§ 572.177 Test conditions and instrumentation.

(a) The following test equipment and instrumentation is needed for qualification as set forth in this subpart:

(1) The test probe for thoracic impacts is of rigid metallic construction, concentric in shape, and symmetric about its longitudinal axis. It has a mass of 6.89 ± 0.012 kg (15.2 ± 0.05 lb) and a minimum mass moment of inertia of 2040 kg-cm\(^2\) (1.81 lbf-in-sec\(^2\)) in yaw and pitch about the CG. One-third (\(\frac{1}{3}\)) of the weight of the suspension cables and their attachments to the impact probe may be included in the calculation of mass, and such components may not exceed five percent of the total weight of the test probe. The impacting end of the probe, perpendicular to and concentric with the longitudinal axis, is at least 25.4 mm (1.0 in) long, and has a flat, continuous, and non-deformable 0.25 mm (4.76 ± 0.01 in) diameter face with a maximum edge radius of 12.7 mm (0.5 in). The probe’s end opposite to the impact face has provisions for mounting an accelerometer with its sensitive axis collinear with the longitudinal axis of the probe. No concentric portions of the impact probe may exceed the diameter of the impact face. The impact probe has a free air resonant frequency of not less than 1000 Hz, which may be determined using the procedure listed in the PADI (incorporated by reference, see §572.170).

(2) The test probe for knee impacts is of rigid metallic construction, concentric in shape, and symmetric about its longitudinal axis. It has a mass of 1.91 ± 0.01 kg (4.21 ± 0.02 lb) and a minimum mass moment of inertia of 140 kg-cm\(^2\) (0.124 lbf-in-sec\(^2\)) in yaw and pitch about the CG. One third (\(\frac{1}{3}\)) of the weight of the suspension cables and their attachments to the impact probe may be included in the calculation of mass, and such components may not exceed five percent of the total weight of the test probe. The impacting end of the probe, perpendicular to and concentric with the longitudinal axis, is at least 12.5 mm (0.5 in) long, and has a flat, continuous, and non-deformable 76.2 ± 0.2 mm (3.00 ± 0.01 in) diameter face with a maximum edge radius of 12.7 mm (0.5 in). The probe’s end opposite to the impact face has provisions for mounting an accelerometer with its sensitive axis collinear with the longitudinal axis of the probe. No concentric portions of the impact probe may exceed the diameter of the impact face. The impact probe has a free air resonant frequency of not less than 1000 Hz, which may be determined using the procedure listed in the PADI (incorporated by reference, see §572.170).

(3) Head accelerometers have dimensions, response characteristics, and sensitive mass locations specified in drawing SA572–S4 (included in drawing 420–0000) and are mounted in the head as shown in drawing 420–0000 (both incorporated by reference, see §572.170), sheet 2 of 6.

(4) The upper neck force and moment transducer has the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S11 (included in drawing 420–0000) and are mounted in the head as shown in drawing 420–0000 (both incorporated by reference, see §572.170), sheet 2 of 6.

(b) The force shall be calculated by the product of the impactor mass and its deceleration.

(c) Test Procedure. The test procedure for the knee assembly is as follows:

(1) Soak the knee assembly in a controlled environment at any temperature between 20.6 and 22.2 °C (69 and 72 °F) and a relative humidity between 10 and 70 percent for at least four hours prior to a test.

(2) Mount the test material and secure it to a rigid test fixture as shown in Figure T6. No part of the foot or tibia may contact any exterior surface.

(3) Align the test probe so that throughout its stroke and at contact with the knee it is within 2 degrees of horizontal and collinear with the longitudinal centerline of the femur.

(4) Guide the pendulum so that there is no significant lateral, vertical, or rotational movement at the time of initial contact between the impactor and the knee.

(5) The test probe velocity at the time of contact shall be 2.1 ± 0.03 m/s (6.9 ± 0.1 ft/s).

(6) No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, shall make contact with the dummy during the test.
0000) and is mounted in the head-neck assembly as shown in drawing 420–0000 (both incorporated by reference, see §572.170), sheet 2 of 6.

(5) The chest deflection transducer has the dimensions and response characteristics specified in drawing SA572–S50 (included in drawing 420–0000) and is mounted to the upper torso assembly as shown in drawing 420–0000 (both incorporated by reference, see §572.170), sheet 2 of 6.

(b) The following instrumentation may be required for installation in the dummy for compliance testing. If so, it is installed during qualification procedures as described in this subpart:

(1) The thorax CG accelerometers have the dimensions, response characteristics, and sensitive mass locations specified in drawing SA572–S4 (included in drawing 420–0000) (incorporated by reference, see §572.170) and are mounted in the torso assembly in a triaxial configuration within the spine box instrumentation cavity.

(2) The lower neck force and moment transducer has the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S40 (included in drawing 420–0000) and is mounted to the neck assembly by replacing the lower neck mounting bracket 420–2070 as shown in drawing 420–2000 (all incorporated by reference, see §572.170).

(3) The clavicle force transducers have the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S41 (included in drawing 420–0000) and are mounted in the shoulder assembly as shown in drawing 420–3800 (both incorporated by reference, see §572.170).

(4) The IR-Trac chest deflection transducers have the dimensions and response characteristics specified in drawing SA572–S43 (included in drawing 420–0000) and are mounted to the spine box assembly as shown in drawing 420–8000 (both incorporated by reference, see §572.170).

(5) The spine and sternum accelerometers have the dimensions, response characteristics, and sensitive mass locations specified in drawing SA572–S4 (included in drawing 420–0000) and are mounted in the torso assembly in uniaxial fore-and-aft oriented configuration arranged as corresponding pairs in two locations each on the sternum and at the spine box of the upper torso assembly as shown in drawing 420–0000 (both incorporated by reference, see §572.170), sheet 2 of 6.

(6) The lumbar spine force-moment transducer has the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S12 (included in drawing 420–0000) and is mounted in the lower torso assembly as shown in drawing 420–4000 (both incorporated by reference, see §572.170).

(7) The iliac force transducers have the dimensions and response characteristics specified in drawing SA572–S13 L and R (included in drawing 420–0000) and are mounted in the lower torso assembly as shown in drawing 420–0000 (both incorporated by reference, see §572.170).

(8) The pelvis accelerometers have the dimensions, response characteristics, and sensitive mass locations specified in drawing SA572–S4 (included in drawing 420–0000) and are mounted in the torso assembly in triaxial configuration in the pelvis bone as shown in drawing 420–0000 (both incorporated by reference, see §572.170).

(9) The femur force and moment transducers (SA572–S10, included in drawing 420–0000) have the dimensions, response characteristics, and sensitive axis locations specified in the appropriate drawing and are mounted in the upper leg assembly, replacing the femur load cell simulator (drawing 420–5121) as shown in drawing 420–5100 (all incorporated by reference, see §572.170).

(10) The tilt sensors have the dimensions and response characteristics specified in drawing SA572–S42 (included in drawing 420–0000) and are mounted to the head, thorax, and pelvis assemblies as shown in drawing 420–0000 (both incorporated by reference, see §572.170), sheet 2 of 6.

(c) The outputs of transducers installed in the dummy and in the test equipment specified by this part are to be recorded in individual data channels that conform to SAE Recommended Practice J211 (incorporated by reference, see §572.170) except as noted, with channel frequency classes as follows:
(1) Pendulum acceleration, CFC 180,
(2) Pendulum D-plane rotation (if transducer is used), CFC 60,
(3) Torso flexion pulling force (if transducer is used), CFC 60,
(4) Head acceleration, CFC 1000,
(5) Neck forces, upper and lower, CFC 1000,
(6) Neck moments, upper and lower, CFC 600,
(7) Thorax CG acceleration, CFC 180,
(8) Sternum deflection, Class 600,
(9) Sternum and rib accelerations, Class 1000,
(10) Spine accelerations, CFC 180,
(11) Lumbar forces, CFC 1000,
(12) Lumbar moments, CFC 600,
(13) Shoulder forces, CFC 180,
(14) Pelvis accelerations, CFC 1000,
(15) Iliac forces, CFC 180,
(16) Femur and tibia forces, CFC 600,
(17) Femur and tibia moments, CFC 600.
(d) Coordinate signs for instrumentation polarity are to conform to SAE Information Report J1733 (incorporated by reference, see §572.170).
(e) The mountings for sensing devices have no resonant frequency less than 3 times the frequency range of the applicable channel class.
(f) Limb joints are set at one G, barely restraining the weight of the limb when it is extended horizontally. The force needed to move a limb segment is not to exceed 2G throughout the range of limb motion.
(g) Performance tests of the same component, segment, assembly, or fully assembled dummy are separated in time by not less than 30 minutes unless otherwise noted.
(h) Surfaces of dummy components may not be painted except as specified in this subpart or in drawings submitted by this subpart.