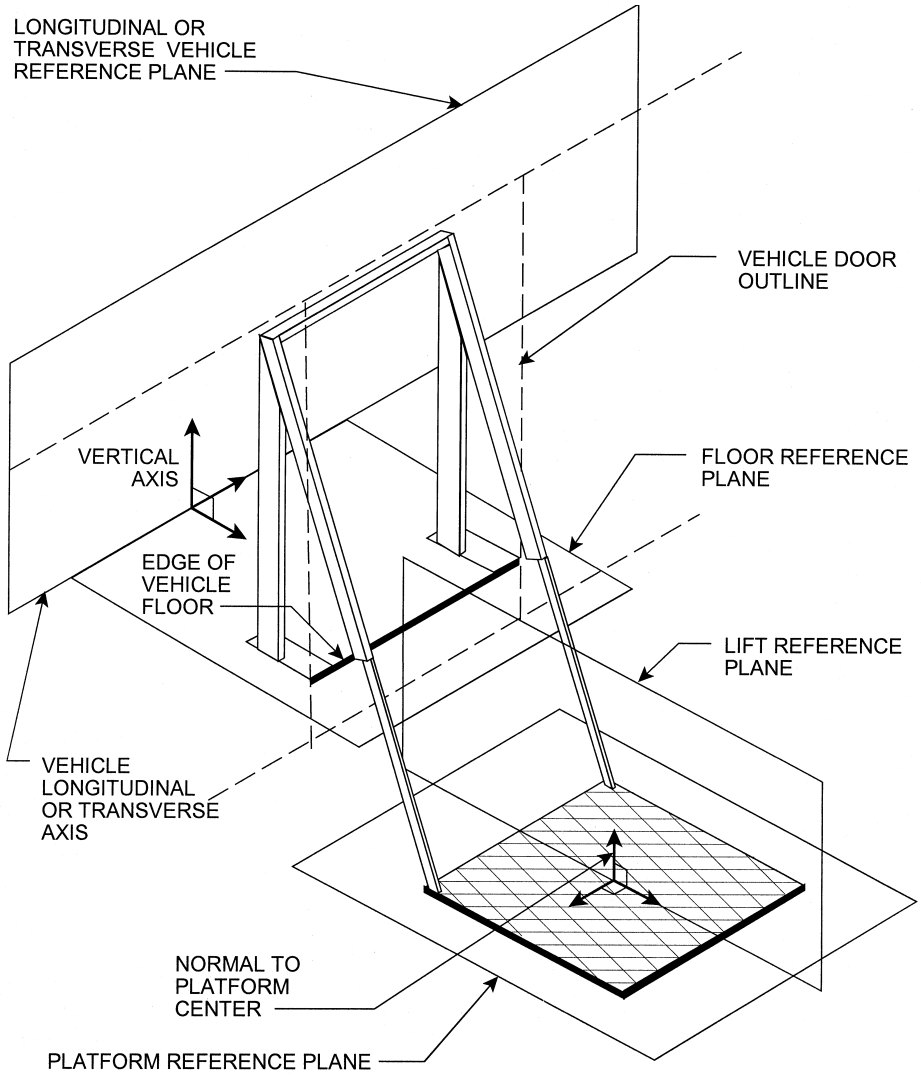
S7.14 *Static load test III—ultimate load.*

S7.14.1 Perform the test procedures as specified in S7.14.2 through S7.14.4 to determine compliance with S6.5.3.

S7.14.2 Reinforce the vehicle structure where the lift is attached such that it is rigid and will not deform, break or separate during application of the load specified in S7.14.3 or remove the platform lift from the vehicle and install it on a test jig that is rigid and will not deform, break or separate during application of the load specified in S7.14.3.

S7.14.3 When the platform is at the vehicle floor loading position, center four times the standard load, including the test pallet, on the platform surface. Fully place the pallet on the platform within 1 minute of beginning to place it.

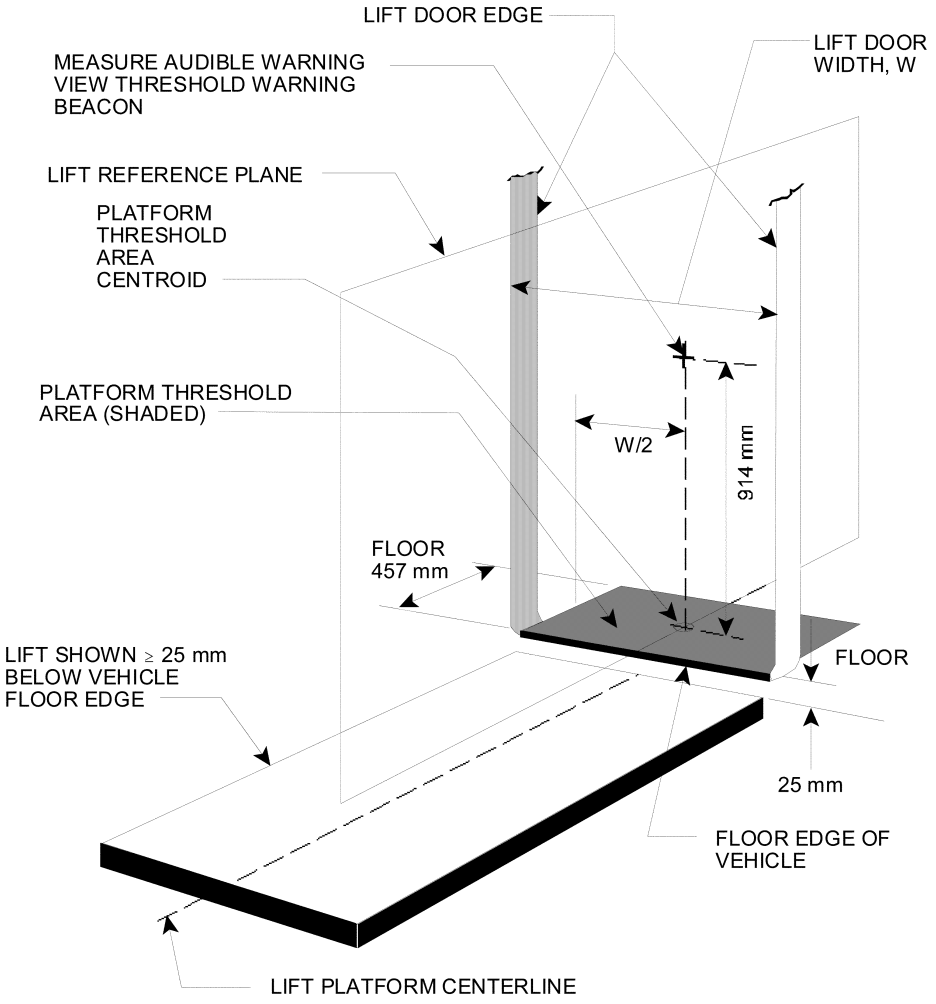
S7.14.4 Two minutes after fully placing the loaded test pallet on the platform surface, remove the loaded test pallet and examine the platform lift for separation, fracture or breakage.



PLANES OF REFERENCE

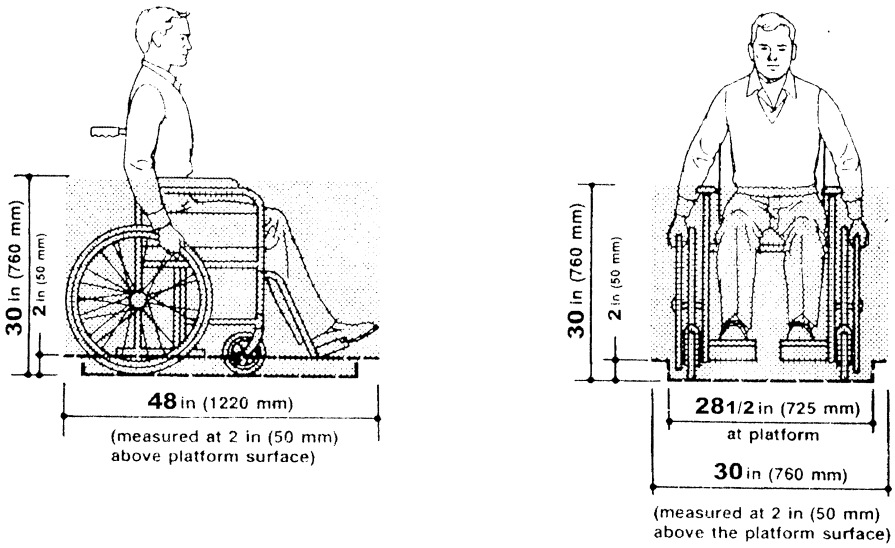
FIGURE 1

FIGURE 2



PLATFORM THRESHOLD AREA AUDIBLE WARNING MEASUREMENT POINT

FIGURE 2



Minimum Unobstructed Platform Operating Volume for Public Use Lifts

Figure 3

[67 FR 79439, Dec. 27, 2002, as amended at 69 FR 58852, Oct. 1, 2004; 69 FR 76870, Dec. 23, 2004; 77 FR 769, Jan. 6, 2012; 77 FR 20567, Apr. 5, 2012]

§571.404 Standard No. 404; Platform lift installations in motor vehicles.

S1. *Scope.* This standard specifies requirements for vehicles equipped with platform lifts used to assist persons with limited mobility in entering or leaving a vehicle.

S2. *Purpose.* The purpose of this standard is to prevent injuries and fatalities to passengers and bystanders during the operation of platform lifts installed in motor vehicles.

S3 *Application.* This standard applies to motor vehicles manufactured on and after July 1, 2005, that are equipped with a platform lift designed to carry standing passengers who may be aided by canes or walkers, as well as persons seated in wheelchairs, scooters, and other mobility aids, into and out of the vehicle.

S4. *Requirements.*

S4.1 *Installation requirements.*

S4.1.1 Lift-equipped buses, school buses, and MPVs other than motor homes with a GVWR greater than 4,536 kg (10,000 lb) must be equipped with a public use lift certified as meeting Federal Motor Vehicle Safety Standard No. 403, Lift Systems for Motor Vehicles (49 CFR 571.403).

S4.1.2 Lift-equipped motor vehicles, other than ones subject to paragraph S4.1.1, must be equipped with a platform lift certified as meeting either the public use lift or private use lift requirements of Federal Motor Vehicle Safety Standard No. 403, Lift Systems for Motor Vehicles (49 CFR 571.403).

S4.1.3 Platform lifts must be installed in the vehicle in accordance with the installation instructions or procedures provided pursuant to S6.13 of Standard 403. The vehicle must be of

a type identified in the installation instructions as appropriate for the platform lift as certified by the platform lift manufacturer.

S4.1.4 The platform lift, as installed, must continue to comply with all the applicable requirements of Federal Motor Vehicle Safety Standard No. 403, Lift Systems for Motor Vehicles (49 CFR 571.403).

S4.1.5 *Platform Lighting on public use lifts.* Public-use lifts must be provided with a light or set of lights that provide at least 22 lm/m^2 or 22 Lux (2 lm/ft^2 or 2 foot-candles) of illumination on all portions of the surface of the platform when the platform is at the vehicle floor level. Additionally, a light or set of lights must provide at least 11 lm/m^2 or 11 Lux (1 lm/ft^2 or 1 foot-candle) of illumination on all portions of the surface of the platform and all portions of the surface of the passenger-unloading ramp at ground level. In preparation for taking illumination measurements, operate the vehicle engine by idling or driving the test vehicle, with the vehicle's HVAC system turned off, for a minimum of 20 minutes, after which the engine is turned off. Illumination measurements are then recorded no later than 10 minutes after the time the engine is turned off, with the vehicle in a location where there is no apparent ambient light, and with the sensing element of the measuring device within 50 mm (2 inches) of the platform surface being measured.

S4.2 *Vehicle owner's manual insert requirements.* If the vehicle is equipped with an owner's manual, the owner's manual must contain the inserts provided by the lift manufacturer pursuant to S6.12 of 49 CFR 571.403.

S4.3 *Control panel switches.*

S4.3.1 Instructions regarding the platform lift operating procedures, including backup operations, as specified by S6.7.8 of 49 CFR 571.403, must be permanently affixed to a location adjacent to the controls.

S4.3.2 *Public use lift*: In addition to meeting the requirements of S4.3.1, for vehicles equipped with public use lifts, as defined in 49 CFR 571.403, any and all controls provided for the lift by the platform lift manufacturer other than those provided for back-up operation of the platform lift specified in S5.9 of 49 CFR 571.403, must be located together and in a position such that the control operator has a direct, unobstructed view of the platform lift passenger and/or their mobility aid throughout the lift's range of passenger operation. Additional power controls and controls for back-up operation of the lift may be located in other positions.

[67 FR 79451, Dec. 27, 2002, as amended at 69 FR 58855, Oct. 1, 2004; 69 FR 76870, Dec. 23, 2004; 77 FR 20571, Apr. 5, 2012]

§ 571.500 Standard No. 500; Low-speed vehicles.

S1. *Scope.* This standard specifies requirements for low-speed vehicles.

S2. *Purpose.* The purpose of this standard is to ensure that low-speed vehicles operated on the public streets, roads, and highways are equipped with the minimum motor vehicle equipment appropriate for motor vehicle safety.

S3. *Applicability.* This standard applies to low-speed vehicles.

S4. [Reserved]

S5. *Requirements.*

(a) When tested in accordance with test conditions in S6 and test procedures in S7, the maximum speed attainable in 1.6 km (1 mile) by each low-speed vehicle shall not more than 40 kilometers per hour (25 miles per hour).

(b) Each low-speed vehicle shall be equipped with:

(1) Headlamps,

(2) Front and rear turn signal lamps,

(3) Taillamps,

(4) Stop lamps,

(5) Reflex reflectors: one red on each side as far to the rear as practicable, and one red on the rear,

(6) An exterior mirror mounted on the driver's side of the vehicle and either an exterior mirror mounted on the passenger's side of the vehicle or an interior mirror,

(7) A parking brake,

(8) A windshield that conforms to the Federal motor vehicle safety standard on glazing materials (49 CFR 571.205).

(9) A VIN that conforms to the requirements of part 565 *Vehicle Identification Number* of this chapter, and

(10) A Type 1 or Type 2 seat belt assembly conforming to Sec. 571.209 of this part, Federal Motor Vehicle Safety Standard No. 209, *Seat belt assemblies*,

installed at each designated seating position.

(11) Low-speed vehicles shall comply with the rear visibility requirements specified in paragraphs S6.2 of FMVSS No. 111.

(12) An alert sound as required by §571.141.

S6. *General test conditions.* Each vehicle must meet the performance limit specified in S5(a) under the following test conditions.

S6.1. *Ambient conditions.*

S6.1.1. *Ambient temperature.* The ambient temperature is any temperature between 0 °C (32 °F) and 40 °C (104 °F).

S6.1.2. *Wind speed.* The wind speed is not greater than 5 m/s (11.2 mph).

S6.2. *Road test surface.*

S6.2.1. *Pavement friction.* Unless otherwise specified, the road test surface produces a peak friction coefficient (PFC) of 1.02 when measured using a ASTM F2493 standard reference test tire, in accordance with ASTM E1337–19, at a speed of 64.4 km/h (40.0 mph), without water delivery (incorporated by reference; see §571.5).

S6.2.2. *Gradient.* The test surface has not more than a 1 percent gradient in the direction of testing and not more than a 2 percent gradient perpendicular to the direction of testing.

S6.2.3. *Lane width.* The lane width is not less than 3.5 m (11.5 ft).

S6.3. *Vehicle conditions.*

S6.3.1. The test weight for maximum speed is unloaded vehicle weight plus a mass of 78 kg (170 pounds), including driver and instrumentation.

S6.3.2. No adjustment, repair or replacement of any component is allowed after the start of the first performance test.

S6.3.3. *Tire inflation pressure.* Cold inflation pressure is not more than the maximum permissible pressure molded on the tire sidewall.

S6.3.4. *Break-in.* The vehicle completes the manufacturer's recommended break-in agenda as a minimum condition prior to beginning the performance tests.

S6.3.5. *Vehicle openings.* All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) are closed except as required for instrumentation purposes.

S6.3.6. *Battery powered vehicles.* Prior to beginning the performance tests, propulsion batteries are at the state of charge recommended by the manufacturer or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. No further charging of any propulsion battery is permissible.

S7. *Test procedure.* Each vehicle must meet the performance limit specified in S5(a) under the following test procedure. The maximum speed performance is determined by measuring the maximum attainable vehicle speed at any point in a distance of 1.6 km (1.0 mile) from a standing start and repeated in the opposite direction within 30 minutes.

[63 FR 33216, June 17, 1998, as amended at 68 FR 43972, July 25, 2003; 79 FR 19249, Apr. 7, 2014; 81 FR 90521, Dec. 14, 2016; 87 FR 34810, June 8, 2022]

APPENDIX A TO SUBPART B—SECTION 571.108 TABLE OF CONTENTS

Sec.
571.108 Standard No. 108; Lamps, reflective devices, and associated equipment.
S1 *Scope.*
S2 *Purpose.*
S3 *Application.*
S4 *Definitions.*
S5 *References to SAE publications.*
S6 *Vehicle requirements.*
S6.1 *Required lamps, reflective devices, and associated equipment by vehicle type.*
S6.1.1 *Quantity.*
S6.1.1.1 *Conspicuity systems.*
S6.1.1.2 *High-mounted stop lamps.*
S6.1.1.3 *Truck tractor rear turn signal lamps.*
S6.1.1.4 *Daytime running lamps.*
S6.1.2 *Color.*
S6.1.3 *Mounting location.*
S6.1.3.3 *License plate lamp.*
S6.1.3.4 *High-mounted stop lamps.*
S6.1.3.4.1 *Interior mounting.*
S6.1.3.4.2 *Accessibility.*
S6.1.3.5 *Headlamp beam mounting.*
S6.1.3.5.1 *Vertical headlamp arrangement.*
S6.1.3.5.2 *Horizontal headlamp arrangement.*
S6.1.3.6 *Auxiliary lamps mounted near identification lamps.*
S6.1.4 *Mounting height.*
S6.1.4.1 *High-mounted stop lamps.*
S6.1.5 *Activation.*
S6.1.5.1 *Hazard warning signal.*
S6.1.5.2 *Simultaneous beam activation.*
S6.2 *Impairment.*
S6.2.3 *Headlamp obstructions.*
S6.3 *Equipment combinations.*
S6.4 *Lens area, visibility and school bus signal lamp aiming.*

S6.4.1 *Effective projected luminous lens area requirements.*
S6.4.2 *Visibility.*
S6.4.3 *Visibility options.*
S6.4.3(a) *Lens area option.*
S6.4.3(b) *Luminous intensity option.*
S6.4.4 *Legacy visibility alternative.*
S6.4.5 *School bus signal lamp aiming.*
S6.5 *Marking.*
S6.5.1 *DOT marking.*
S6.5.2 *DRL marking.*
S6.5.3 *Headlamp markings.*
S6.5.3.1 *Trademark.*
S6.5.3.2 *Voltage and trade number.*
S6.5.3.3 *Sealed beam headlamp markings.*
S6.5.3.4 *Replaceable bulb headlamp markings.*
S6.5.3.5 *Additional headlamp markings.*
S6.6 *Associated equipment.*
S6.6.3 *License plate holder.*
S6.7 *Replacement equipment.*
S6.7.1 *General.*
S6.7.2 *Version of this standard.*
S7 *Signal lamp requirements.*
S7.1 *Turn signal lamps.*
S7.1.1 *Front turn signal lamps.*
S7.1.1.1 *Number.*
S7.1.1.2 *Color of light.*
S7.1.1.3 *Mounting location.*
S7.1.1.4 *Mounting height.*
S7.1.1.5 *Activation.*
S7.1.1.6 *Effective projected luminous lens area.*
S7.1.1.7 *Visibility.*
S7.1.1.8 *Indicator.*
S7.1.1.9 *Markings.*
S7.1.1.10 *Spacing to other lamps.*
S7.1.1.10.2 *Spacing measurement for non-reflector lamps.*
S7.1.1.10.3 *Spacing measurement for lamps with reflectors.*
S7.1.1.10.4 *Spacing based photometric multipliers.*
S7.1.1.11 *Multiple compartment lamps and multiple lamps.*
S7.1.1.11.4 *Lamps installed on vehicles 2032 mm or more in overall width.*
S7.1.1.12 *Ratio to parking lamps and clearance lamps.*
S7.1.1.13 *Photometry.*
S7.1.1.14 *Physical tests.*
S7.1.2 *Rear turn signal lamps.*
S7.1.2.1 *Number.*
S7.1.2.2 *Color of light.*
S7.1.2.3 *Mounting location.*
S7.1.2.4 *Mounting height.*
S7.1.2.5 *Activation.*
S7.1.2.6 *Effective projected luminous lens area.*
S7.1.2.7 *Visibility.*
S7.1.2.8 *Indicator.*
S7.1.2.9 *Markings.*
S7.1.2.10 *Spacing to other lamps.*
S7.1.2.11 *Multiple compartments and multiple lamps.*
S7.1.2.11.4 *Lamps installed on vehicles 2032 mm or more in overall width.*
S7.1.2.12 *Ratio to taillamps and clearance lamps.*
S7.1.2.13 *Photometry.*
S7.1.2.14 *Physical tests.*
S7.1.3 *Combined lamp bulb indexing.*
S7.2 *Taillamps.*
S7.2.1 *Number.*
S7.2.2 *Color of light.*
S7.2.3 *Mounting location.*
S7.2.4 *Mounting height.*
S7.2.5 *Activation.*
S7.2.6 *Effective projected luminous lens area.*
S7.2.7 *Visibility.*
S7.2.8 *Indicator.*
S7.2.9 *Markings.*
S7.2.10 *Spacing to other lamps.*
S7.2.11 *Multiple compartments and multiple lamps.*
S7.2.11.4 *Taillamps installed on vehicles 2032 mm or more in overall width.*
S7.2.12 *Ratio.*
S7.2.13 *Photometry.*
S7.2.14 *Physical tests.*
S7.3 *Stop lamps.*
S7.3.1 *Number.*
S7.3.2 *Color of light.*
S7.3.3 *Mounting location.*
S7.3.4 *Mounting height.*
S7.3.5 *Activation.*
S7.3.6 *Effective projected luminous lens area.*
S7.3.7 *Visibility.*
S7.3.8 *Indicator.*
S7.3.9 *Markings.*
S7.3.10 *Spacing to other lamps.*
S7.3.11 *Multiple compartments and multiple lamps.*
S7.3.11.4 *Lamps installed on vehicles 2032 mm or more in overall width.*
S7.3.12 *Ratio to taillamps.*
S7.3.13 *Photometry.*
S7.3.14 *Physical tests.*
S7.3.15 *Combined lamp bulb indexing.*
S7.4 *Side marker lamps.*
S7.4.1 *Number.*
S7.4.2 *Color of light.*
S7.4.3 *Mounting location.*
S7.4.4 *Mounting height.*
S7.4.5 *Activation.*
S7.4.6 *Effective projected luminous lens area.*
S7.4.7 *Visibility.*
S7.4.8 *Indicator.*
S7.4.9 *Markings.*
S7.4.10 *Spacing to other lamps.*
S7.4.11 *Multiple compartments and multiple lamps.*
S7.4.12 *Ratio.*
S7.4.13 *Photometry.*
S7.4.13.2 *Inboard photometry.*
S7.4.14 *Physical tests.*
S7.5 *Clearance and identification lamps.*
S7.5.1 *Number.*
S7.5.2 *Color of light.*
S7.5.3 *Mounting location.*
S7.5.4 *Mounting height.*
S7.5.5 *Activation.*
S7.5.6 *Effective projected luminous lens area.*
S7.5.7 *Visibility.*
S7.5.8 *Indicator.*
S7.5.9 *Markings.*
S7.5.10 *Spacing to other lamps.*

S7.5.11 *Multiple compartments and multiple lamps.*
S7.5.12 *Ratio.*
S7.5.12.1 *Clearance lamps.*
S7.5.12.2 *Identification lamps.*
S7.5.13 *Photometry.*
S7.5.14 *Physical tests.*
S7.6 *Backup lamps.*
S7.6.1 *Number.*
S7.6.2 *Color of light.*
S7.6.3 *Mounting location.*
S7.6.4 *Mounting height.*
S7.6.5 *Activation.*
S7.6.6 *Effective projected luminous lens area.*
S7.6.7 *Visibility.*
S7.6.8 *Indicator.*
S7.6.9 *Markings.*
S7.6.10 *Spacing to other lamps.*
S7.6.11 *Multiple compartments and multiple lamps.*
S7.6.12 *Ratio.*
S7.6.13 *Photometry.*
S7.6.14 *Physical tests.*
S7.7 *License plate lamps.*
S7.7.1 *Number.*
S7.7.2 *Color of light.*
S7.7.3 *Mounting location.*
S7.7.4 *Mounting height.*
S7.7.5 *Activation.*
S7.7.6 *Effective projected luminous lens area.*
S7.7.7 *Visibility.*
S7.7.8 *Indicator.*
S7.7.9 *Markings.*
S7.7.10 *Spacing to other lamps.*
S7.7.11 *Multiple compartments and multiple lamps.*
S7.7.12 *Ratio.*
S7.7.13 *Photometry.*
S7.7.14 *Physical tests.*
S7.7.15 *Installation.*
S7.7.15.4 *Incident light from single lamp.*
S7.7.15.5 *Incident light from multiple lamps.*
S7.8 *Parking lamps.*
S7.8.1 *Number.*
S7.8.2 *Color of light.*
S7.8.3 *Mounting location.*
S7.8.4 *Mounting height.*
S7.8.5 *Activation.*
S7.8.6 *Effective projected luminous lens area.*
S7.8.7 *Visibility.*
S7.8.8 *Indicator.*
S7.8.9 *Markings.*
S7.8.10 *Spacing to other lamps.*
S7.8.11 *Multiple compartments and multiple lamps.*
S7.8.12 *Ratio.*
S7.8.13 *Photometry.*
S7.8.14 *Physical tests.*
S7.9 *High-mounted stop lamps.*
S7.9.1 *Number.*
S7.9.2 *Color of light.*
S7.9.3 *Mounting location.*
S7.9.4 *Mounting height.*
S7.9.5 *Activation.*
S7.9.6 *Effective projected luminous lens area.*
S7.9.7 *Visibility.*
S7.9.8 *Indicator.*
S7.9.9 *Markings.*
S7.9.10 *Spacing to other lamps.*
S7.9.11 *Multiple compartments and multiple lamps.*
S7.9.12 *Ratio.*
S7.9.13 *Photometry.*
S7.9.14 *Physical tests.*
S7.10 *Daytime running lamps (DRLs).*
S7.10.1 *Number.*
S7.10.2 *Color of light.*
S7.10.3 *Mounting location.*
S7.10.4 *Mounting height.*
S7.10.5 *Activation.*
S7.10.6 *Effective projected luminous lens area.*
S7.10.7 *Visibility.*
S7.10.8 *Indicator.*
S7.10.9 *Markings.*
S7.10.10 *Spacing to other lamps.*
S7.10.10.1 *Spacing to turn signal lamps.*
S7.10.11 *Multiple compartments and multiple lamps.*
S7.10.12 *Ratio.*
S7.10.13 *Photometry.*
S7.10.14 *Physical tests.*
S7.11 *School bus signal lamps.*
S7.11.1 *Number.*
S7.11.2 *Color of light.*
S7.11.3 *Mounting location.*
S7.11.4 *Mounting height.*
S7.11.5 *Activation.*
S7.11.6 *Effective projected luminous lens area.*
S7.11.7 *Visibility.*
S7.11.8 *Indicator.*
S7.11.9 *Markings.*
S7.11.10 *Spacing to other lamps.*
S7.11.11 *Multiple compartments and multiple lamps.*
S7.11.12 *Ratio.*
S7.11.13 *Photometry.*
S7.11.14 *Physical tests.*
S8 *Reflective device requirements.*
S8.1 *Reflex reflectors.*
S8.1.1 *Number.*
S8.1.2 *Color.*
S8.1.3 *Mounting location.*
S8.1.4 *Mounting height.*
S8.1.5 *Activation.*
S8.1.6 *Effective projected luminous lens area.*
S8.1.7 *Visibility.*
S8.1.8 *Indicator.*
S8.1.9 *Markings.*
S8.1.10 *Spacing to other lamps or reflective devices.*
S8.1.11 *Photometry.*
S8.1.12 *Physical tests.*
S8.1.13 *Alternative side reflex reflector material.*
S8.2 *Conspicuity systems.*
S8.2.1 *Retroreflective sheeting.*
S8.2.1.2 *Retroreflective sheeting material.*
S8.2.1.3 *Certification marking.*
S8.2.1.4 *Application pattern.*
S8.2.1.4.1 *Alternating red and white materials.*
S8.2.1.5 *Application location.*
S8.2.1.6 *Application spacing.*
S8.2.1.7 *Photometry.*
S8.2.2 *Conspicuity reflex reflectors.*

S8.2.2.1 *Certification marking.*
S8.2.2.2 *Application pattern.*
S8.2.2.2.1 *Alternating red and white materials.*
S8.2.2.2.2 *White material.*
S8.2.2.3 *Photometry.*
S8.2.3 *Conspicuity system installation on trailers.*
S8.2.3.1 *Trailer rear.*
S8.2.3.1.1 *Element 1—alternating red and white materials.*
S8.2.3.1.2 *Element 2—white.*
S8.2.3.1.3 *Element 3—alternating red and white materials.*
S8.2.3.2 *Trailer side-alternating red and white materials.*
S8.2.4 *Conspicuity system installation on truck tractors.*
S8.2.4.1 *Element 1—alternating red and white materials.*
S8.2.4.2 *Element 2—white.*
S9 *Associated equipment requirements.*
S9.1 *Turn signal operating unit.*
S9.1.2 *Physical tests.*
S9.2 *Turn signal flasher.*
S9.2.2 *Physical tests.*
S9.3 *Turn signal pilot indicator.*
S9.3.4 *Indicator size and color.*
S9.3.6 *Turn signal lamp failure.*
S9.4 *Headlamp beam switching device.*
S9.4.1 *Semi-automatic headlamp beam switching device.*
S9.4.1.1 *Operating instructions.*
S9.4.1.2 *Manual override.*
S9.4.1.3 *Fail safe operation.*
S9.4.1.4 *Automatic dimming indicator.*
S9.4.1.5 *Option 1 (Semiautomatic Headlamp Beam Switching Devices other than Adaptive Driving Beam systems).*
S9.4.1.5.1 *Lens accessibility.*
S9.4.1.5.2 *Mounting height.*
S9.4.1.5.3 *Physical tests.*
S9.4.1.6 *Option 2 (Adaptive Driving Beam systems).*
S9.4.1.7 *Physical tests.*
S9.5 *Upper beam headlamp indicator.*
S9.5.1 *Indicator size and location.*
S9.6 *Vehicular hazard warning signal operating unit.*
S9.6.2 *Operating unit switch.*
S9.6.3 *Physical tests.*
S9.7 *Vehicular hazard warning signal flasher.*
S9.7.2 *Physical tests.*
S9.8 *Vehicular hazard warning signal pilot indicator.*
S9.8.4 *Indicator size and color.*
S10 *Headlighting system requirements.*
S10.1 *Vehicle headlighting systems.*
S10.2 *[Reserved].*
S10.3 *Number.*
S10.4 *Color of light.*
S10.5 *Mounting location.*
S10.6 *Mounting height.*
S10.7 *Activation.*
S10.8 *Effective projected luminous lens area.*
S10.9 *Visibility.*
S10.10 *Indicator.*
S10.11 *Markings.*
S10.12 *Spacing to other lamps.*
S10.13 *Sealed beam headlighting systems.*
S10.13.1 *Installation.*
S10.13.2 *Simultaneous aim.*
S10.13.3 *Photometry.*
S10.13.4 *Physical tests.*
S10.14 *Integral beam headlighting systems.*
S10.14.1 *Installation.*
S10.14.2 *Aimability.*
S10.14.3 *Simultaneous aim.*
S10.14.4 *Markings.*
S10.14.5 *Additional light sources.*
S10.14.6 *Photometry.*
S10.14.7 *Physical tests.*
S10.15 *Replaceable bulb headlighting systems.*
S10.15.1 *Installation.*
S10.15.2 *Aiming restrictions.*
S10.15.3 *Replacement lens reflector units.*
S10.15.4 *Markings.*
S10.15.5 *Additional light sources.*
S10.15.6 *Photometry.*
S10.15.7 *Physical tests.*
S10.16 *Combination headlighting systems.*
S10.16.1 *Installation.*
S10.16.2 *Photometry.*
S10.16.3 *Physical tests.*
S10.17 *Motorcycle headlighting systems.*
S10.17.1 *Installation.*
S10.17.1.1 *Single headlamp.*
S10.17.1.2 *Two headlamps with both beams.*
S10.17.1.3 *Two headlamps, upper beam and lower beam.*
S10.17.2 *Motorcycle replaceable bulb headlamp marking.*
S10.17.3 *Photometry.*
S10.17.4 *Physical tests.*
S10.17.5 *Motorcycle headlamp modulation system.*
S10.17.5.1 *Modulation.*
S10.17.5.2 *Replacement modulators.*
S10.17.5.2.1 *Replacement performance.*
S10.17.5.2.2 *Replacement instructions.*
S10.18 *Headlamp aimability performance requirements (except motorcycles).*
S10.18.1 *Headlamp mounting and aiming.*
S10.18.2 *Headlamp aiming systems.*
S10.18.3 *Aim adjustment interaction.*
S10.18.4 *Horizontal adjustment-visually aimed headlamp.*
S10.18.5 *Optical axis marking.*
S10.18.5.1 *Optical axis marking-vehicle.*
S10.18.5.2 *Optical axis marking-lamp.*
S10.18.5.3 *Optical axis marking-visual/optical aim headlamp.*
S10.18.6 *Moveable reflectors.*
S10.18.7 *External aiming.*
S10.18.7.1 *Headlamp aiming device locating plates.*
S10.18.7.2 *Nonadjustable headlamp aiming device locating plates.*
S10.18.8 *On-vehicle aiming.*
S10.18.8.1 *Aim.*
S10.18.8.1.1 *Vertical aim.*
S10.18.8.1.2 *Horizontal aim.*
S10.18.8.2 *Aiming instructions.*
S10.18.8.3 *Permanent calibration.*
S10.18.8.4 *Replacement units.*

S10.18.8.5 *Physical tests.*
S10.18.9 *Visual/optical aiming.*
S10.18.9.1 *Vertical aim, lower beam.*
S10.18.9.1.1 *Vertical position of the cutoff.*
S10.18.9.1.2 *Vertical gradient.*
S10.18.9.1.3 *Horizontal position of the cutoff.*
S10.18.9.1.4 *Maximum inclination of the cutoff.*
S10.18.9.1.5 *Measuring the cutoff parameter.*
S10.18.9.2 *Horizontal aim, lower beam.*
S10.18.9.3 *Vertical aim, upper beam.*
S10.18.9.4 *Horizontal aim, upper beam.*
S10.18.9.5 *Photometry.*
S10.18.9.6 *Visual/optical aiming identification marking.*
S11 *Replaceable light source requirements.*
S11.1 *Markings.*
S11.2 *Ballast markings.*
S11.3 *Gas discharge laboratory life.*
S11.4 *Physical tests.*
S12 *Headlamp concealment device requirements.*
S12.7 *Certification election.*
S13 *Replaceable headlamp lens requirements.*
S14 *Physical and photometry test procedures and performance requirements.*
S14.1 *General test procedures and performance requirements.*
S14.1.2 *Plastic optical materials.*
S14.1.4 *Samples.*
S14.1.5 *Laboratory facilities.*
S14.2 *Photometric test procedures.*
S14.2.1 *Photometry measurements for all lamps except license lamps, headlamps, and DRLs.*
S14.2.1.1 *Mounting.*
S14.2.1.2 *School bus signal lamp aiming.*
S14.2.1.3 *Measurement distance.*
S14.2.1.4 *Location of test points.*
S14.2.1.5 *Multiple compartment and multiple lamp photometry of turn signal lamps, stop lamps, and taillamps.*
S14.2.1.6 *Bulbs.*
S14.2.2 *License plate lamp photometry.*
S14.2.2.1 *Illumination surface.*
S14.2.2.2 *Test stations.*
S14.2.3 *Reflex reflector and retroreflective sheeting photometry.*
S14.2.3.1 *Mounting.*
S14.2.3.2 *Illumination source.*
S14.2.3.3 *Measurement distance.*
S14.2.3.4 *Test setup.*
S14.2.3.5 *Photodetector.*
S14.2.3.6 *Photometry surface.*
S14.2.3.7 *Procedure.*
S14.2.3.8 *Measurements.*
S14.2.3.8.1 *Reflex reflectors.*
S14.2.3.8.2 *Retroreflective sheeting.*
S14.2.3.8.3 *Reflex reflector photometry measurement adjustments.*
S14.2.4 *Daytime running lamp (DRL) photometry measurements.*
S14.2.5 *Headlamp photometry measurements.*
S14.2.5.1 *Mounting.*
S14.2.5.3 *Measurement distance.*
S14.2.5.4 *Seasoning and test voltage.*
S14.2.5.5 *Aiming.*
S14.2.5.5.1 *Mechanically aimable headlamps using an external aimer.*
S14.2.5.5.2 *Mechanically aimable headlamps equipped with a VHAD.*
S14.2.5.5.3 *Visually aimable lower beam headlamps-vertical aim.*
S14.2.5.5.4 *Visually aimable lower beam headlamps-horizontal aim.*
S14.2.5.5.5 *Visually aimable upper beam headlamps-vertical aim.*
S14.2.5.5.6 *Visually aimable upper beam headlamps-horizontal aim.*
S14.2.5.5.7 *Simultaneous aim Type F sealed beam headlamps and beam contributor integral beam headlamps.*
S14.2.5.5.8 *Motorcycle headlamp-upper beam headlamps designed to comply with Table XX.*
S14.2.5.5.9 *Motorcycle headlamp-lower beam headlamps designed to comply with Table XX.*
S14.2.5.6 *Positioner.*
S14.2.5.7 *Photometer.*
S14.2.5.7.2 *Sensor.*
S14.2.5.8 *Location of test points.*
S14.2.5.9 *Beam contributor photometry measurements.*
S14.2.5.10 *Moveable reflector aimed headlamp photometry measurements.*
S14.3 *Motorcycle headlamp out of focus test procedure and performance requirements.*
S14.3.1 *Procedure.*
S14.3.2 *Performance requirements.*
S14.4 *General test procedures and performance requirements.*
S14.4.1 *Color test.*
S14.4.1.1 *Samples.*
S14.4.1.2 *General procedure.*
S14.4.1.3 *Visual method.*
S14.4.1.3.1 *Visual method procedure.*
S14.4.1.3.2 *Visual method performance requirements.*
S14.4.1.3.2.1 *Red.*
S14.4.1.3.2.2 *Yellow (Amber).*
S14.4.1.3.2.3 *White.*
S14.4.1.4 *Tristimulus method.*
S14.4.1.4.1 *Tristimulus method procedure.*
S14.4.1.4.2 *Tristimulus method performance requirements.*
S14.4.1.4.2.1 *Red.*
S14.4.1.4.2.2 *Yellow (Amber).*
S14.4.1.4.2.3 *White (achromatic).*
S14.4.1.4.2.4 *Green.*
S14.4.1.4.2.5 *Restricted Blue.*
S14.4.1.4.2.6 *Signal Blue.*
S14.4.2 *Plastic optical materials tests.*
S14.4.2.1 *Samples.*
S14.4.2.2 *Outdoor exposure test.*
S14.4.2.2.3 *Procedure.*
S14.4.2.2.4 *Performance requirements.*
S14.4.2.3 *Heat test.*
S14.4.2.3.1 *Procedure.*
S14.4.2.3.2 *Performance requirements.*
S14.5 *Signal lamp and reflective device physical test procedures and performance requirements.*
S14.5.1 *Vibration test.*
S14.5.1.1 *Procedure.*
S14.5.1.2 *Performance requirements.*

S14.5.2 *Moisture test.*
S14.5.2.1 *Procedure.*
S14.5.2.2 *Performance requirements.*
S14.5.3 *Dust test.*
S14.5.3.1 *Samples.*
S14.5.3.2 *Procedure.*
S14.5.3.3 *Performance requirements.*
S14.5.4 *Corrosion test.*
S14.5.4.1 *Procedure.*
S14.5.4.2 *Performance requirements.*
S14.6 *Headlamp physical test procedures and performance requirements.*
S14.6.1 *Abrasion test.*
S14.6.1.1 *Procedure.*
S14.6.1.1.1 *Abrading pad.*
S14.6.1.1.2 *Abrading pad alignment.*
S14.6.1.1.3 *Abrasion test procedure.*
S14.6.1.2 *Performance requirements.*
S14.6.2 *Chemical resistance test.*
S14.6.2.1 *Procedure.*
S14.6.2.1.1 *Test fluids.*
S14.6.2.1.2 *Fluid application.*
S14.6.2.1.3 *Test duration.*
S14.6.2.2 *Performance requirements.*
S14.6.3 *Corrosion test.*
S14.6.3.1 *Procedure.*
S14.6.3.2 *Performance requirements.*
S14.6.4 *Corrosion-connector test.*
S14.6.4.1 *Procedure.*
S14.6.4.2 *Performance requirements.*
S14.6.5 *Dust test.*
S14.6.5.1 *Procedure.*
S14.6.5.2 *Performance requirements.*
S14.6.6 *Temperature cycle test and internal heat test.*
S14.6.6.1 *Samples.*
S14.6.6.2 *General procedure.*
S14.6.6.3 *Temperature cycle test.*
S14.6.6.3.1 *Procedure.*
S14.6.6.3.2 *Performance requirements.*
S14.6.6.4 *Internal heat test.*
S14.6.6.4.1 *Procedure.*
S14.6.6.4.2 *Performance requirements.*
S14.6.7 *Humidity test.*
S14.6.7.1 *Procedure.*
S14.6.7.2 *Performance requirements.*
S14.6.8 *Vibration test.*
S14.6.8.1 *Samples.*
S14.6.8.2 *Procedure.*
S14.6.8.3 *Performance requirements.*
S14.6.9 *Sealing test.*
S14.6.9.1 *Procedure.*
S14.6.9.2 *Performance requirements.*
S14.6.10 *Chemical resistance test of reflectors of replaceable lens headlamps.*
S14.6.10.1 *Procedure.*
S14.6.10.1.1 *Test fluids.*
S14.6.10.1.2 *Fluid application.*
S14.6.10.1.3 *Test duration.*
S14.6.10.2 *Performance requirements.*
S14.6.11 *Corrosion resistance test of reflectors of replaceable lens headlamps.*
S14.6.11.1 *Procedure.*
S14.6.11.2 *Performance requirements.*
S14.6.12 *Inward force test.*
S14.6.12.1 *Procedure.*
S14.6.12.2 *Performance requirements.*
S14.6.13 *Torque deflection test.*
S14.6.13.1 *Procedure.*
S14.6.13.2 *Performance requirements.*
S14.6.14 *Retaining ring test.*
S14.6.14.1 *Procedure.*
S14.6.14.2 *Performance requirements.*
S14.6.15 *Headlamp connector test.*
S14.6.15.1 *Procedure.*
S14.6.15.2 *Performance requirements.*
S14.6.16 *Headlamp wattage test.*
S14.6.16.1 *Procedure.*
S14.6.16.2 *Performance requirements.*
S14.6.17 *Aiming adjustment test-laboratory.*
S14.6.17.1 *Procedure.*
S14.6.17.2 *Performance requirements.*
S14.6.18 *Aiming adjustment test-on vehicle.*
S14.6.18.1 *Procedure.*
S14.6.18.2 *Performance requirements.*
S14.7 *Replaceable light source physical test procedures and performance requirements.*
S14.7.1 *Deflection test for replaceable light sources.*
S14.7.1.1 *Procedure.*
S14.7.1.2 *Performance requirements.*
S14.7.2 *Pressure test for replaceable light sources.*
S14.7.2.1 *Procedure.*
S14.7.2.2 *Performance requirements.*
S14.7.3 *Replaceable light source power and flux measurement procedure.*
S14.7.3.1 *Seasoning.*
S14.7.3.1.1 *Resistive filament source.*
S14.7.3.1.2 *Discharge source.*
S14.7.3.2 *Test voltage.*
S14.7.3.3 *Luminous flux measurement.*
S14.7.3.3.1 *Resistive filament light source setup.*
S14.7.3.3.3.2 *Discharge light source setup.*
S14.8 *Vehicle headlamp aiming devices (VHAD) physical test procedures and performance requirements.*
S14.8.1 *Samples.*
S14.8.2 *Scale graduation test.*
S14.8.2.1 *Procedure.*
S14.8.2.2 *Performance requirements.*
S14.8.3 *Cold scale graduation test.*
S14.8.3.1 *Procedure.*
S14.8.3.2 *Performance requirements.*
S14.8.4 *Hot scale graduation test.*
S14.8.4.1 *Procedure.*
S14.8.4.2 *Performance requirements.*
S14.8.5 *Thermal cycle test.*
S14.8.5.1 *Procedure.*
S14.8.5.2 *Performance requirements.*
S14.8.6 *Corrosion test.*
S14.8.6.1 *Procedure.*
S14.8.6.2 *Performance requirements.*
S14.8.7 *Photometry test.*
S14.8.7.1 *Procedure.*
S14.8.7.2 *Performance requirements.*
S14.9 *Associated equipment physical test procedures and performance requirements.*
S14.9.1 *Turn signal operating unit durability test.*
S14.9.1.1 *Power supply specifications.*
S14.9.1.2 *Procedure.*
S14.9.1.3 *Performance requirements.*

S14.9.2 *Vehicular hazard warning signal operating unit durability test.*
S14.9.2.1 *Procedure.*
S14.9.2.2 *Performance requirements.*
S14.9.3 *Turn signal flasher and vehicular hazard warning flasher tests.*
S14.9.3.1 *Standard test circuit.*
S14.9.3.1.1 *Test circuit setup.*
S14.9.3.2 *Power supply specifications.*
S14.9.3.2.1 *Starting time, voltage drop, and flash rate and percent current ''on'' time tests.*
S14.9.3.2.2 *Durability tests.*
S14.9.3.3 *Turn signal flasher starting time test.*
S14.9.3.3.1 *Samples.*
S14.9.3.3.2 *Procedure.*
S14.9.3.3.3 *Performance requirements.*
S14.9.3.4 *Turn signal flasher voltage drop test.*
S14.9.3.4.1 *Samples.*
S14.9.3.4.2 *Procedure.*
S14.9.3.4.3 *Performance requirements.*
S14.9.3.5 *Turn signal flasher flash rate and percent current ''on'' time test.*
S14.9.3.5.1 *Samples.*
S14.9.3.5.2 *Procedure.*
S14.9.3.5.3 *Performance requirements.*
S14.9.3.6 *Turn signal flasher durability test.*
S14.9.3.6.1 *Samples.*
S14.9.3.6.2 *Procedure.*
S14.9.3.6.3 *Performance requirements.*
S14.9.3.7 *Vehicular hazard warning signal flasher starting time test.*
S14.9.3.7.1 *Samples.*
S14.9.3.7.2 *Procedure.*
S14.9.3.7.3 *Performance requirements.*
S14.9.3.8 *Vehicular hazard warning signal flasher voltage drop test.*
S14.9.3.8.1 *Samples.*
S14.9.3.8.2 *Procedure.*
S14.9.3.8.3 *Performance requirements.*
S14.9.3.9 *Vehicular hazard warning signal flasher flash rate and percent ''on'' time test.*
S14.9.3.9.1 *Samples.*
S14.9.3.9.2 *Procedure.*
S14.9.3.9.3 *Performance requirements.*
S14.9.3.10 *Vehicular hazard warning signal flasher durability test.*
S14.9.3.10.1 *Samples.*
S14.9.3.10.2 *Procedure.*
S14.9.3.10.3 *Performance requirements.*
S14.9.3.11 *Semiautomatic headlamp beam switching device tests.*
S14.9.3.11.1 *Test conditions.*
S14.9.3.11.2 *Sensitivity test.*
S14.9.3.11.2.1 *Samples.*
S14.9.3.11.2.2 *Procedure.*
S14.9.3.11.2.3 *Performance requirements.*
S14.9.3.11.2.3.1 *Operating limits.*
S14.9.3.11.3 *Voltage regulation test.*
S14.9.3.11.3.1 *Procedure.*
S14.9.3.11.3.2 *Performance requirements.*
S14.9.3.11.4 *Manual override test.*
S14.9.3.11.4.1 *Procedure.*
S14.9.3.11.4.2 *Performance requirements.*
S14.9.3.11.5 *Warmup test.*
S14.9.3.11.5.1 *Procedure.*
S14.9.3.11.5.2 *Performance requirements.*
S14.9.3.11.6 *Temperature test.*
S14.9.3.11.6.1 *Procedure.*
S14.9.3.11.6.2 *Performance requirements.*
S14.9.3.11.7 *Dust test.*
S14.9.3.11.7.1 *Procedure.*
S14.9.3.11.7.2 *Performance requirements.*
S14.9.3.11.8 *Corrosion test.*
S14.9.3.11.8.1 *Procedure.*
S14.9.3.11.8.2 *Performance requirements.*
S14.9.3.11.9 *Vibration test.*
S14.9.3.11.9.1 *Procedure.*
S14.9.3.11.9.2 *Performance requirements.*
S14.9.3.11.10 *Sunlight test.*
S14.9.3.11.10.1 *Procedure.*
S14.9.3.11.10.2 *Performance requirements.*
S14.9.3.11.11 *Durability test.*
S14.9.3.11.11.1 *Procedure.*
S14.9.3.11.11.2 *Performance requirements.*
S14.9.3.11.12 *Return to upper beam test.*
S14.9.3.11.12.1 *Procedure.*
S14.9.3.11.12.2 *Performance requirements.*
S14.9.3.12 *Test for compliance with adaptive driving beam photometry requirements.*
S14.9.3.12.1 *Test Scenarios.*
S14.9.3.12.2 *Compliance Criteria.*
S14.9.3.12.3 *Stimulus test fixtures.*
S14.9.3.12.4 *Test vehicle preparation.*
S14.9.3.12.5 *Test road.*
S14.9.3.12.6 *Other test parameters and conditions.*
Table I–a *Required lamps and reflective devices All passenger cars, multipurpose passenger vehicles (MPV), trucks, and buses*
Table I–b *Required lamps and reflective devices All trailers*
Table I–c *Required lamps and reflective devices All motorcycles*
Table II–a *Headlighting systems Sealed beams*
Table II–b *Headlighting systems Combination*
Table II–c *Headlighting systems Integral beams*
Table II–d *Headlighting systems Replaceable bulb*
Table III *Marking requirements location*
Table IV–a *Effective projected luminous lens area requirements*
Table IV–b *Effective projected luminous lens area requirements*
Table IV–c *Effective projected luminous lens area requirements*
Table V–a *Visibility requirements of installed lighting devices*
Table V–b *Visibility requirements of installed lighting devices Lens area visibility option*
Table V–c *Visibility requirements of installed lighting devices Luminous intensity visibility option*
Table V–d *Visibility requirements of installed lighting devices (Legacy visibility alternative)*
Table VI–a *Front turn signal lamp photometry requirements*
Table VI–b *Front turn signal lamp photometry requirements*
Table VII *Rear turn signal lamp photometry requirements*

Table VIII *Taillamp photometry requirements*
Table IX *Stop lamp photometry requirements*
Table X *Side marker lamp photometry requirements*
Table XI *Clearance and identification lamps photometry requirements*
Table XII *Backup lamp photometry requirements*
Table XIII–a *Motorcycle turn signal lamp alternative photometry requirements*
Table XIII–b *Motor driven cycle stop lamp alternative photometry requirements*
Table XIV *Parking lamp photometry requirements*
Table XV *High-mounted stop lamp photometry requirements*
Table XVI–a *Reflex reflector photometry requirements*
Table XVI–b *Additional photometry requirements for conspicuity reflex reflectors*
Table XVI–c *Retroreflective sheeting photometry requirements*
Table XVII *School bus signal lamp photometry requirements*
Table XVIII *Headlamp upper beam photometry requirements*
Table XIX–a *Headlamp lower beam photometry requirements*
Table XIX–b *Headlamp lower beam photometry requirements*
Table XIX–c *Headlamp lower beam photometry requirements*
Table XX *Motorcycle and motor driven cycle headlamp photometry requirements*
Table XXI *Adaptive Driving Beam Photometry Requirements*
Table XXII *Adaptive Driving Beam Test Matrix*
Figure 1 *Chromaticity diagram*
Figure 2 *Flasher performance chart*
Figure 3 *Replaceable bulb headlamp aim pads*
Figure 4 *Headlamp connector test setup*
Figure 5 *Headlamp abrasion test fixture*
Figure 6 *Thermal cycle test profile*
Figure 7 *Dirt/Ambient test setup*
Figure 8 *Replaceable light source deflection test setup*
Figure 9 *Environmental test profile*
Figure 10 *Replaceable light source pressure test setup*
Figure 11 *Trailer conspicuity treatment examples*
Figure 12–1 *Trailer conspicuity detail I*
Figure 12–2 *Trailer conspicuity detail II*
Figure 13 *Tractor conspicuity treatment examples*
Figure 14 *92 x 150 Headlamp aim deflection test setup*
Figure 15 *Types G and H headlamp aim deflection test setup*
Figure 16 *Types A and E headlamp aim deflection test setup*
Figure 17 *Type B headlamp aim deflection test setup*
Figure 18 *Types C and D headlamp aim deflection test setup*
Figure 19 *License plate lamp target locations*
Figure 20 *License plate lamp measurement of incident light angle*
Figure 21 *Vibration test machine*
Figure 22 *Flasher standard test circuit*
Figure 23 *Car/Truck opposite direction stimulus test fixture dimensions*
Figure 24 *Car/Truck same direction stimulus test fixture dimensions*
Figure 25 *Motorcycle opposite direction stimulus test fixture dimensions*
Figure 26 *Motorcycle same direction stimulus test fixture dimensions*
Figure 27 *Opposite direction test scenarios*
Figure 28 *Same direction test scenarios*
Figure 29 *Left Curve Test Scenarios*
Figure 30 *Right Curve Test Scenarios*

[87 FR 10021, Feb. 22, 2022]