light more evenly and thus reduce the glare. Toyota stated that the maximum allowable candlepower values were unnecessarily high. It argued that a lamp designed to meet this maximum could create a distraction for a following driver, and that these lamps would still function effectively if lower maximum values were adopted. Toyota has recommended that the current requirements for the aforementioned lamps be lowered to the levels set by the Economic Commission for Europe (ECE). All the ECE maximum requirements are approximately 50 percent less than those in Standard No. 108.

AAMA recommended that the optical axis of a lamp be defined as the centroid. AAMA also recommended that we permit the manufacturer to choose the optical axis of any given lamp based on the design.

V. Agency Decision To Withdraw Rulemaking

After careful consideration, NHTSA has decided to withdraw this rulemaking. With respect to the proposed method of determining the number of lighted sections within one LED signal lamp, NHTSA is concerned that adopting the proposed requirement might result in LED lamps having lower light intensity compared to incandescent lamps with a similar projected luminous lens area. The agency believes that lower light intensity could decrease visibility or confuse vehicle operators by making a normally bright stop lamp appear to be a taillamp. Because of this concern, the agency concludes that adopting the proposed requirements would be inappropriate.

With respect to the proposed LED lamp heat test methods, the agency has concluded that the proposed test is not a good surrogate for the real world performance of LEDs under increased or decreased ambient temperature conditions because the test does not accurately replicate high or low ambient temperatures occurring in various climates throughout U.S. The proposed test would energize the lamp for a period of 30 minutes in order to raise the LED lamp temperature (self-heating) before taking photometric measurements. However, some LED lamps do not necessarily heat up after being energized for an extended period of time. Nevertheless, some of the same lamps respond to low or high ambient temperatures by becoming much brighter or dimmer. Therefore, the agency believes that in order ensure adequate performance of the LED lamps in typical driving environments, it may be necessary to conduct additional research on alternative tests, including testing in a temperature chamber. We note that two comments on the NPRM suggested that testing should be more representative of the real-world environmental conditions vehicles may experience. One commenter provided information on two photometry test procedures, one from the Institute of Transportation Engineers and the other from the California Department of Transportation, which replicate real world temperatures. Transport Canada has also developed test procedures that replicate real world temperatures in a laboratory environment.

We continue to believe that it might be appropriate at some point to adopt new requirements related to LED lamp performance. As to photometric requirements and number of lighted sections, we would want to explore a single requirement equally applicable to LED, incandescent, or any other light sources, that would better relate lamp size to its intensity. As to the LED lamp heat test methods, we would want to explore test procedures that better replicate real-world ambient temperatures.

Given the complexity of the issues involved, however, and considering agency priorities and allocation of limited resources available to best carry out the agency's safety mission, NHTSA has decided, for the reasons discussed above, to withdraw this rulemaking.

Authority: 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.50.

Issued: September 8, 2004.

Stephen R. Kratzke,

Associate Administrator for Rulemaking.

[FR Doc. 04–20720 Filed 9–14–04; 8:45 am]

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DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 572

[Docket No. NHTSA–2004–18864]

RIN 2127–AI89

Anthropomorphic Test Devices; ES–2re Side Impact Crash Test Dummy (ES–2 With Rib Extensions); 50th Percentile Adult Male

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT).

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: In May 2004, NHTSA published a notice of proposed rulemaking that proposed to upgrade Federal Motor Vehicle Safety Standard No. 214, ''Side Impact Protection,'' by requiring that all passenger vehicles with a gross vehicle weight rating of 4,536 kilograms (10,000 pounds) or less protect front seat occupants against head, thoracic, abdominal and pelvic injuries in a vehicle-to-pole test simulating a vehicle's crashing sideways into narrow fixed objects like telephone poles and trees. That NPRM proposed that compliance with the pole test would be determined in two test configurations, one using a new, second-generation test dummy representing mid-size adult males and the other using a new test dummy representing small adult females. The NPRM also proposed using the new dummies in the standard's existing vehicle-to-vehicle test that uses a moving deformable barrier to simulate a moving vehicle being struck in the side by another moving vehicle.

Today's NPRM proposes specifications and qualification requirements for the new mid-size adult male crash test dummy. The new 50th percentile adult male side impact test dummy has enhanced injury assessment capabilities compared to devices existing today, which allows for a fuller assessment of the types and magnitudes of the injuries occurring in side impacts and of the efficacy of countermeasures in improving occupant protection.

DATES: You should submit your comments early enough to ensure that Docket Management receives them not later than November 15, 2004.

ADDRESSES: You may submit comments (identified by the DOT DMS Docket Number) by any of the following methods:

- *Web Site: http://dms.dot.gov.* Follow the instructions for submitting comments on the DOT electronic docket site.
- *Fax:* 1–202–493–2251.
- *Mail:* Docket Management Facility; U.S. Department of Transportation, 400 Seventh Street, SW., Nassif Building, Room PL–401, Washington, DC 20590–001.
- *Hand Delivery:* Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal Holidays.
- *Federal eRulemaking Portal:* Go to *http://www.regulations.gov.* Follow the online instructions for submitting comments.

Instructions: All submissions must include the agency name and docket

number or Regulatory Identification Number (RIN) for this rulemaking. For detailed instructions on submitting comments and additional information on the rulemaking process, see the Public Participation heading of the Supplementary Information section of this document. Note that all comments received will be posted without change to *http://dms.dot.gov,* including any personal information provided. Please see the Privacy Act discussion under the Public Participation heading.

Docket: For access to the docket to read background documents or comments received, go to *http://dms.dot.gov* at any time or to Room PL–401 on the plaza level of the Nassif Building, 400 Seventh Street, SW., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal Holidays.

FOR FURTHER INFORMATION CONTACT: For non-legal issues, you may call Stan Backaitis, NHTSA Office of Crashworthiness Standards (telephone 202–366–4912). For legal issues, you may call Deirdre Fujita, NHTSA Office of Chief Counsel (telephone 202–366–2992). You may send mail to these officials at the National Highway Traffic Safety Administration, 400 Seventh St., SW., Washington, DC, 20590.

SUPPLEMENTARY INFORMATION:

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I. Introduction

This NPRM proposes to amend 49 CFR part 572 by adding specifications and calibration procedures for an advanced crash test dummy representing a 50th percentile adult male for use in side impact testing. This document relates to an NPRM previously issued by NHTSA (69 FR 27990, May 17, 2004; Docket 2004–17694) that proposed to add a vehicle-to-pole test to Federal Motor Vehicle Safety Standard (FMVSS) No. 214, ''Side Impact Protection'' (49 CFR 571.214). The pole test simulates a vehicle's crashing sideways into narrow fixed objects like telephone poles and trees. If adopted as a final rule, the proposed pole test is likely to result in the installation of dynamically deploying side impact air bag systems and other measures to protect front seat occupants against head, thoracic, abdominal and pelvic injuries in side crashes.

In the proposed pole test, a vehicle is propelled at an angle of 75 degrees (measured from the front end of the vehicle longitudinal axis in the counter-clockwise direction (driver's side) or clockwise direction (front outboard passenger side)) into a 254 millimeter (10 inch) rigid pole at a speed of 32 kilometers per hour (20 miles per hour (mph)). An anthropomorphic test dummy representing a 50th percentile adult male is in the front outboard seat on the struck side of the vehicle. Vehicles would have to be certified as complying with an established head injury criterion and with thoracic, abdominal and pelvic injury criteria developed for the new dummy. The agency has also proposed to use the advanced dummy in FMVSS No. 214's existing moving deformable barrier (MDB) test, which simulates a vehicle-to-vehicle ''T-bone'' type intersection crash, replacing the present side impact dummy (SID) used in the test.

Today's NPRM proposes the specifications and calibration requirements for the 50th percentile adult male test dummy that NHTSA has proposed to use in the upgrades to FMVSS No. 214. The dummy is a modified version of a European side impact dummy, the ES–2 dummy. The dummy has a weight of 72 kilograms (kg) (158.8 pounds) and seated height of 90.9 centimeters (cm) (35.8 inches), as originally designed by a European consortium under the guidance of EEVC (European Enhanced Vehicle-Safety Committee) Working Group 9 (Intereurope Regulations, EEC document 96/27/EC, July, 1996). The modifications are with regard to thoracic rib extensions that have been added to address structural deficiencies identified by NHTSA that could affect injury measurement made by instruments within the chest of the dummy. The modified dummy proposed today is hereinafter referred to as the ''ES–2re,'' the ''re'' indicating the use of the rib extensions on the dummy.

NHTSA currently specifies two 50th percentile male side impact test dummies in part 572. A test dummy set forth in Subpart F of part 572 is used in the agency's MDB test of FMVSS No. 214. This dummy is commonly referred to as ''SID,'' short for the FMVSS No. 214 ''side impact dummy.'' The other test dummy is set forth in Subpart M of part 572, and is used in a 90-degree vehicle-to-pole test that manufacturers can choose to use to meet the upper interior head impact protection requirements of FMVSS No. 201, ''Occupant Protection in Interior Impact'' (49 CFR 571.201). The Subpart M dummy is based on two existing dummies, the Subpart F ''SID'' and a part 572, Subpart E ''Hybrid III'' test device that is used in testing under FMVSS No. 208, ''Occupant Crash Protection'' (49 CFR 571.208) The combined Subpart M side impact dummy is commonly referred to as the ''SID/HIII'' dummy.

Overall, the ES–2re is technically an improvement over the SID and SID/HIII test dummies, offering more human-like features for side impact protection assessment. The ES–2re has improved biofidelity and enhanced injury assessment capability compared to the other dummies. The agency tentatively believes that the dummy is a sound test device that will provide valuable data in assessing the potential for injury in side impacts and is suitable for incorporation into part 572.

II. Background

a. Need for the Dummy

The agency evaluated the ES–2re dummy in a variety of test exposures and found it to be more versatile for side impact injury assessment purposes than the SID and SID/HIII dummies.

The ES–2re dummy has provisions for instrumentation that can assess the potential for head injury (it measures the resultant head acceleration, which is used to calculate the Head Injury Criterion (HIC), the primary measure in the Federal motor vehicle safety standards for head injury); neck injuries via upper and lower neck load cells; thoracic injuries in terms of spine and rib accelerations and rib deflections; abdominal injuries through three load cells to assess the magnitude of lateral and oblique forces; acetabulum and pubic symphysis injuries by way of load cell measurements, as well as pelvis acceleration. The ES–2re can also assess

load transfer between the upper and the lower torso halves, torso interaction with the vehicle seat back, and the impact severity of the vehicle structure on the legs by way of a femur load cell. In addition, a clavicle load cell is available to assess shoulder loading.

The ES–2re dummy has articulated half-arms, terminating at the elbow height, that can be placed at the side of the thorax. In this position, the impacted arm acts as an interposer between the vehicle interior and the chest. The arms may also be swung up to several positions, leaving the thorax and the abdomen exposed to direct contact by the vehicle interior.[1]

The ES–2re would be representative of a major segment of the population that is exposed to the risk of fatal and serious injuries in side impacts. Table 1 shows the fatality and injury distribution of the estimated target population (U.S. motor vehicle occupants) in all types of side impact crashes between 12 and 25 mph delta V, categorized by MAIS (maximum abbreviated injury scale) and body regions for the head, chest, abdomen and pelvis. Of these, approximately 35 percent are small stature occupants.[2] The remaining occupants fall into midsize and large segments of the population. The ES–2re dummy would address the risk of injury of these occupants in side impacts. The agency identified three injured occupant size categories: (a) Small (or 142 centimeters (cm) to 163 cm (or 56 to 64 inches)); (b) median (165–180 cm or 65–71 inches) (''midsize''); and large (183–229 cm or 72–90 inches).

TABLE 1.—U.S. MOTOR VEHICLE OCCUPANT POPULATION INJURY SEVERITY DISTRIBUTION IN SIDE CRASHES

[For delta–V of 12–25 mph]

Body region	MAIS 1	MAIS 2	MAIS 3	MAIS 4	MAIS 5	Fatality	Total
Head and Face	12759	3353	287	506	476	1400	18781
Thorax	7652	508	2408	1868	32	1147	13615
Abdomen	509	150	62	308	77	240	1346
Pelvis	0	0	247	0	0	14	261

The injuries to the midsize and large occupant population, categorized by MAIS and body regions for the head, chest, abdomen and pelvis, are shown in Table 2, below.

TABLE 2.—U.S. MOTOR VEHICLE OCCUPANT MID-SIZE AND ABOVE INJURY SEVERITY DISTRIBUTION IN SIDE CRASHES

[For delta–V of 12–25 mph]

Body region	MAIS 1	MAIS 2	MAIS 3	MAIS 4	MAIS 5	Fatality	Total
Head and Face	8293	2179	187	329	309	910	12208
Thorax	4974	330	1565	1214	21	746	8850
Abdomen	331	98	40	200	50	156	875
Pelvis	0	0	161	0	0	9	170

b. Evolution of the Dummy

The ES–2 dummy evolved from the predecessor European EuroSID and EuroSID–1 dummies. Development of the EuroSID prototype was initiated in Europe in the early 1980s. EuroSID–1 was introduced as the European side impact dummy in a report published by EEVC–WG9 in 1989, approximately one year after the agency issued an NPRM to use the SID dummy in what was then the proposed incorporation of the MDB test into FMVSS 214. When the agency examined EuroSID–1 during the course of that rulemaking, it determined that the dummy had a number of technical problems involving flat topping,''[3] biofidelity, reproducibility of results, and durability. Because of these limitations, NHTSA decided against adopting EuroSID–1 and instead adopted SID as the anthropomorphic test device used in the FMVSS No. 214 MDB test.

Subsequent to NHTSA's adoption of the SID into FMVSS No. 214 in 1990, the European developers subjected the EuroSID–1 to further modifications and testing. The dummy was finally incorporated in the European Directive 96/27/EC on July 1996.

In 1996, NHTSA undertook an extensive evaluation of the EuroSID–1, in response to a Congressional directive, to determine whether the side impact provisions of EU 96/27/EC were at least functionally equivalent to the requirements of FMVSS No. 214. In the evaluation, NHTSA found that flat topping was still a problem. The data for the EuroSID–1 rib deflections indicated the existence of mechanism within the rib structure that would limit the ribs from full compression even under very high load. Flat topping was a matter of concern, especially at low levels of deflection, because it is an indication that the dummy's rib deflection mechanism is binding, and consequently, that the dummy's thorax is not responding correctly to the load from the intruding side structure. With flat topping, the resulting rib deflections and the V*C computations[4] are suspect. As a result, NHTSA concluded that the

[1] The SID dummy presently used in FMVSS No. 214 measures accelerations of the ribs, spine and pelvis and does not have articulating arms or shoulders.

[2] To address this population, the FMVSS No. 214 NPRM also proposed that a test dummy representing a 5th percentile adult female would be used in the pole and MDB tests of FMVSS No. 214.

[3] Flat-topping in the EuroSID dummy was described in the preamble to NHTSA's final rule adopting SID. The agency stated, ''[o]ne of the problems discovered in NHTSA's EuroSID sled tests was that the ribs were bottoming out, which may have invalidated the V*C measurements being made. This condition was characterized by a flat spot on the displacement-time history curve, while the acceleration-time history curve showed an increase with time until the peak g was reached. Although considerable attempts were made to correlate V*C and TTI(d), the deflection data collected continue to be questionable.'' 55 FR 45757, 45765 (October 30, 1990).

[4] V*C, viscous criterion, is another way of measuring the potential for thoracic injury. It is based upon the product of chest compression normalized by the chest half-width and the rate of rib compression.

EuroSID–1 dummy was still not suitable for use in FMVSS No. 214.[5, 6]

Since that time, the EuroSID line of dummies has made steady progress toward overcoming the concerns raised by NHTSA and other users of the dummy. Beyond flat topping, concerns had been raised about the projecting back plate of the dummy's upper torso grabbing into the seat back of the vehicle, upper femur bone's contact impact with the pubic load cell hardware, binding in the shoulder assembly resulting in limited shoulder rotation, and data spikes in the pubic symphysis load measurements associated with knee-to-knee contact. To address these concerns, the dummy manufacturer installed new hardware in the dummy, including an improved rib guide system in the thorax, a curved and narrower back plate, a revision in the pelvis to increase the range of upper leg abduction, the inclusion of a high mass flesh system in the legs and beveled edges in the shoulder clavicle guide assembly. The upgraded dummy was identified as the ES–2.

c. ES–2 Rib Extensions

The dummy manufacturer initially addressed the problem of the EuroSID–1's back plate grabbing the seat back by reducing the size and shape of the back plate. Nonetheless, the back plate continued to grab the seat back in some of NHTSA's tests. To further address the problem, the dummy manufacturer redesigned the rib module by adding rib extensions. The extended ribs provide a continuous loading surface that nearly encircles the thorax, and enclose the posterior gap of the ES–2 ribcage that was thought to be responsible for the ''grabbing'' effects.

The ES–2 with the rib extensions is the ES–2re dummy proposed today for incorporation into part 572. Our test data indicate that these rib extensions reduce the back plate grabbing force that had the effect of lowering rib deflections to insignificant amounts in vehicle side impact tests that had exhibited rather large back plate loads. The rib extensions also do not appear to affect the dummy's rib deflection responses in tests in which high back plate loads did not occur.

III. Description

A technical report and other materials describing the ES–2re in detail have been placed in the docket for today's NPRM (see also Docket No. 17694, *supra*).

The specifications for the ES–2re would consist of: (a) A drawing package containing all of the technical details of the dummy; (b) a parts list; and (c) a user manual containing instructions for inspection, assembly, disassembly, use, and adjustments of dummy components. These drawings[7] and specifications would ensure that the dummies would be the same in their design and construction. The performance calibration tests proposed in this NPRM would serve to assure that the ES–2re responses are within the established biomechanical corridors and further assure the uniformity of dummy assembly, structural integrity, consistency of response and adequacy of instrumentation. As a result, the repeatability of the dummy's impact response in vehicle certification tests would be ensured.

Drawings and specifications for the ES–2re are available for examination in the NHTSA docket section. Copies of those materials and the user manual may also be obtained from Leet-Melbrook, Division of New RT, 18810 Woodfield Road, Gaithersburg, MD, 20879, tel. (301) 670–0090.

The ES–2re consists of a ''skeleton'' which is covered by ''soft tissue'' consisting of rubber, plastic and foam. The dummy does not have lower arms because researchers concluded that lower arms on the side crash test dummy could interfere with the interaction of the side structure of a vehicle and the dummy's measurement of potential harm to the thoracic and pelvic regions. So as to assure to the extent possible the accuracy of the assessment of the potential for injury to these body regions, the lower arms were thus not included on the dummy. The ES–2re has a mass of 72 kilograms (kg) (158.8 pounds), which is the mass of a 50th percentile adult male without the lower arms.[8]

The 90.0 cm seated height of the ES–2re is representative of a 50th percentile adult male. In terms of assessing the effectiveness of head-protecting side air bags to vehicle occupants, NHTSA believes that the height of the dummy is a determinative factor in ascertaining where an occupant's head will impact a vehicle's interior. Since the height of the ES–2re is representative of a 50th percentile adult male, the dummy would provide valuable data on where mid-size occupants will impact the vehicle's interior in the side impact test.

IV. Biofidelity

Biofidelity is a measure of how well a test device duplicates the responses of a human being in an impact. Two methods are currently available for assessing the biofidelity of a dummy in side impact testing. These are: (a) An International Organization of Standardization (ISO) procedure, referred to as ISO Technical Report (TR) 9790, which determines the biofidelity of a dummy by how well does the dummy's body segment and/or subsystem impact responses replicate cadaver responses in defined impact environments; and (b) a newly developed NHTSA Biofidelity Ranking System. The latter method determines the dummy's biofidelity based on two assessment measures: (a) The ability of a dummy to load a vehicle or some other type of an impact surface as a cadaver does, termed ''External Biofidelity'; and (b) the ability of a dummy to replicate those cadaver responses that best predict injury potential, termed ''Internal Biofidelity.'' The NHTSA Biofidelity Ranking System method was reported by Rhule H., *et al.*, in a technical paper in the 2002 Stapp Car Crash Journal, Vol. 46, p. 477, ''Development of a New Biofidelity Ranking System for Anthropomorphic Test Devices.'' The ES–2re's biofidelity was evaluated under both of these methodologies.

a. ISO Technical Report 9790 Methodology

The Occupant Safety Research Partnership (OSRP) and Transport Canada conducted biomechanical testing on the ES–2 dummy using the ISO specified methodology and test procedures. The results of these tests have been reported by Byrnes *et al.* in the 2002 Stapp Car Crash Journal, Vol.

[5] ''Report to Congress: NHTSA Plan for Achieving Harmonization of the U.S. and European Side Impact Standards,'' April 1997; ''Report to Congress: Status of NHTSA Plan For Side Impact Regulation Harmonization and Upgrade,'' March 1999. NHTSA Docket No. 1998–3935–1 and –10 of the DOT Docket Management System at *dms.dot.gov*.

[6] In 2000, the agency granted a petition for rulemaking from the Association of International Automobile Manufacturers, the Insurance Institute for Highway Safety, and the organization then called the American Automobile Manufacturers Association, asking NHTSA to replace the SID with the EuroSID–1 used in a European side impact standard (EU/96/27/EC). Although the agency had concluded that EuroSID–1 had flat topping and other problems, NHTSA granted the petition anticipating that the problems could be cured and that a dummy technically superior to the SID could be incorporated into FMVSS No. 214.

[7] NHTSA notes that some of the drawings are the same as those used to specify the Hybrid II 50th percentile male dummy (set forth in 49 CFR Part 572, Subpart B) and the Hybrid III 50th percentile male dummy (49 CFR Part 572, Subpart D). It is proposed that such drawings of the ES–2re would bear two drawing numbers: a number that identifies the drawing for purposes of the ES–2re drawing package and a reference to the drawing of the Subparts B or D dummy that is identical to that drawing.

[8] A 50th percentile adult male with lower arms has a mass of approximately 78 kg (172 pounds).

46, paper No. 2002–22–0014. The ES–2re dummy's backplate modifications were performed with the express objective not to alter in any way the ES–2 dummy's impact response. Inasmuch as in subsequent tests it was shown that the new ES–2re conformed to the same calibration levels, it was assumed that the rib extension modifications to the ES–2 had no effect on its ISO based biofidelity assessment. (The validity of the assumption has been confirmed in the NHTSA Biofidelity Ranking System tests in which it was established that both the ES–2 and the ES–2re dummies had nearly identical biofidelity levels.) The ISO rating system is based on a scale of 0 to 10, with 0 signifying total lack of biofidelity and 10 signifying that the body segment has the same biofidelic response as a human subject. Once the ratings are established for each body segment, the overall dummy's biofidelity is calculated and its ranking determined using the classification scale shown in Table 3.

TABLE 3.—ISO BIOFIDELITY CLASSIFICATIONS

Excellent	>8.6 to 10.
Good	>6.5 to 8.6.
Fair	>4.4 to 6.5.
Marginal	>2.6 to 4.4.
Unacceptable	0 to 2.6.

The overall ES–2re dummy's biofidelity rating was determined to be ''fair,'' at 4.6, an improvement over the SID and EuroSID–1, which received ratings of 2.3 and 4.4, respectively (Byrnes, *et al.*, ''ES–2 Dummy Biomechanical Responses,'' 2002, Stapp Car Crash Journal, Vol. 46, #2002–22–0014, p. 353).

The ES–2 (ES–2re) ISO biofidelity rating also compares favorably to that of the SID/HIII, which, on account of its new special purpose side impact head and neck, received an overall rating of 3.8.[9]

b. NHTSA Biofidelity Ranking System

The biofidelity ranking system developed by Rhule, H., *et al., supra,* includes an assessment of the dummy's External Biofidelity and Internal Biofidelity. The Overall External and Internal Biofidelity ranks are an average of each of the external and internal body region ranks, respectively. In contrast to the ISO classification method, a lower biofidelity rank indicates a more biofidelic dummy by this NHTSA ranking method. A dummy with an External and/or Internal Biofidelity rank of less than 2.0 is considered to respond much like a human subject.

The NHTSA ranking system is based on a variety of cadaver and dummy exposures, such as head drop tests, thorax and shoulder drop tests, thorax and shoulder pendulum tests, and whole body sled tests. The NHTSA ranking system also includes the abdominal and pelvic offset sled test conditions. Each test condition is assigned a weight factor, based on the number of human subjects tested, to form a biomechanical response corridor. For each response requirement, the cumulative variance of the dummy response relative to the mean cadaver response (DCV) and the cumulative variance of the mean cadaver response relative to the mean plus one standard deviation (CCV) are calculated. The ratio of DCV/CCV expresses how well the dummy response duplicates the mean cadaver response: a smaller ratio indicating better biofidelity.

Although this method does not establish an ''absolute'' ranking scale, the ranks provide a relative sense of the ''number of standard deviations away'' the dummy's responses are from the mean human response. Rhule conducted an analysis and found that if the dummy's biofidelity ranking is below two, then the dummy is behaving similar to the human cadaver. The evaluation methodology provides a comparison of both dummy response to cadaver response as well as a comparison of two or more dummies.

Rhule *et al., supra,* determined external and internal biofidelity rankings for the ES–2 dummy. NHTSA later repeated the tests for the ES–2re to determine that dummy's biofidelity rankings. Tables 4 and 5, below, provide a summary of External Biofidelity and Internal Biofidelity rankings, respectively, for the ES–2 and the ES–2re. The results of NHTSA's Biofidelity Ranking System tests indicate that the ES–2 and ES–2re dummies have essentially the same external and internal biofidelity assessment values, and that the rib extensions have thus had no effect on the biofidelity of the ES–2. The ES–2re dummy had an Overall External Biofidelity rank of 2.6, compared to 2.7 for the ES–2. Its Overall Internal Biofidelity rank was 1.6.

TABLE 4.—EXTERNAL BIOFIDELITY RANKINGS OF THE ES–2 AND ES–2re

External biofidelity rank	ES–2	ES–2re
Overall	2.7	2.6
Head/Neck	3.7	3.7
Shoulder	1.4	1.4
Thorax	3.2	2.9
Abdomen	2.5	2.6
Pelvis	2.7	2.7

TABLE 5.—INTERNAL BIOFIDELITY RANKINGS OF THE ES–2 AND ES–2re

Internal biofidelity rank	ES–2	ES–2re
Overall with T1 (w/o abdomen)		1.5
Overall with Defl. (w/o abdomen)	1.6	1.6
Overall with TTI (w/o abdomen)	n/a	1.6
Head	1.6	1.0
Thorax–T1	n/a	1.5
Thorax–Delft	1.7	1.8
Thorax–TTI		1.8
Abdomen	n/a	n/a
Pelvis	2.1	2.0

Based on all of the testing, the agency tentatively concludes that the ES–2re has sufficient biofidelity for use in FMVSS No. 214's side impact injury assessment tests. According to both the ISO and NHTSA biofidelity ranking systems, the ES–2 and the ES–2re dummies have nearly identical biofidelity rankings. While a more biofidelic test device than the ES–2re may be developed in the future, the agency tentatively concludes that the ES–2re is a suitable and valuable test device for use in side impact testing today.

V. Repeatability and Reproducibility

A dummy's repeatability [10] and reproducibility [11] is typically based on the results of component tests and sled tests. In the tests, the impact input as well as the test equipment are carefully controlled to minimize external effects on the dummy's response. Component tests are typically better controlled and thus produce more reliable estimates of the dummy's repeatability and reproducibility than is possible in sled and vehicle tests. Sled tests, on the other hand, offer a method of efficiently evaluating the dummy as a complete system in an environment much like a vehicle test.

Component tests are needed to establish the dummy's component performance relative to the

[9] The biofidelity rating for the SID dummy used in FMVSS No. 214 is 2.3. The rating for the SID/HIII of 3.8, using the ISO method, reflects use of the special purpose side impact HIII head and neck as noted in 63 FR 41468, August 4, 1998.

[10] Repeatability is defined as a similarity of responses of a single dummy measured under identical test conditions.

[11] Reproducibility is defined as the smallness of response variability between different dummies of the same design under identical test conditions.

biomechanical corridors to which each major body segment must correctly respond. That is, if the dummy's component is or becomes deficient, the component test will identify to the user that the component will not respond properly in impact tests. Sled tests in turn are needed to establish the consistency of the dummy's kinematics, its impact response as an assembly, and the integrity of the dummy's structure and instrumentation under controlled and representative crash environment test conditions.

The agency's component and sled repeatability and reproducibility tests were based on two dummies. (See ''Technical Report—Design, Development and Evaluation of the ES–2re Side Crash Test Dummy,'' *supra*.)

a. Component Tests

The component tests were conducted on head, neck, shoulder, upper rib, middle rib, lower rib, abdomen, lumbar spine and pelvis body regions. The repeatability assessment was made in terms of percent CV (Coefficient of Variance). A CV value of less than 5 percent is considered excellent, 5–8 percent good, 8–10 percent acceptable, and above 10 percent poor.[12] The repeatability of the dummies was assessed in two separate series of tests. In the first series, the dummy calibrations were performed between sled or vehicle crash tests. In the second series, the calibration tests were performed consecutively without any other intermittent tests. In the first series, nine tests were performed with one of the dummies, and seven tests with the other. In the second series, two newly acquired dummies were exposed to five sets of calibration tests each. Reproducibility was assessed by comparing the average responses of both dummies.

The results of the component repeatability tests indicate ''excellent'' and good repeatability for the ES–2re dummy for all components except for the pelvis, which has a rating classification of ''good,'' and the shoulder with a rating of ''acceptable.''

The reproducibility assessment was made in terms of response differences between each of the two sets of dummies with respect to the mean. The rating for reproducibility takes into account the cumulative variabilities of two or more dummies and is primarily indicative of the repeatability of the manufacturing process of the same type of dummy and to some extent the repeatability of design specifications, inspection, and test methodology. The reproducibility assessment does not serve the purposes of accepting or rejecting the dummy; rather it is an indication of how far the responses of different dummies could vary under identical test conditions. The results of the pooled component tests indicate that the neck, thorax lumbar spine and pelvis responses are well below the 5% level and the head, shoulder and abdomen response below the 7% level.

b. Sled Tests

To reduce test-to-test variation of sled pulse parameters, NHTSA tested two ES–2re dummies (designated ''dummy #070'' and ''dummy #071'') simultaneously on a dual occupant side impact Hyge sled buck developed by the agency. The sled pulse was an approximate half-sine wave, with the peak acceleration of 12.7 g's and duration of approximately 80 ms. The impact speed was 6.7 meters per second (m/s) (22 ft/s). Two test conditions were used for the repeatability and reproducibility assessment: a flat rigid wall; and a rigid wall with abdomen offset (simulating a vehicle armrest). The two ES–2re dummies were exposed to two series of five Hyge sled tests, for a total of 10 test exposures per dummy.

For the flat wall test condition, the wall was 374 mm (14.7 in) high from the front edge of the seat, and 368 mm (14.5 in) long from the back of the seat. For the abdomen offset test condition, the same flat wall was used, with a protruding 305 mm (12 in) long, 76 mm (3 in) thick and 83 mm (3.3 in) wide wooden offset block attached to the wall. The offset block, simulating an armrest, was oriented such that it would impact the abdomen only, above the pelvis and below the lower rib. The objective of the abdomen offset tests was to provide a test environment with severe loading of the abdominal region.

The sled buck incorporated a Teflon-covered bench seat with two Teflon-covered rails to support the seated dummies from behind. As the sled buck was accelerated, the buck slid beneath the dummies until the dummies' left side impacted the rigid wall.

High-speed digital video cameras were positioned in front of each dummy in order to capture head motion for use in performing motion analysis of the head translation. The dummies were instrumented with sensors to record principal injury indicators such as head, resultant lower spine (T12) and pelvis accelerations, rib deflections, abdominal, lumbar and pubic symphysis loads, and other parameters. A contact switch was positioned on the side of each dummy and on the load wall at the location of first contact to indicate the precise instant of dummy contact with the wall.

1. Flat Wall Test Results

Using the dummy rating practice set forth in ISO/TC22/SC12/WG5, generally the responses in the flat wall tests displayed either excellent or good repeatability, except for the lumbar Y (shear) force repeatability of dummy Serial Number (S/N) #070 falling outside the CV acceptability boundary at 14.8%. This elevated CV value for dummy #070 also was responsible for a reproducibility assessment at 17.5%. While these CV values are relatively high, the agency is not considering an injury assessment associated with this response. Moreover, this response is not considered to be of importance since it did not have an effect on either the magnitude of the loading or the variability of the adjacent structure responses, such as pubic symphysis, the abdomen and the T12. HIC responses exhibited excellent repeatability of each dummy and reproducibility of both dummies. In all tests, the rib displacement time history provided a smooth response, with no indications of the flat topping phenomena that had been a shortcoming of previous versions of the EuroSID, EuroSID–1, and the prototype ES–2 dummies.

2. Abdomen Offset Test Results

Upon thorough review of the response traces after the test series was completed, it was noted that the first test in the series with dummy S/N #070, exhibited responses that were somewhat different from the responses observed in the remaining four tests. When compared to the subsequent four tests, the first test had significantly lower abdominal and lumbar loads and larger rib displacements (See Appendix C, Figures C.10 through .18 of the Technical Report, *supra*). Upon review, the data for that test indicated that impact contact with the abdominal offset block appear to have slightly favored the proximity of the lower rib rather than the middle of the abdomen, as had been the case in the subsequent four tests. This could have been caused either by a slight variation in the set-up of the dummy for the test or a slight posture realignment during the dummy's movement while approaching the impact surface. Inasmuch as the seating procedure was not varied and this aberration did not reoccur in the four subsequent tests, this test was considered to be a legitimate outlier. Therefore, that test was excluded from the analysis.

The remaining responses for the abdomen offset sled tests provided

[12] ISO/TC22/SC12/WG5.

either excellent or good repeatability and reproducibility, except for one test in which the lumbar moment reproducibility response had a CV value of 16.7, which is only by 1.7% into the poor range. While this CV value is high, this measurement is not considered for injury assessment with the EuroSID, EuroSID–1 and ES–2re dummies. Furthermore, this slightly elevated response appears not to affect either the magnitude of the loading or the variability of the adjacent structure responses, such as pubic symphysis, the abdomen, the T12 moment and the rib displacement time history, without any indications of flat topping.

Based on the above, the agency tentatively concludes that the repeatability and reproducibility of the ES–2re responses in flat wall and abdominal offset impacts are acceptable (generally in the order of ''excellent'').

VI. Vehicle Tests

The agency performed an extensive set of vehicle crash tests with the ES–2 and ES–2re dummies to compare their responses, to determine the levels of dummy responses at different loading conditions, to determine the integrity of the measurements, and the dummies' structural durability. The testing consisted of:

(a) FMVSS No. 214 tests with a higher and heavier moving deformable barrier;

(b) Fleet performance testing to FMVSS No. 214 and NHTSA New Car Assessment Program (NCAP) side impact test protocols; and

(c) FMVSS No. 201 type and oblique side impact pole testing.

The tests were also designed to compare the ES–2 and ES–2re dummies for the effectiveness of the rib extension backplate fix. The test matrix included 14 MDB-to-vehicle and/or vehicle-to-vehicle crash tests with the ES–2 dummy and 6 crash tests with the ES–2re dummy, and 8 vehicle-to-pole crashes with the ES–2 and 4 with the ES–2re dummies.

Findings of Testing the ES–2 with Rib Extension Fix (ES–2re)

The findings of the crash tests were as follows:

- In comparable full scale crash tests with the ES–2, the ES–2re dummy demonstrates nearly identical performance in which seat back ''grabbing'' was not evident;
- Full scale crash tests of vehicles in the FMVSS Nos. 201, 214, and NCAP tests, and those tested with an MDB of the Insurance Institute for Highway Safety (IIHS), indicate that the ES–2re has resolved the back plate ''grabbing'' problem. (In the NCAP tests, the FMVSS No. 214 moving deformable barrier impacted the vehicle at 62 km/h (38.5 mph). In the IIHS test, a high-profile and relatively stiff MDB was used to impact the target test vehicle.)
- While in some vehicles the back plate still senses loading from the seat back structure, the loading is caused primarily by a protruding seat frame geometry which interacts with the dummy's ribcage structure rather than by back plate grabbing;
- In those vehicles in which the localized back plate load path was in evidence and now has been mostly eliminated, the momentum transfer, that was originally passed through the back plate with the ES–2, is now being directed mainly through the ribs and partly through the shoulder of the ES–2re. As a result, rib deflections, in which ''grabbing'' was in evidence, are expected to increase;
- In oblique side impact pole tests and additional FMVSS No. 214 and NHTSA side NCAP tests, the durability of ES–2re, and the good mechanical performance of the rib deflection system and back plate loading, were further verified; and
- The ES–2re demonstrated consistent performance and the ability to perform useful measurements under the most severe loading conditions.

VI. Durability and High Severity Loading

a. Durability

No durability problems arose with the ES–2re dummies in any of the full scale vehicle crash tests and sled tests. The majority of the rib deflections, although close to the maximum available deflection range, did not bottom out against the deflection stop. The only new parts required after the full series of full scale crash tests were shoulder foams, pelvis foam plugs, and one set of ribs. It was also observed that sharp edges on socket head screws attached to the clavicle load cell were causing the shoulder foam cap to tear. The screws were later modified by rounding off their sharp edges to avoid tearing of the shoulder foam cap. Also, there was a tear in one of the dummies' abdomen, but the abdomen passed the impact calibration requirements.

b. High Severity Loading

The ES–2re performed well without producing distorted or truncated measurements in higher severity overload tests, such as the IIHS MDB and the side NCAP tests as well as rigid wall and abdominal offset sled impact tests. In these tests, the majority of the rib deflections were also within the maximum available compression range. Only in two instances did the dummy's ribs deflect to their maximum range. However, even under these circumstances none of the measurements indicated data discontinuities and/or signal distortions in spite of the very rigorous impact exposures of the side NCAP test and the IIHS MDB test. Given that the measurements were neither distorted, nor discontinuous, the ES–2re responses appear to be satisfactory even in high severity loading conditions.

VIII. Reversibility

The design of the original EuroSID incorporated reversibility features to accommodate the dummy's use for both left and right side impacts. Although test literature related to the EuroSID, EuroSID–1 and ES–2 dummies specifications do not indicate which side of the dummy was tested, to our knowledge all of the EuroSID, EuroSID–1 and ES–2 dummies' tests were evaluated in left side impact applications. In turn, the agency is aware that the EuroSID–1 has been and still is being used in England, Japan and Australia for right side impacts. Accordingly, we believe that the ES–2re dummy—which has the same left to right side impact conversion provisions as the ES–2 and its predecessor the EuroSID–1 dummy—will perform equally well, upon appropriate conversion when struck on either side, *i.e.*, in both driver (left) side and passenger (right) side crash tests. For right side impacts, the dummy must be reconfigured and instrumented to the right side by: (a) Inverting the three rib modules and installing them for right side impact; (b) moving the load cell on the left clavicle to the right side and the shoulder load cell structural replacement to the left side; (c) moving the abdomen load cells to the right side and the load cell structural replacements to the left side; (d) moving the femur load cells to the right side of the dummy, if only the left femur is instrumented; and (e) reconfiguring the polarities of all sensors of the reverse installed parts, in accordance with the SAE J211 Recommended Practice. The agency Manual for Users (the Procedures for Assembly, Disassembly and Inspection) (PADI) describes in more detail the steps that need to be taken to convert the dummy for use from the left to the right side of the vehicle.

IX. Directional Impact Sensitivity

Limited agency testing of the dummy's thorax in oblique pendulum impacts indicates some directional

sensitivity in the rib deflection and spine acceleration responses. Literature published by EEVC suggests similar sensitivity in the ES–2 dummy's thorax ribs compression measurements in oblique pendulum impact tests. This is indicated by increased rib deflections when the ribcage is obliquely impacted from the rear and by reduced deflections when impact occurs from the front. Similar sensitivity, but of a lower magnitude, is in evidence for the upper spine acceleration. In contrast, there is less sensitivity in the abdominal force measurement and lower spine accelerometer output.

While the EEVC acknowledges the existence of some sensitivity of the ES–2 dummy to oblique impacts, it believes that the dummy offers increased injury assessment and measurement capabilities to meet the needs of legislative authorities worldwide. The EEVC states further that the ES–2 dummy forms a solid basis for interim harmonization and will further support activities to help realize this objectives (EEVC WG12 Report, August 12, 2001). The EuroNCAP program has used the EuroSID–1 for several years and lately, the ES–2 for the same purpose. While our own evaluation of the ES–2re dummy in oblique pendulum tests confirms the EEVC-noted sensitivity, we do not believe the pendulum test is necessarily reflective of the dynamic interaction between impacted door and occupant during the crash event. In the pendulum test, the loading is imposed on the dummy's ribcage in a fixed, large oblique impact angle throughout the entire loading period as well as by an impactor that produces a very concentrated, localized loading to the ribcage. Review of our full scale test data do not indicate evidence of the magnitude of sensitivity produced in pendulum type impacts. Accordingly, the agency believes that while there is some evidence of response sensitivity to pendulum type oblique impacts, it is not of concern for MDB and pole type full scale crash tests. Comments are requested on whether ES–2 and ES–2re dummy users have seen such effects in measured responses during full scale crash tests. If so, please provide details on the loading conditions and vehicle design configuration (*e.g.*, test speed, impact orientation, side air bag, etc.).

X. Temperature

While the 18° C to 26° C (64.4° F to 71.6° F) temperature range is specified for the EuroSID–1 by EU in 96/27/EC and for the ES–2 by EEVC in EuroNCAP side impact tests, NHTSA proposes that the ES–2re's temperature at the time of calibration, sled and full scale crash tests be in the range of 20.6° C to 22.2° C (69° F to 72° F). This temperature range is specified for all NHTSA Hybrid III series and SID/HIII dummies. This temperature range is proposed to reduce the variability of the dummy's impact response due to temperature sensitivity of damping and rubber and plastic materials used within the dummy. The agency believes that the proposed range is also practical for the ES–2re dummy.

XI. Proposed Calibration Tests

The agency proposes the following calibration test specifications and procedures for the ES–2re dummy. There would be qualification tests for components of the dummy (the head; neck; thorax; and lumbar spine), and impact tests performed on local areas (the shoulder, abdomen; and pelvis) of a fully assembled seated dummy. The agency is also exploring the possibility of replacing the individual rib module tests by a single pendulum test to the side of the rib cage of the seated dummy, and to relegate the rib module specification to the drawing level and its assembly-disassembly procedures to the user manual.

a. Head Drop Test Specifications

The head is dropped from 200 mm onto a flat, steel plate such that its midsagittal plane makes a 35 degree angle with respect to the impact surface and its anterior-posterior axis is horizontal. When the dummy head is dropped in accordance with the above test procedure, the agency proposes the following certification specifications:

1. When the head assembly is dropped in accordance with 49 CFR 572.112(a), the measured peak resultant acceleration must be between 125 g's and 155 g's;
2. The resultant acceleration-time curve must be unimodal to the extent that oscillations occurring after the main acceleration pulse must not exceed 15% (zero to peak) of the main pulse;
3. The fore-and-aft acceleration vector must not exceed 15 g's.

b. Neck Pendulum Test

The proposed test procedure involves attaching the neck to a EuroSID–1 headform, and attaching the assembly to the bottom of the pendulum specified in Subpart E of 49 CFR Part 572, Figure 22. The pendulum is raised to a height from which it would achieve an impact velocity of 3.4 ± 0.1 meters per seconds (m/s) in free fall. Lateral flexion, as well as rotation and translation of the headform would be measured.

When the ES–2re neck is tested in accordance with the proposed test procedure, the following specifications would have to be met:

1. The pendulum deceleration pulse is to be characterized in terms of its change (decrease) in velocity as shown in Table 5 with the velocity profile obtained by integrating the pendulum accelerometer output.

TABLE 5.—ES–2re NECK CERTIFICATION PENDULUM VELOCITY CORRIDOR

Time (ms)	Velocity (m/s)
Upper boundary	
1.0	0.0
3.0	−0.25
14.0	−3.2
Lower boundary	
0.0	−0.05
2.5	−0.375
13.5	−3.7
17.0	−3.7

2. The neck must have the following performance characteristics:

(a) the maximum headform flexion angle relative to time zero is 52 to 57 degrees and occurs within 54 to 64 ms.

(b) The maximum neck orientations at fore (A)[13] pendulum base angle is 32.0 to 37.0 degrees occurring between 53 and 63 ms, and

(c) The maximum neck orientations at the fore (B) pendulum base angle is 0.81*(A)+3.0+/−1.25 degrees respectively occurring between 54 and 64 ms.

Items (b) and (c) are shown for this NPRM in Figure U–2b. In view of the maximum flexion angle specification in (a), above, to avoid over-specification of the required performance, comments are requested on whether (b) and (c), above, are necessary for evaluating the adequacy of the neck.

c. Thorax

The dummy's thoracic response is evaluated by testing each individual rib module mounted in a drop test fixture. Upon disassembly from the dummy, each rib module is rigidly mounted in the drop rig fixture and the rib is impacted at 4.0 ± 0.1 m/s in free fall by an impactor with a mass of 7.78 kg. Each rib module is tested individually in the drop test rig by an impactor to impact the rib at 3.0 m/s and 4.0 m/s.

[13] The fore (A) and aft (B) base angles and the headform angle (C) are directly measured during the test. The headform flexion angle is calculated by summing the fore (A) and headform (C) angles. After the calculations, all rotations are digitally filtered using the SAE J211 CFC180 and the pendulum acceleration is digitally filtered using the SAE J211 CFC 60.

The response criteria are based on the minimum and maximum deflection of the rib. For each rib (upper, middle, and lower rib), the proposed rib deflection for the 3.0 m/s impact would be 36 to 40 mm, and for the 4.0 m/s impact 46.0 to 51.0 mm.

While the EEVC rib module test also specifies impacts at a lower speed (2 m/s), the agency data indicate that the same rib modules tested at all of the three speeds are consistent in the responses to the their respective performance corridors. Inasmuch as door velocities into dummies at FMVSS No. 214 and NCAP test speeds are never below 4.0 m/s impact speed, it is our tentative view that there is no need or value in evaluating the rib modules at 2 m/s. Furthermore, the rib modules are tightly controlled by design specifications. The agency tentatively concludes that the 3.0 m/s and 4.0 m/s impact tests provide a reasonably good assurance that any other rib module would respond consistently at any other impact speed. Accordingly, the agency is proposing to limit the calibration requirement to the 3.0 and 4.0 m/s impact speeds. Comments are requested on this issue.

As an alternative or addition to the individual rib tests, NHTSA is considering a certification procedure and response corridors that would address the performance of the thorax of the dummy as a complete system. It is anticipated that the thorax of a seated dummy would be impacted by a pendulum at a specified impact speed in the procedure described in a report entitled, ''Development of a Full-Body Thorax Certification Procedure and Preliminary Response Requirements for the ES–2re Dummy'' (see docket 18864). A rib deflection range would be specified. Advantages to this approach are that it would require no disassembly and re-assembly of the dummy, as opposed to the approach used by the EU that requires the dummy's partial disassembly and tests of each rib individually. The agency is considering using the thorax impactor currently specified in Subpart E of 49 CFR Part 572 to calibrate the thorax performance of the Hybrid III 50th percentile male frontal test dummy. If that impact procedure were to be specified, it is possible that neither new drop test equipment nor multiple rib module tests would be needed. A ''systems'' test of the thorax is used in calibration tests of all frontal impact and side impact dummies currently specified. Comments are requested on a systems test for calibration of the ES–2re thorax.

d. Lumbar Spine

This test would be similar to the neck calibration procedure, involving an impact test with a Subpart E, 49 CFR Part 572 neck test pendulum at 6.05 ± 0.10 m/s using the EuroSID–1 headform and interface.

When the lumbar spine is tested in accordance with the proposed test procedure, the following specification would have to be met:

1. The pendulum deceleration pulse is to be characterized in terms of its change (decrease) in velocity as obtained by integrating the pendulum accelerometer output as shown in Table 6.

2. The lumbar spine must have the following performance characteristics:

(a) The maximum lumbar spine flexion angle (relative to time zero) is 45–55 degrees occurring between 39 to 53 ms;

(b) The maximum lumbar orientation at fore (A) [14] pendulum base angle is 31 to 35 degrees occurring between 44 and 52 ms; and

(c) The maximum lumbar orientation at the fore (B) pendulum base angle is 0.8*(A)+3.25 +/− 1.25 degrees respectively occurring between 44 and 62 ms.

Items (b) and (c) are shown in this preamble in Figure U–2b. In view of the maximum flexion angle specification in (a), above, to avoid over-specification of the required performance, comments are requested on whether (b) and (c), above, are necessary for evaluating the adequacy of the lumbar spine.

e. Shoulder

The calibration test would be an impact test performed on the shoulder area of a fully assembled, seated dummy. A 49 CFR Part 572, Subpart E pendulum (23.4 kg) would impact the dummy laterally (the dummy's midsagittal plane is perpendicular to the direction of impact). The impactor would swing freely to impact the dummy's upper arm pivot at a velocity of 4.3 m/s. The shoulder would pass the test if the peak acceleration of the impactor were between 7.5 and 10.5 g.

[14] The fore (A) and aft (B) base angles and the head form angle (C) are directly measured during the test. The head form flexion angle is calculated by summing the fore (A) and head Form (C) angles. After the calculations, all rotations are digitally filtered using the SAE J211 CFC180 and the pendulum acceleration is digitally filtered using the SAE J211 CFC 60.

f. Abdomen

TABLE 6.—LUMBAR PENDULUM REDUCTION IN IMPACT VELOCITY FROM TIME OF CONTACT WITH THE DECELERATION BLOCK

Time (ms)	Pendulum Delta V (m/s)
0.00–1.00	0.00 to −0.05.
2.70–3.70	−0.24 to −0.425.
24.50–27.0	−5.80 to −6.50.

This calibration test is performed on a fully assembled, seated dummy. The abdomen would be impacted laterally at 4.0 m/s by a 49 CFR Part 572, Subpart E, 23.4 kg pendulum that has an impact face configured to replicate a horizontally-oriented 70 mm high, 150 mm wide, and 60–80 mm deep rigid block simulating a vehicle armrest. The midsaggital plane of the dummy is perpendicular to the direction of impact. The following requirements would have to be met:

1. The maximum pendulum impact force measured by the pendulum-mounted accelerometer must be between 4,000 N and 4,800 N, between 10.60 to 13.00 ms from time zero,

2. The sum of the forces of the three abdominal load sensors must be not less than 2,200 N and not more than 2,700 N at any time between 10.0 ms and 12.3 ms from time zero.

g. Pelvis

This calibration test would be performed on a fully assembled, seated dummy. The dummy pelvis would be impacted by the 49 CFR Part 572, Subpart E, 23.4 kg pendulum at a velocity of 4.3 m/s. The midsagittal plane of the dummy is perpendicular to the direction of impact and the centerline of the impactor is aligned within 5 mm of the center of the H point.

1. The maximum impact force measured by the pendulum accelerometer would be not less than 4800 N and not more than 5500 N, occurring between 10.3 and 15.5 ms from time zero.

2. Maximum pubic force would have to be 1310 N and not more than 1490 N occurring between 9.90 and 15.9 ms from time zero.

XII. Other Advantages

The agency tentatively concludes that the improved biofidelity and additional injury assessment capability of the ES–2re compared to the other commercially available mid-size male side impact test dummies supports a decision to adopt the ES–2re into 49 CFR Part 572. The

dummy would allow for a better assessment of the risk of injury to human occupants than the currently-specified SID crash test dummy used in side impact testing. The availability of these additional features also are of crucial importance to the design, development and evaluation of the development of occupant protection systems in side impacts, particularly those involving inflatable air bag systems, as noted in the May 17, 2004 NPRM proposing to amend FMVSS No. 214, supra. The ES–2re test dummy is available today, and has been thoroughly evaluated for suitable reproducibility and repeatability of results.

Further, incorporation of the ES–2re test dummy into 49 CFR Part 572 would be a step toward harmonizing our regulations with non-U.S. regulations. The ES–2 dummy has not yet supplanted the EuroSID–1 dummy in Europe or elsewhere for use in regulations as of this time. However, based on a proposal from the Netherlands, the UN/ECE's Working Party on Passive Safety (GRSP) has recommended to the WP.29 that ECE Regulation No. 95 be amended to use the ES–2 dummy in place of the EuroSID–1.[15] The GRSP's proposal takes into account the modifications that NHTSA has done to ES–2 to fix the back plate problem, as well as other minor outstanding technical problems raised by other participants. If this is adopted, the European Union is expected to also amend its Directive 96/27/EC to use the ES–2 dummy. Adopting the ES–2re into part 572 would also accord with the practices of the European New Car Assessment Program (EuroNCAP) on side impact. EuroNCAP began using the ES–2 dummy with the injury criteria specified in EU 96/27/EC in February 2003.

[15] The UN/ECE World Forum for Harmonization of Vehicle Regulations (WP.29) administers several agreements relating to the global adoption of uniform technical regulations. An agreement, known as the 1958 Agreement, concerns the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts and the development of motor vehicle safety regulations for application primarily in Europe. UN-member countries and regional economic integration organizations set up by UN country members may participate in a full substantive capacity in the activities of WP.29 by becoming a Contracting Party to the Agreement. Various expert groups (e.g., the GRSP) within WP.29 make recommendations to WP.29 as to whether regulations should be adopted by the Contracting Parties to the 1958 Agreement. Under the 1958 Agreement, new Regulations and amendments to existing Regulations are established by a vote of two-thirds majority of Contracting Parties. The new Regulation or amendment becomes effective for all Contracting Parties that have not noticed the Secretary-General of their objection within six months after notification.

Rulemaking Analyses and Notices

Executive Order 12866 and DOT Regulatory Policies and Procedures

Executive Order 12866, ''Regulatory Planning and Review'' (58 FR 51735, October 4, 1993), provides for making determinations whether a regulatory action is ''significant'' and therefore subject to Office of Management and Budget (OMB) review and to the requirements of the Executive Order. This rulemaking action was not considered a significant regulatory action under Executive Order 12866. This rulemaking action was also determined not to be significant under the Department of Transportation's (DOT's) regulatory policies and procedures (44 FR 11034, February 26, 1979). The cost of an uninstrumented ES–2re is in the range of $54–57,000. Instrumentation would add approx. $43–47,000 for minimum requirements and approximately $80–84,000 for maximum instrumentation to the cost of the dummy.

This document proposes to amend 49 CFR Part 572 by adding design and performance specifications for a 50th percentile adult male side impact dummy that the agency may use in research and in compliance tests of the Federal side impact protection safety standards. If this proposed Part 572 rule becomes final, it would not impose any requirements on anyone. Businesses would be affected only if they choose to manufacture or test with the dummy. Because the economic impacts of this proposal are minimal, no further regulatory evaluation is necessary.

Regulatory Flexibility Act

Pursuant to the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996), whenever an agency is required to publish a proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (*i.e.*, small businesses, small organizations, and small governmental jurisdictions), unless the head of the agency certifies the rule will not have a significant economic impact on a substantial number of small entities. The Small Business Administration's regulations at 13 CFR Part 121 define a small business, in part, as a business entity ''which operates primarily within the United States.'' (13 CFR 121.105(a)).

We have considered the effects of this rulemaking under the Regulatory Flexibility Act. I hereby certify that the proposed rulemaking action would not have a significant economic impact on a substantial number of small entities. This action would not have a significant economic impact on a substantial number of small entities because the addition of the test dummy to Part 572 would not impose any requirements on anyone. NHTSA would not require anyone to manufacture the dummy or to test vehicles with it.

National Environmental Policy Act

NHTSA has analyzed this proposal for the purposes of the National Environmental Policy Act and determined that it will not have any significant impact on the quality of the human environment.

Executive Order 13132 (Federalism)

Executive Order 13132 requires agencies to develop an accountable process to ensure ''meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.'' ''Policies that have federalism implications'' is defined in the Executive Order to include regulations that have ''substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.''

NHTSA has analyzed this proposed amendment in accordance with the principles and criteria set forth in Executive Order 13132. The agency has determined that this proposal does not have sufficient federalism implications to warrant consultation and the preparation of a Federalism Assessment.

Civil Justice Reform

This proposed rule would not have any retroactive effect. Under 49 U.S.C. 30103, whenever a Federal motor vehicle safety standard is in effect, a State may not adopt or maintain a safety standard applicable to the same aspect of performance which is not identical to the Federal standard, except to the extent that the state requirement imposes a higher level of performance and applies only to vehicles procured for the State's use. 49 U.S.C. 30161 sets forth a procedure for judicial review of final rules establishing, amending, or revoking Federal motor vehicle safety standards. That section does not require submission of a petition for reconsideration or other administrative proceedings before parties may file suit in court.

Paperwork Reduction Act

Under the Paperwork Reduction Act of 1995, a person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid control number from the Office of Management and Budget (OMB). This proposed rule would not have any requirements that are considered to be information collection requirements as defined by the OMB in 5 CFR Part 1320.

National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law 104–113, section 12(d) (15 U.S.C. 272) directs NHTSA to use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.*, materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs NHTSA to provide Congress, through OMB, explanations when the agency decides not to use available and applicable voluntary consensus standards. NHTSA searched for but did not find voluntary consensus standards relevant to this proposed rule.

Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA), Pub. L. 104–4, Federal requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of more than $100 million annually (adjusted for inflation with base year of 1995). Before promulgating a NHTSA rule for which a written statement is needed, section 205 of the UMRA generally requires the agency to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule.

This proposed rule would not impose any unfunded mandates under the UMRA. This proposed rule would not meet the definition of a Federal mandate because it would not impose requirements on anyone. It would amend 49 CFR Part 572 by adding design and performance specifications for a side impact dummy that the agency may use in the Federal motor vehicle safety standards. If this proposed rule becomes final, it would affect only those businesses that choose to manufacture or test with the dummy. It would not result in costs of $100 million or more to either State, local, or tribal governments, in the aggregate, or to the private sector.

Plain Language

Executive Order 12866 requires each agency to write all rules in plain language. Application of the principles of plain language includes consideration of the following questions:

—Has the agency organized the material to suit the public's needs?
—Are the requirements in the rule clearly stated?
—Does the rule contain technical language or jargon that is not clear?
—Would a different format (grouping and order of sections, use of headings, paragraphing) make the rule easier to understand?
—Would more (but shorter) sections be better?
—Could the agency improve clarity by adding tables, lists, or diagrams?
—What else could the agency do to make this rulemaking easier to understand?

If you have any responses to these questions, please include them in your comments on this NPRM.

Regulation Identifier Number

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

Public Participation

How Do I Prepare and Submit Comments?

Your comments must be written and in English. To ensure that your comments are correctly filed in the Docket, please include the docket number of this document in your comments.

Your comments must not be more than 15 pages long. (49 CFR 553.21). NHTSA established this limit to encourage you to write your primary comments in a concise fashion. However, you may attach necessary additional documents to your comments. There is no limit on the length of the attachments.

Please submit two copies of your comments, including the attachments, to Docket Management at the address given above under **ADDRESSES.**

You may also submit your comments to the docket electronically by logging onto the Dockets Management System Web site at *http://dms.dot.gov.* Click on ''Help & Information'' or ''Help/Info'' to obtain instructions for filing the document electronically.

How Can I Be Sure That My Comments Were Received?

If you wish Docket Management to notify you upon its receipt of your comments, enclose a self-addressed, stamped postcard in the envelope containing your comments. Upon receiving your comments, Docket Management will return the postcard by mail.

How Do I Submit Confidential Business Information?

If you wish to submit any information under a claim of confidentiality, you should submit three copies of your complete submission, including the information you claim to be confidential business information, to the Chief Counsel, NHTSA, at the address given above under **FOR FURTHER INFORMATION CONTACT**. In addition, you should submit two copies, from which you have deleted the claimed confidential business information, to Docket Management at the address given above under **ADDRESSES**. When you send a comment containing information claimed to be confidential business information, you should include a cover letter setting forth the information specified in our confidential business information regulation. (49 CFR Part 512.)

Will the Agency Consider Late Comments?

NHTSA will consider all comments that Docket Management receives before the close of business on the comment closing date indicated above under DATES. To the extent possible, the agency will also consider comments that Docket Management receives after that date. If Docket Management receives a comment too late for the agency to consider it in developing a final rule (assuming that one is issued), the agency will consider that comment as an informal suggestion for future rulemaking action.

How Can I Read the Comments Submitted by Other People?

You may read the comments received by Docket Management at the address given above under **ADDRESSES**. The

hours of the Docket are indicated above in the same location.

You may also see the comments on the Internet. To read the comments on the Internet, take the following steps:

1. Go to the Docket Management System (DMS) Web page of the Department of Transportation (*http://dms.dot.gov/*).

2. On that page, click on ''search.''

3. On the next page (*http://dms.dot.gov/search/*), type in the four-digit docket number shown at the beginning of this document. Example: If the docket number were ''NHTSA–1998–1234,'' you would type ''1234.'' After typing the docket number, click on ''search.''

4. On the next page, which contains docket summary information for the docket you selected, click on the desired comments. You may download the comments. Although the comments are imaged documents, instead of word processing documents, the ''pdf'' versions of the documents are word searchable.

Please note that even after the comment closing date, NHTSA will continue to file relevant information in the Docket as it becomes available. Further, some people may submit late comments. Accordingly, the agency recommends that you periodically check the Docket for new material.

Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (Volume 65, Number 70; Pages 19477–78) or you may visit *http://dms.dot.gov.*

List of Subjects in 49 CFR Part 572

Motor vehicle safety, Incorporation by reference.

In consideration of the foregoing, NHTSA is proposing to amend 49 CFR Part 572 as follows:

PART 572—ANTHROPOMORPHIC TEST DUMMIES

1. The authority citation for Part 572 would continue to read as follows:

Authority: 49 U.S.C. 322, 30111, 30115, 30117 and 30166; delegation of authority at 49 CFR 1.50.

2. 49 CFR part 572 would be amended by adding and reserving a new subpart T.

3. 49 CFR part 572 would be amended by adding a new subpart U, consisting of §§ 572.180 through 572.189.

The added subparts would read as follows:

Subpart T—[Reserved]

Subpart U—ES-2re Side Impact Crash Test Dummy, 50th Percentile Adult Male

Sec.

Subpart U, ES-2re Side Impact Crash Test Dummy, 50th Percentile Adult Male

§ 572.180 Incorporated materials.

(a) The following materials are hereby incorporated into this Subpart by reference:

(1) A drawings and inspection package entitled ''Drawings and Specifications for the ES-2re Side Impact Test Dummy, 50th percentile, August 2004'', consisting of:

(i) Drawing No. 175–0000 ES-2re Dummy Assembly, incorporated by reference in § 572.xxx;

(ii) Drawing No. 175–1000 Head Assembly, incorporated by reference in § 572.182;

(iii) Drawing No. 175–2000, Neck Assembly, incorporated by reference in § 572.183;

(iv) Drawing No. 175–3000, Shoulder Assembly, incorporated by reference in § 572.184;

(v) Drawing No. 175–4000, Upper Torso Assembly, incorporated by reference in § 572.185;

(vi) Drawing No. 175–5000, Abdomen Assembly, incorporated by reference in § 572.186;

(vii) Drawing No. 175–5500 Lumbar Assembly, incorporated by reference in § 572.187;

(viii) Drawing No. 175–6000 Pelvis Assembly, incorporated by reference in § 572.188;

(ix) Drawing No. 175–7000–1, Complete Leg Assembly—left, incorporated by reference in § 572.181;

(x) Drawing No. 175–7000–2, Complete Leg Assembly—right, incorporated by reference in § 572.181;

(xi) Drawing No. 175–3500 Complete Arm Assembly—left, incorporated by reference in § 572.181; and

(xii) Drawing No. 175–3800 Complete Arm Assembly—right, incorporated by reference in § 572.181.

(2) A procedures manual entitled ''Procedures for Assembly, Disassembly and Inspection (PADI) of the ES-2re Side Impact Test Dummy, August 2004'', incorporated by reference in § 572.181;

(3) SAE Recommended Practice J211, Rev. Mar 95 ''Instrumentation for Impact Tests—Part 1—Electronic Instrumentation'';

(4) SAE J1733 of 1994–12 ''Sign Convention for Vehicle Crash Testing.''

(b) The Director of the Federal Register approved the materials incorporated by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of the materials may be inspected at NHTSA's Technical Reference Library, 400 Seventh Street S.W., Room 5109, Washington, DC, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call (202) 741–6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.*

(c) The incorporated materials are available as follows:

(1) The Drawings and Specifications for the ES–2re Side Impact Crash Test Dummy, 50th Percentile Adult Male, August xx, 2004,'' referred to in paragraph (a)(1) of this section are available in electronic format through the DOT docket management system and in paper format from Leet-Melbrook, Division of New RT, 18810 Woodfield Road, Gaithersburg, MD 20879, (301) 670–0090.

(2) The SAE materials referred to in paragraphs (a)(3) and (a)(4) of this section are available from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

§ 572.181 General Description.

(a) The ES-2re Side Impact Crash Test Dummy, 50th Percentile Adult Male, is defined by drawings and specifications containing the following materials:

(1) Technical drawings and specifications package P/N 175–0000, dated August 2004, the titles of which are listed in Table A;

TABLE A

Component assembly	Drawing No.
Head Assembly	175–1000
Neck Assembly	175–2000
Shoulder Assembly	175–3000
Upper Torso Assembly	175–4000
Abdomen	175–5000
Pelvis Assembly	175–6000
Lumbar Spine Assembly	175–5500
Complete Leg Assembly—left	175–7000–1
Complete Leg Assembly—right	175–7000–2
Complete Arm Assembly—left	175–3500
Complete Arm Assembly—right	175–3800

(2) The ES-2re Crash Test Dummy Parts List, dated August 2004, and containing 8 pages, incorporated by reference in § 572.180;

(3) A listing of available transducers-crash test sensors for the ES-2re Crash Test Dummy is shown in drawing 175–0000 sheet 4 of 4, dated August 2004, incorporated by reference in § 572.180;

(4) Procedures for Assembly, Disassembly and Inspection (PADI) of the ES-2re Side Impact Crash Test Dummy, August 2004, incorporated by reference in § 572.180,

(5) Sign convention for signal outputs reference document SAE 1733 Information Report, titled ''Sign Convention for Vehicle Crash Testing'' dated July 15, 1986.

(b) Exterior dimensions of ES-2re test dummy are shown in drawing 175–0000 sheet 3 of 4, dated August 2004.

(c) Weights and center of gravity locations of body segments (head, neck, upper and lower torso, arms and upper and lower segments) are shown in drawing 175–0000 sheet 2 of 4, dated August 2004.

(d) Adjacent segments are joined in a manner such that, except for contacts existing under static conditions, there is no additional contact between metallic elements of adjacent body segments throughout the range of motion.

(e) The structural properties of the dummy are such that the dummy conforms to this subpart in every respect before use in any test similar to those proposed in Standard 214, Side Impact Protection and Standard 201, Occupant Protection in Interior Impact.

§ 572.182 Head assembly.

(a) The head assembly consists of the head (drawing 175–1000), the neck upper transducer structural replacement (drawing 175–1010), and a set of three (3) accelerometers in conformance with specifications in § 572.189(b) and mounted as shown in drawing 175–0000 (sheet 4 of 4). When tested to the test procedure specified in paragraph (b) of this section, the head assembly shall meet performance requirements specified in paragraph (c) of this section.

(b) *Test procedure.* The head shall be tested per procedure specified in 49 CFR 572.112(a).

(c) *Performance criteria.* (1) When the head assembly is dropped in accordance with § 572.112(a), the measured peak resultant acceleration shall be between 125 g's and 155 g's;

(2) The resultant acceleration-time curve shall be unimodal to the extent that oscillations occurring after the main acceleration pulse shall not exceed 15% (zero to peak) of the main pulse;

(3) The fore-and-aft acceleration vector shall not exceed 15 g's.

§ 572.183 Neck assembly.

(a) The neck assembly consists of parts shown in drawing 175–2000. For purposes of this test, the neck is mounted within the headform assembly 175–9000 as shown in Figure U1 in Appendix A to this subpart. When subjected to test procedures specified in paragraph (b) of this section, the neck-headform assembly shall meet performance requirements specified in paragraph (c) of this section.

(b) *Test procedure.* (1) Soak the neck-headform-flexion transducer assembly in a test environment as specified in § 572.189(n);

(2) Attach the neck-headform assembly to the Part 572 subpart E pendulum test fixture as shown in Figure U2–A in Appendix A to this subpart, so that the midsagittal plane of the neck-headform assembly is vertical and perpendicular to the plane of motion of the pendulum longitudinal centerline shown in Figure U2–A;

(3) Release the pendulum from a height sufficient to allow it to fall freely to achieve an impact velocity of 3.4+/−0.1 m/s measured at the center of the pendulum accelerometer (Figure 15 of Part 572) at the time the pendulum makes contact with the decelerating mechanism;

(4) Allow the neck to flex without the neck-headform assembly making contact with any object;

(5) Time zero is defined in § 572.189(j);

(6) Allow a period of at least thirty (30) minutes between successive tests on the same neck assembly.

(c) *Performance criteria.* (1) The pendulum deceleration pulse is to be characterized in terms of decrease in velocity as determined by integrating the filtered pendulum acceleration response from time-zero. The velocity-time history of the pendulum falls inside the corridor determined by the upper and lower boundaries specified in Table A1;

TABLE A1.—ES–2re NECK CERTIFICATION PENDULUM VELOCITY CORRIDOR

Time (ms)	Velocity (m/s)
Upper boundary	
1.0	0.00
3.0	−0.25
14.0	−3.20
Lower boundary	
0.0	−0.05
2.5	−0.38
13.5	−3.7
17.0	−3.7

(2) The maximum translation-rotation in the lateral direction of the reference plane of the headform (175–9000) as shown in Figure U2–B in Appendix A to this suppart, shall be 52 to 57 degrees with respect to the longitudinal axis of the pendulum occurring between 54 and 64 ms from time zero. Translation-rotation of the headform-neck assembly and the neck angle with respect to the pendulum shall be measured with potentiometers specified in § 572.189(c), installed as shown in drawing 175–9000, and calculated per procedure specified in Figure U2–B;

(3) The decaying headform translation-rotation vs. time curve shall cross the zero angle with respect to its initial position at time of impact relative to the pendulum centerline between 55 ms to 75 ms after the time the peak translation-rotation value is reached.

§ 572.184 Shoulder assembly.

(a) The shoulder (175–3000) is part of the upper torso assembly shown in drawing 175–4000. When subjected to impact tests specified in paragraph (b) of this section, the shoulder assembly shall meet performance requirements of paragraph (c) of this section.

(b) *Test procedure.* (1) Soak the dummy assembly, without suit and shoulder foam cap (175–010), in a test environment as specified in § 572.189(n);

(2) The dummy is seated, as shown in Figure U3 in Appendix A to this subpart on a flat, horizontal, rigid surface covered by two overlaid teflon 2 mm thick sheets and with no back support of the dummy's torso. The dummy's torso spine backplate is vertical within +/−2 degrees and the midsagittal plane of thorax is positioned perpendicular to the direction of the plane of motion of the impactor at contact with the shoulder. The arms are oriented forward at 40+/−2 degrees to the vertical, pointing downward. The dummy's legs are horizontal and symmetrical about the midsagittal plane with the distance between the innermost point on the opposite ankle at 100 +/−5 mm;

(3) The impactor is the same as defined in § th 572.189(a);

(4) The impactor is guided, if needed, so that at contact with the shoulder, its longitudinal axis is within +/−0.5 degrees of a horizontal plane and perpendicular (+/−0.5 degrees) to the midsagittal plane of the dummy and the centerpoint on the impactor's face is within 5 mm of the center of the upper arm pivot bolt (5000040) at contact with the test dummy, as shown in Figure U3;

(5) The impactor impacts the dummy's shoulder at 4.3+/−0.1 m/s.

(c) *Performance criteria.* The peak acceleration of the impactor is between 7.5 g's and 10.5 g's during the pendulum's contact with the dummy.

§ 572.185 Thorax (upper torso) assembly.

(a) For purposes of this test, the rib modules (175–4002), which are part of the thorax assembly (175–4000), are tested as individual units. When subjected to test procedures specified in paragraph (b) of this section, the rib modules shall meet performance requirements specified in paragraph (c) of this section. Each rib is tested to both the 3.0 m/s and the 4.0 m/s tests described in paragraphs (b)(5)(i) and (ii) of this section.

(b) *Test procedure.* (1) Soak the rib modules (175–4002) in a test environment as specified in § 572.189(n);

(2) Mount the rib module rigidly in a drop test fixture as shown in Figure U6 in Appendix A to this subpart with the impacted side of the rib facing up;

(3) The drop test fixture contains a free fall guided mass of 7.78+/−0.01 kg that is of rigid construction and with a flat impact face 150+/−1.0 mm in diameter;

(4) Align the vertical longitudinal centerline of the drop mass so that the centerpoint of the downward-facing flat surface is aligned to impact the centerline of the rib rail guide system within ± 2.5 mm.

(5) The impacting mass is dropped from a height to impact the rib at:

(i) 3.0 ± 0.1 m/s and

(ii) 4.0 ± 0.1 m/s.

(c) *Performance criteria.* (1) Each of the rib modules shall deflect as specified in paragraphs (c)(1)(i) and (ii) of this section, with the deflection measurements made with the internal rib module position transducer specified in § 572.189(d):

(i) Not less than 36 mm and not more than 40 mm when impacted by the dropped mass at 3 m/s; and

(ii) Not less than 46 mm and not more than 51 mm when impacted by the dropped mass at 4 m/s.

(2) [Reserved]

§ 572.186 Abdomen assembly.

(a) The abdomen assembly (175–5000) is part of the dummy assembly shown in drawing 175–0000 including load sensors specified in § 572.189(e). When subjected to tests procedures specified in paragraph (b) of this section, the abdomen assembly shall meet performance requirements specified in paragraph (c) of this section.

(b) *Test procedure.* (1) Soak the dummy assembly (175–0000), without suit, as specified in § 572.189(n);

(2) The dummy is seated as shown in Figure U4 in Appendix A to this subpart;

(3) The abdomen impactor is the same as specified in § 572.189(a) except that on its impact surface is affixed a special purpose rigid block whose weight is 1.0 ± 0.01 kg. The block is 70 mm high, 150 mm wide and 60 to 80 mm deep. The impact surface is flat with an edge radius of 4 to 5 mm. The block's wide surface is horizontally oriented and centered on the longitudinal axis of the probe's impact face as shown in Figure U4–A in Appendix A to this subpart;

(4) The impactor is guided, if needed, so that at contact with the abdomen its longitudinal axis is within ± 0.5 degrees of a horizontal plane and perpendicular ± 0.5 degrees to the midsagittal plane of the dummy and the centerpoint on the impactor's face is within 5 mm of the center point of the middle load measuring sensor in the abdomen as shown in Figure U4;

(5) The impactor impacts the dummy's abdomen at 4.0 m/s ± 0.1 m/s.

(c) *Performance criteria.* (1) The sum of the forces of the three abdominal load sensors, specified in § 572.189(e), shall be not less than 2200 N and not more than 2700 N at any time between 10 ms and 12.3 ms from time zero as defined in § 572.189(k). The calculated sum of the three load cell forces must be concurrent in time.

(2) Maximum impactor force (impact probe acceleration multiplied by its mass) is not less than 4000 N and not more than 4800 N occurring between 10.6 ms and 13.0 ms from time zero.

§ 572.187 Lumbar spine.

(a) The lumbar spine assembly consists of parts shown in drawing 175–5500. For purposes of this test, the lumbar spine is mounted within the headform assembly 175–9000 as shown in Figure U1 in Appendix A to this subpart. When subjected to tests procedures specified in paragraph (b) of this section, the lumbar spine-headform assembly shall meet performance requirements specified in paragraph (c) of this section.

(b) *Test procedure.* (1) Soak the lumbar spine-headform assembly in a test environment as specified in § 572.189(n);

(2) Attach the lumbar spine-headform assembly to the Part 572 pendulum test fixture per procedure in § 572.183(b)(2) and as shown in Figure U2–A in Appendix A to this subpart;

(3) Release the pendulum from a height sufficient to allow it to fall freely to achieve an impact velocity of 6.05 +/−0.1 m/s measured at the center of the pendulum accelerometer (Figure 15 of Part 572) at the time the pendulum makes contact with its decelerating mechanism;

(4) Allow the lumbar spine to flex without the lumbar spine or the headform making contact with any object;

(5) Time zero is defined in § 572.189(j);

(6) Allow a period of at least thirty (30) minutes between successive tests on the same lumbar spine assembly.

(c) *Performance criteria.* (1) The pendulum deceleration pulse is to be characterized in terms of decrease in velocity as determined by integrating

the filtered pendulum acceleration response from time-zero. The velocity-time history of the pendulum falls inside the corridor determined by the upper and lower boundaries specified in Table B1.

TABLE B1.—ES–2re LUMBAR SPINE CERTIFICATION PENDULUM VELOCITY CORRIDOR

Time (ms)	Velocity (m/s)
Upper boundary	
1.0	0.00
3.7	−0.24
27.0	−5.80
Lower boundary	
0.0	−0.05
2.7	−0.43
24.5	−6.50
30.0	−6.50

(2) The maximum translation-rotation in the lateral direction of the reference plane of the headform (175–9000) as shown in Figure U2–B in Appendix A to this subpart, shall be 45 to 55 degrees with respect to the longitudinal axis of the pendulum occurring between 39 and 53 ms from time zero. Translation-rotation of the headform-neck assembly shall be measured with potentiometers specified in § 572.189(c), installed as shown in drawing 175–9000, and calculated per procedure specified in Figure U2–B.

(3) The decaying headform translation-rotation vs. time curve shall cross the zero angle with respect to its initial position at impact relative to the pendulum centerline between 40 ms to 65 ms after the time the peak translation-rotation value is reached.

§ 572.188 Pelvis.

(a) The pelvis (175–6000) is part of the torso assembly shown in drawing 175–0000. The pelvis is equipped with a set of three (3) accelerometers and a pubic symphysis load sensor in conformance with specifications in § 572.189(b) and § 572.189(f) respectively and mounted as shown in drawing (175–0000 sheet 4). When subjected to tests procedures specified in paragraph (b) of this section, the pelvis assembly shall meet performance requirements specified in paragraph (c) of this section.

(b) *Test procedure.* (1) Soak the dummy assembly (175–0000) without suit as specified in § 572.189(n);

(2) The dummy is seated as specified in Figure U5 in Appendix A to this subpart;

(3) The pelvis impactor is the same as specified in § 572.189(a);

(4) The impactor is guided, if needed, so that at contact with the pelvis its longitudinal axis is within ± 0.5 degrees of a horizontal plane and perpendicular to the midsagittal plane of the dummy and the centerpoint on the impactor's face is within 5 mm of the center of the H-point in the pelvis, as shown in Figure U5;

(5) The impactor impacts the dummy's pelvis at 4.3 +/− 0.1 m/s.

(c) *Performance criteria.* (1) The impactor force (probe acceleration multiplied by its mass) shall be not less than 4,800 N and not more than 5,500 N, occurring between 10.3 ms and 15.5 ms from time zero as defined in § 572.189(k);

(2) The pubic symphysis load, measured with load cell specified in § 572.189(f) shall be not less than 1,310 N and not more than 1,490 N occurring between 9.9 ms and 15.9 ms from time zero as defined in § 572.189(k).

§ 572.189 Instrumentation and test conditions.

(a) The test probe for lateral shoulder, abdomen, and pelvis impact tests is the same as that specified in § 572.36(a) and the impact probe has a minimum mass moment of inertia in yaw of 9,000 kg-cm^2, a free air resonant frequency not less than 1,000 Hz and the probe's end opposite to the impact face has provisions to mount an accelerometer with its sensitive axis collinear with the longitudinal axis of the probe.

(b) Accelerometers for the head, the thoracic spine, and the pelvis conform to specifications of SA572–S4.

(c) Rotary potentiometer for the neck and lumbar spin conforms to SA572–53.

(d) Linear position transducer for the thoracic rib conforms to SA572–S54.

(e) Load sensors for the abdomen conform to specifications of SA572–S75.

(f) Load sensor for the pubic symphysis conforms to specifications of SA572–77.

(g) Load sensor for the lumbar spine conforms to specifications of SA572–76.

(h) Instrumentation and sensors conform to the Recommended Practice SAE J–211 (Mar, 1995)—Instrumentation for Impact Test unless noted otherwise.

(i) All instrumented response signal measurements shall be treated to the following specifications:

(1) Head acceleration—Digitally filtered CFC 1000;

(2) Neck and lumbar spine translation-rotations—Digitally filtered CFC 180;

(3)—Neck and lumbar spine pendulum accelerations—Digitally filtered CFC 60;

(4) Pelvis, shoulder and abdomen impactor accelerations—Digitally filtered CFC—180;

(5) Abdominal and pubic symphysis force—Digitally filtered at CFC 600;

(6) Thorax deflection-Digitally filtered CFC 180.

(j)(1) Filter the pendulum acceleration data using a SAE J211 CFC 60 filter.

(2) Determine the time when the filtered pendulum accelerometer data first crosses the − 10 g level (T_{10}).

(3) Calculate time-zero:

$T0 = T_{10} - T_{m.}$,

Where:

T_m = 1.417 ms for the Neck Test

= 1.588 ms for the Lumbar Spine Test

(4) Set the data time-zero to the sample number nearest to the calculated T0.

(k)(1) Filter the pendulum acceleration data using a SAE J211 CFC 60 filter.

(2) Determine the time when the filtered pendulum accelerometer data first crosses the − 1.0 m/s^2 (− .102 g) acceleration level (T0).

(3) Set the data time-zero to the sample number of the new T0.

(l) Mountings for the head, spine and pelvis accelerometers shall have no resonance frequency within a range of 3 times the frequency range of the applicable channel class.

(m) Limb joints of the test dummy are set at the force between 1 to 2 G's, which just supports the limb's weight when the limbs are extended horizontally forward. The force required to move a limb segment does not exceed 2 G's throughout the range of the limb motion.

(n) Performance tests are conducted, unless specified otherwise, at any temperature from 20.6 to 22.2 degrees C. (69 to 72 degrees F.) and at any relative humidity from 10 percent to 70 percent after exposure of the dummy to those conditions for a period of not less than 4 hours.

BILLING CODE 4910–59–P

Appendix A to Subpart U of Part 572—Figures

Figure U1

NECK/LUMBAR SPINE ATTACHED TO HEADFORM

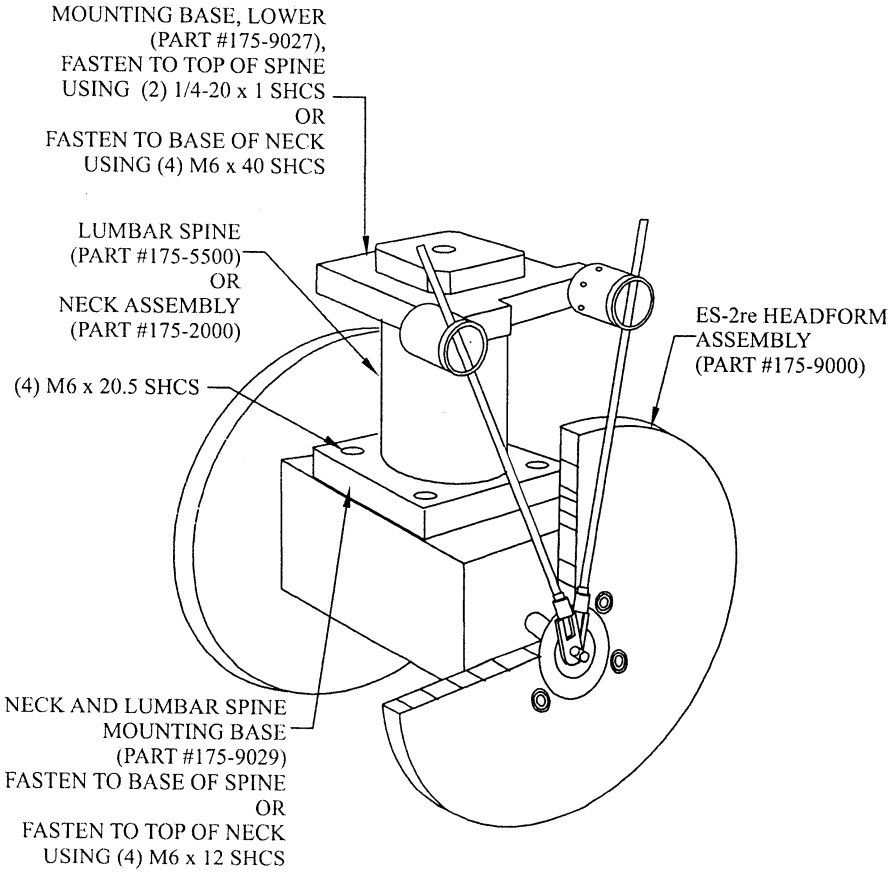


Figure U2-A

NECK/LUMBAR SPINE/HEADFORM ATTACHED TO PENDULUM

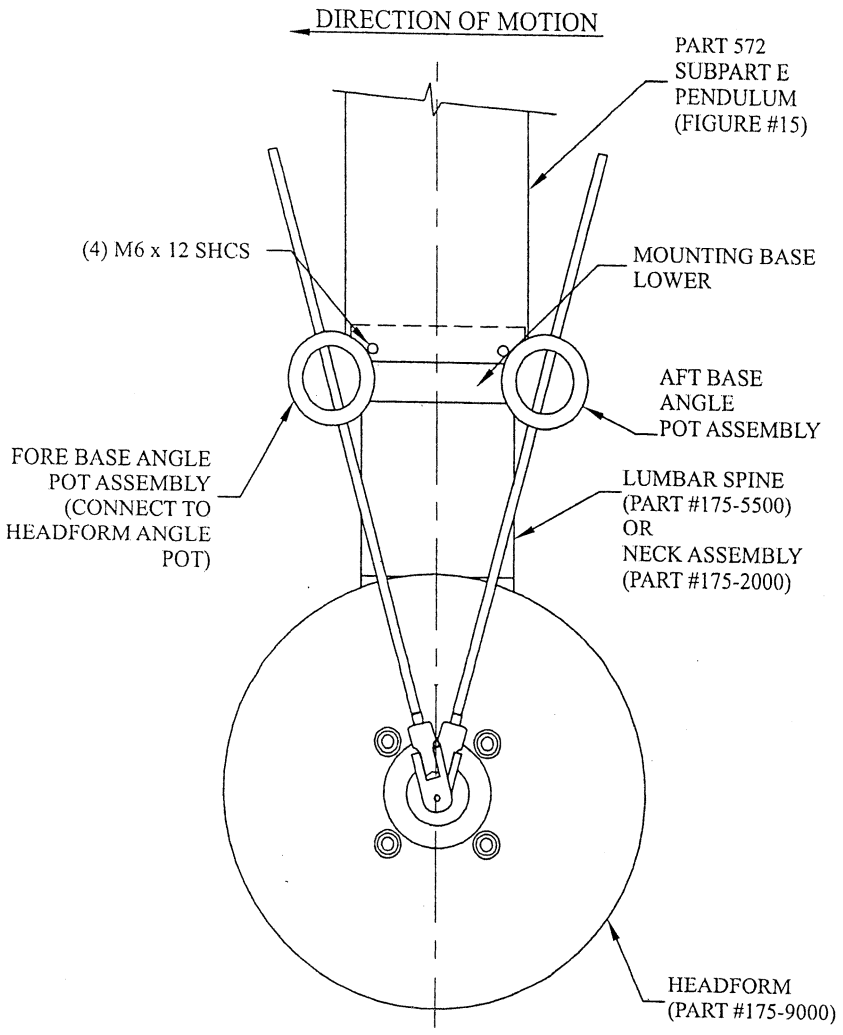


Figure U2-B

ANGLE MEASUREMENTS WITH HEADFORM SET-UP

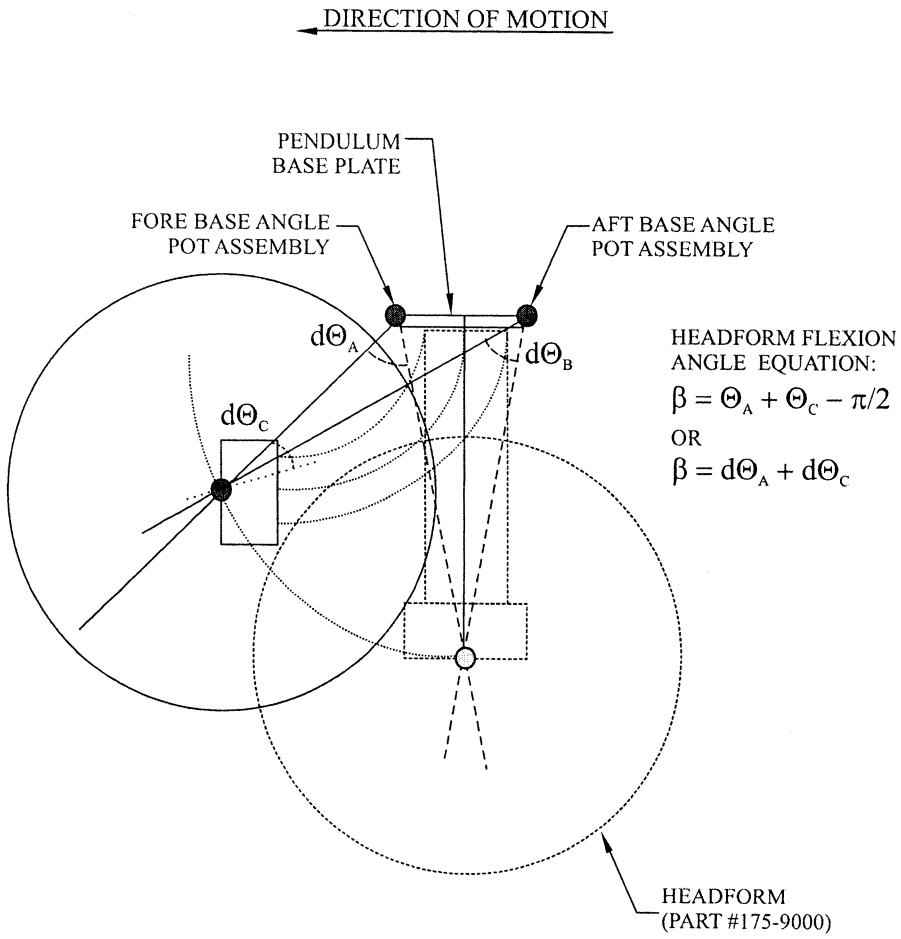


Figure U3
SHOULDER IMPACT

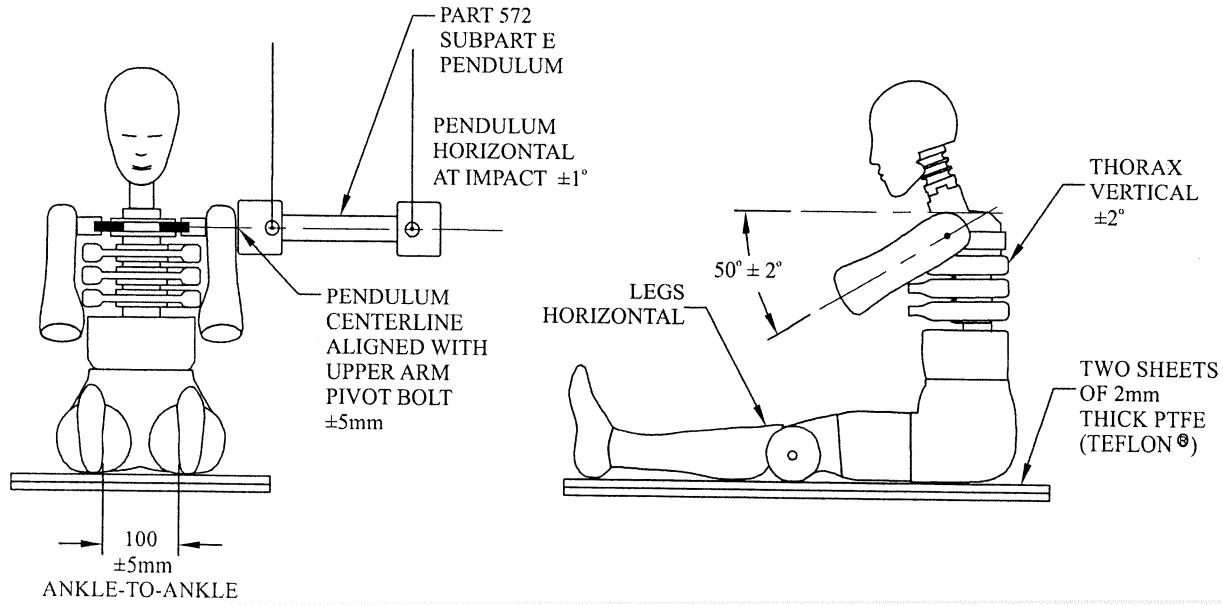


Figure U4
ABDOMEN IMPACT

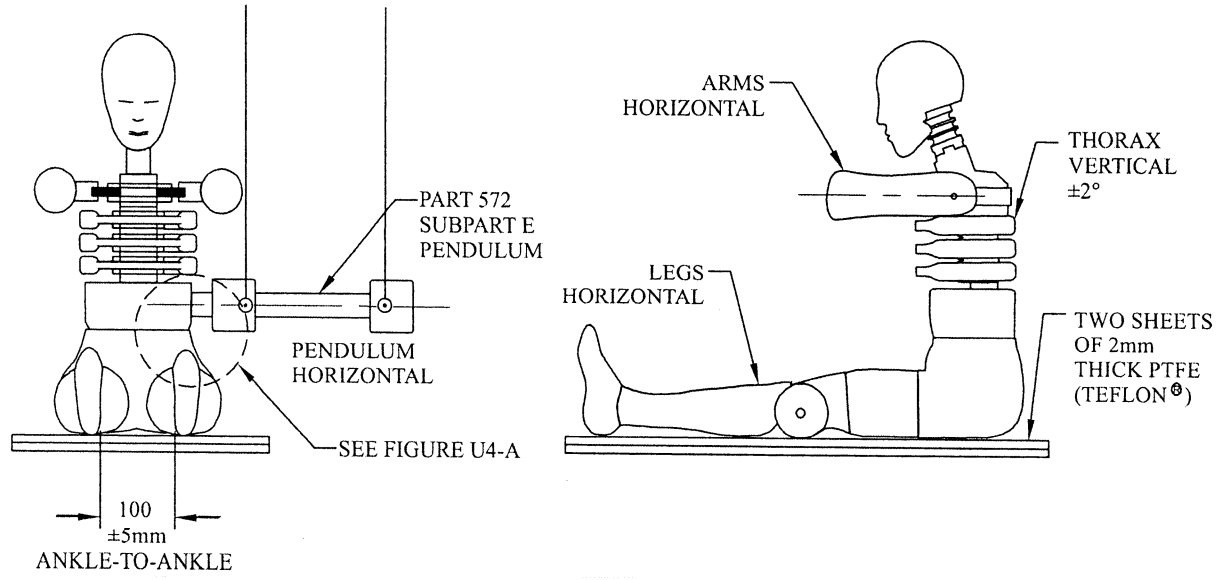
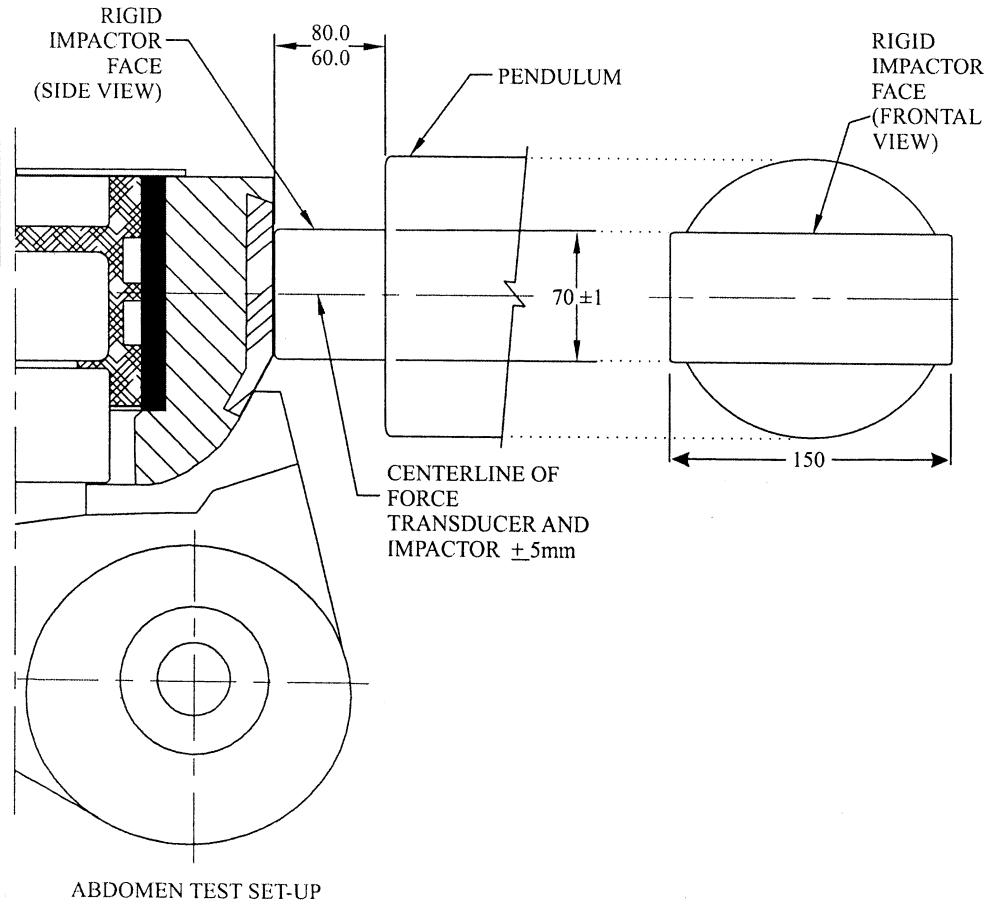


Figure U4-A

ABDOMEN IMPACT - VIEW A



ABDOMEN TEST SET-UP

Figure U5
PELVIS IMPACT

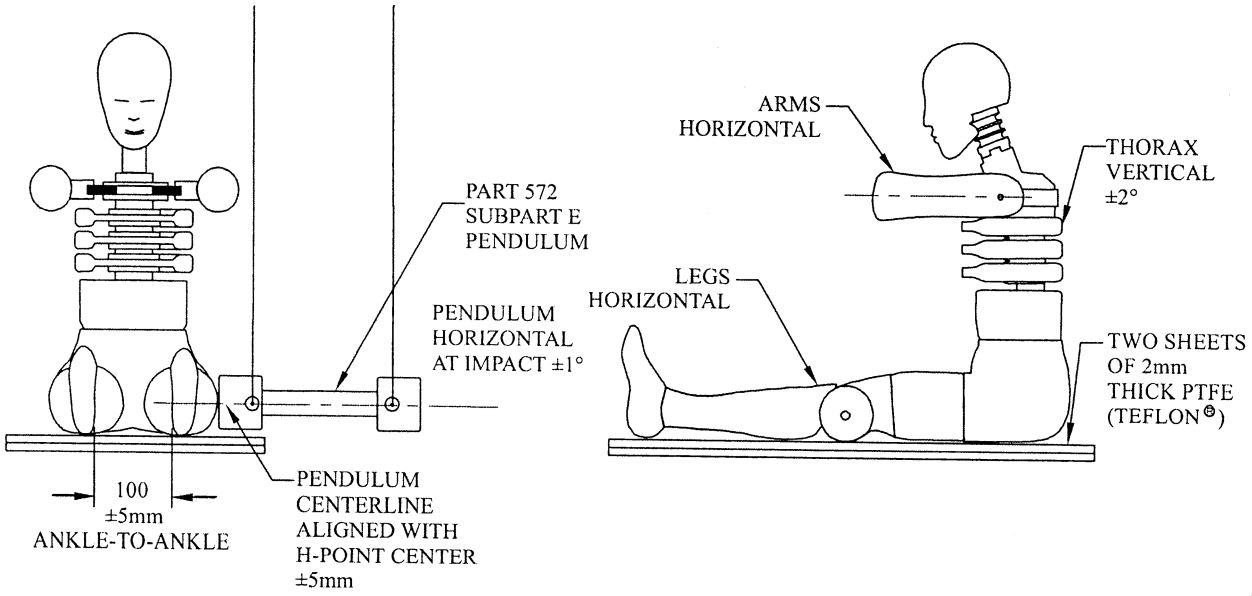
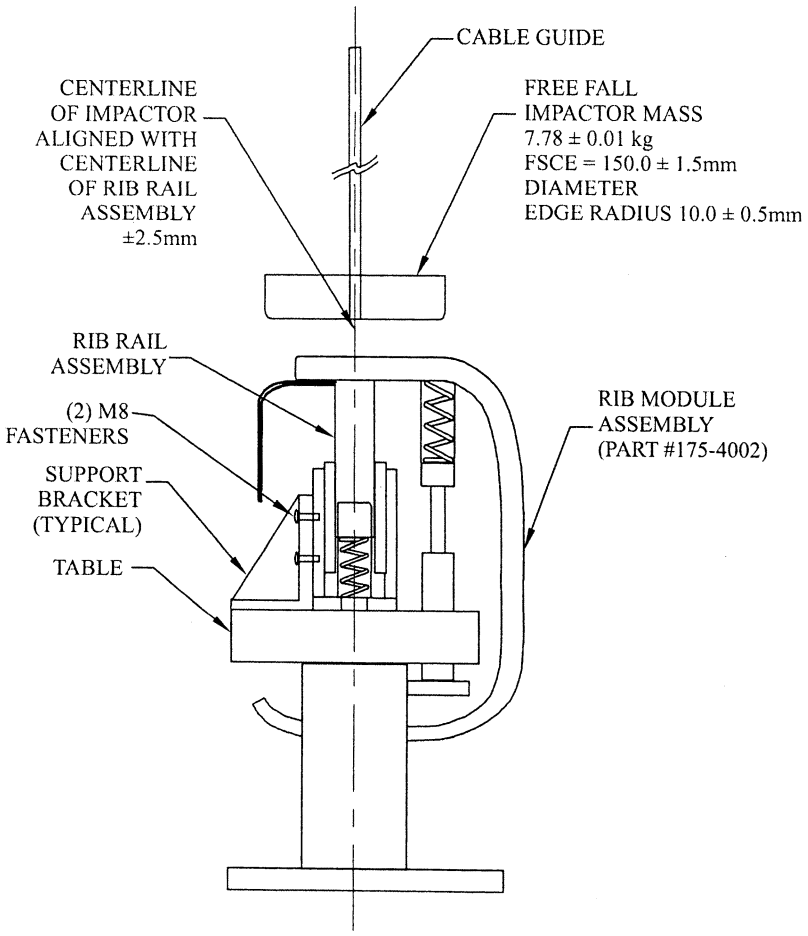


Figure U6
RIB DROP TEST



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