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U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

CALIBRATION TEST PROCEDURE

for

Part 572 Subpart W

Q3s Three-Year-Old Child Test Dummy

ENFORCEMENT
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1. PURPOSE AND APPLICATION

The purpose of this laboratory procedure is to provide dummy users (independent testing laboratories under contract with the Office of Vehicle Safety Compliance (OVSC)) with standard test procedures for performing receiving-inspection and performance calibration tests on the Part 572, Subpart W dummy so that repetitive and correlative test results can be obtained. The following tests have been developed to establish a uniform calibration procedure for all users as the means of verifying the performance of the dummy.

A. EXTERNAL DIMENSIONS (PADI)

B. FRONTAL HEAD DROP TEST (572.212(b)(1))

C. LATERAL HEAD DROP TEST (572.212(b)(2))

D. FORE-AFT NECK FLEXION TEST (572.213(b)(1))

E. LATERAL NECK FLEXION TEST (572.213(b)(2))

F. NECK TORSION TEST (572.213(b)(3))

G. SHOULDER IMPACT TEST (572.214(b))

H. THORAX WITH ARM IMPACT TEST (572.215(b))

I. THORAX WITHOUT ARM IMPACT TEST (572.216(b))

J. FORE-AFT LUMBAR FLEXION TEST (572.217(b)(1))

K. LATERAL LUMBAR FLEXSION TEST (572.217(b)(2))

L. PELVIS IMPACT TEST (572.218(b))

National Highway Traffic Safety Administration (NHTSA) contract laboratories performing FMVSS 213a testing for the Office of Vehicle Safety Compliance (OVSC) must use this laboratory procedure for the calibration of Part 572, Subpart W dummies.

2. GENERAL REQUIREMENTS

Each Part 572, Subpart W dummy used in a compliance test must meet the specifications and performance criteria of Part 572 before each test in order to be an acceptable compliance test tool. The COR will determine when post-test calibrations are necessary.

The Part 572, Subpart W, Q3s, 3-Year-Old Child Dummy consists of components and assemblies specified in the drawing and specifications package which is available from www.regulations.gov under Docket ID No. NHTSA-2020-0088.

The Q3s 3-year-old Child Test Dummy (Q3s) is defined by drawings and specifications containing the following materials:

(1) The engineering drawings and specifications contained in “Parts/Drawing List, Part 572 Subpart W, Q3s Three-Year-Old Child Side Impact Dummy, September 2021” (incorporated by reference, see §572.210), and in “Drawing and Specifications for Q3S Three-Year-Old Child Side Impact Dummy, Part 572 Subpart W, January 2021.”

(2) A manual entitled “Procedures for Assembly, Disassembly and Inspection (PADI) of the Q3s Child Side Impact Crash Test Dummy, January 2021.”

TABLE 1. DRAWING PACKAGE INDEX

Component Assembly		Drawing No.
(i)	Head Assembly	020-1200
(ii)	Neck Assembly	020-2400
(iii)	Calibration Head Form	020-9050
(iv)	Neck Twist Test Fixture Assembly	DL21-200
(v)	Upper Torso Assembly	020-4500
(vi)	Lower Torso Assembly	020-4000
(vii)	Pelvis Assembly	020-7500
(viii)	Left Leg Assembly	020-9500
(ix)	Right Leg Assembly	020-9600
(x)	Left Arm Assembly	020-9700
(xi)	Right Arm Assembly	020-9800
(xii)	Suit	020-8001

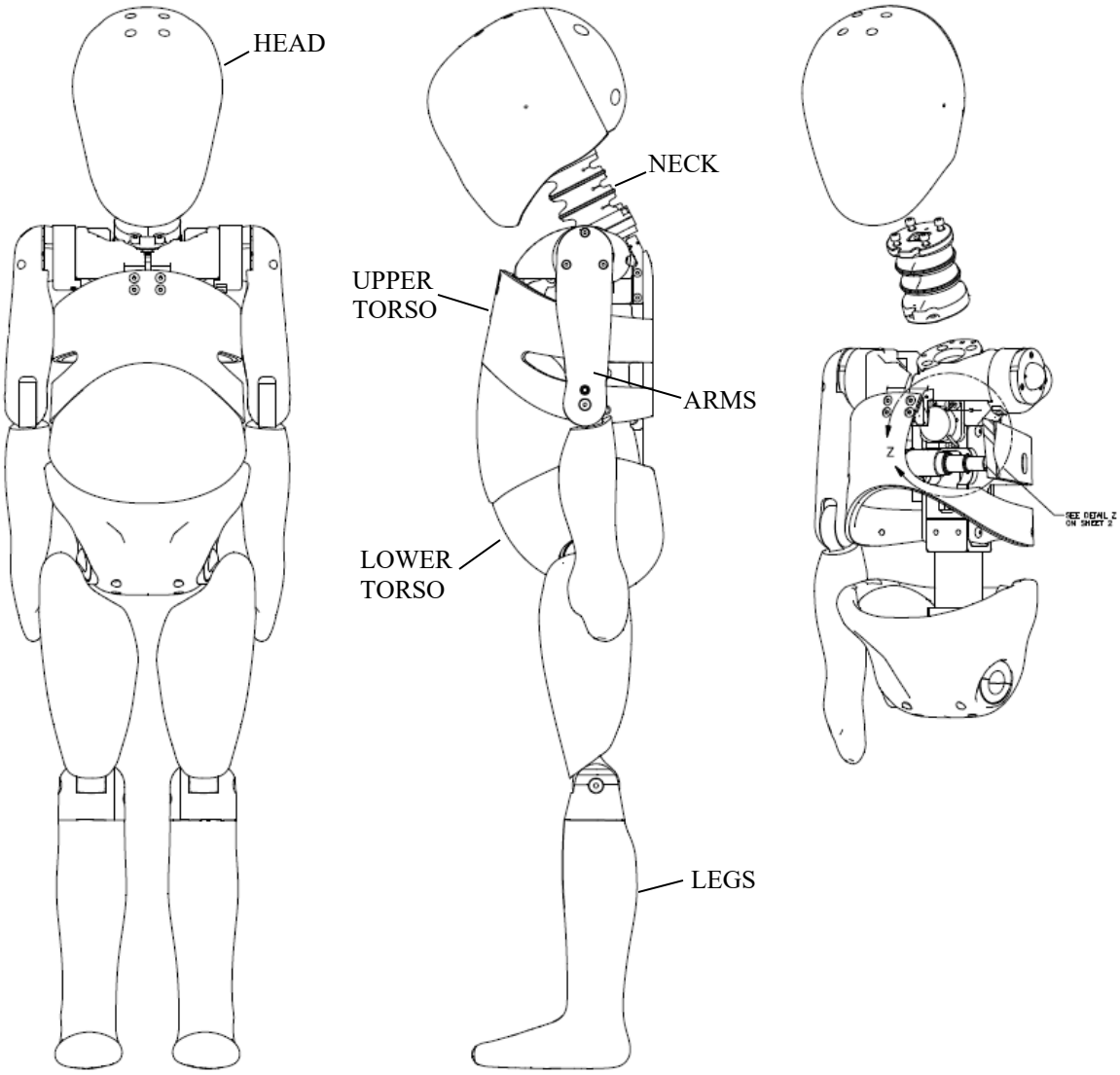


FIGURE 1. ASSEMBLY GROUPS FOR THE Q3s (020-0100)

3. SECURITY

All NHTSA Part 572, Subpart W test dummies delivered to the contract laboratory as Government Furnished Property (GFP) will be stored in a safe and secure area such as the dummy calibration laboratory. Any security problems shall be reported by telephone to the Industrial Property Manager (IPM), Office of Contracts and Procurement, within two working days after the incident. A letter containing specific details of the security problem will be sent to the IPM (with copy to the COR) within 48 hours.

The contractor is responsible for maintaining the NHTSA test dummies in good working order and shall protect and segregate the data that evolves from

conducting Part 572, Subpart W dummy. Ensure that all calibration data is traceable to each corresponding compliance test.

No information concerning the Part 572, Subpart W dummy calibration data shall be released to anyone except the COR, unless specifically authorized by the COR or the COR's Division Chief or Office Director.

NOTE: No individuals, other than contractor personnel directly involved in the dummy calibration test program, shall be allowed to witness dummy calibration tests unless specifically authorized by the COR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the entire equipment compliance testing area, test fixtures and instrumentation in a neat, clean, and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The Part 572, Subpart W dummies are being calibrated as test tools to be used in federal motor vehicle safety standards testing to evaluate potential non-compliance. The schedule for these performance calibration tests must be correlated with that of the compliance test schedule. All testing shall be coordinated to allow monitoring by the COR.

6. TEST DATA DISPOSITION

The contractor shall make all dummy calibration data available to the COR for review and analysis as required.

All backup data sheets, plots, recordings, technician’s notes, etc. shall be either sent to the COR or retained by the contractor for a minimum of 3 years after the conclusion of each delivery order, purchase order, etc. The COR shall direct final disposition at that time.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

Part 572, Subpart W test dummies will be furnished to the contract laboratory by the OVSC. The dummies shall be stored in a chair or similar device which supports the thorax without putting tension on the neck. In the example chair design shown in Figure 2 through Figure 4, the thorax is supported on either side by rails which splay outwards. A seat belt with buckle keeps the dummy from falling forward. To prevent buttocks deformation, the seat is cushioned with foam padding so that the dummy is not directly seated on a hard surface. These dummies shall be stored in a secured room that is kept between 55ºF and 85ºF

and relative humidity between 10% and 70%. The contractor will check dummy components for damage after each test and complete a dummy damage checklist that will be included with the posttest dummy calibration. The COR will be kept informed of the dummies condition in order that replacement parts can be provided.

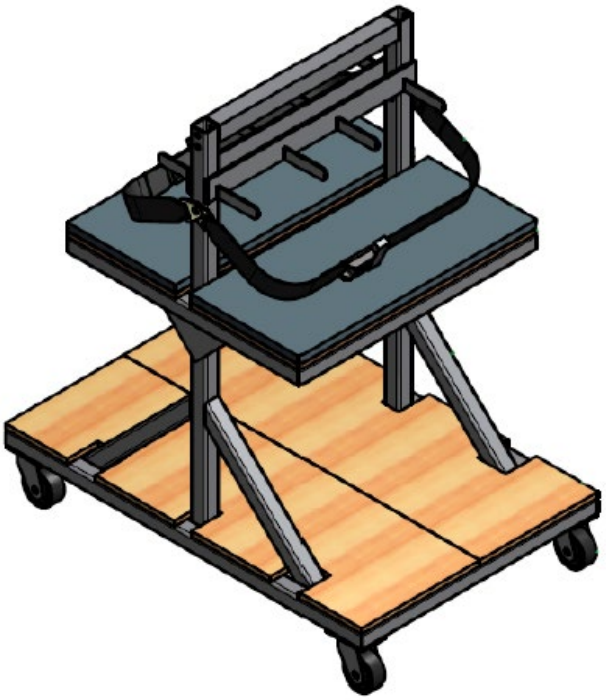


FIGURE 2. EXAMPLE OF Q3s STORAGE CHAIR

FIGURE 3. Q3s POSITIONED IN STORAGE CHAIR

FIGURE 4. Q3s STORAGE CHAIR THORAX SUPPORT RAILS

8. CALIBRATION OF TEST INSTRUMENTATION

Before the contractor initiates the dummy performance calibration test program, a test instrumentation calibration system must be implemented and maintained in accordance with the following calibration practices:

A. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 12 months for instruments and 12 months for the calibration standards except for static types of measuring devices such as rulers, weights, etc., which shall be calibrated at periodic intervals not to exceed two years. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment.

C. All measuring and test equipment and measuring standards shall be labeled with the following information:

1. Date of calibration
2. Date of next scheduled calibration
3. Name of the technician who calibrated the equipment

D. The contractor shall provide the COR a written calibration procedure that includes, as a minimum, the following information for all measurement and test equipment:

1. Type of equipment, manufacturer, model number, etc.
2. Measurement range
3. Accuracy
4. Calibration interval
5. Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident).
6. The actual procedures and forms used to perform the calibrations.

E. The contractor shall keep records of calibrations for all test instrumentation in a manner that assures the maintenance of established calibrations schedules. All such records shall be readily available for inspection when requested by the COR. The calibration will need the written acceptance of the COR before testing begins.

G. Test equipment shall receive a calibration check immediately prior to each test. This check shall be recorded by the test technician(s) and made available if requested by the COR.

9. DEFINITIONS

PADI- Procedures for Assembly, Disassembly, and Inspection

10. INSTRUMENTATION AND TEST CONDITIONS

10.1 INSTRUMENTATION REQUIRED FOR QUALIFICATION TESTS (572.219)

The contractor shall provide and install the following instrumentation to the GFP dummies for qualification testing and if required, for compliance testing. The instrumentation used during the compliance tests shall be those installed during qualification testing.

A. HEAD – The head accelerometers shall have dimensions; response characteristics and sensitive mass locations specified in drawing SA572-S4 and be mounted in the head as shown in drawing 020-0100. (572.219(a)(2))

   Three accelerometers shall be mounted in the head cavity to measure orthogonal accelerations (Ax, Ay, Az) at the center of gravity (CG) of the head assembly.

B. NECK – The upper neck force transducer shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572-S8 and shall be mounted at the head-neck assembly location as shown in drawing 020-0100. (572.219(a)(3))

   Angular rate sensors for the fore-aft neck flexion and lateral neck flexion qualification tests have the dimensions and response characteristics specified in drawing SA572-S58 and are mounted in the head form and on the pendulum as shown in Figures 12 and 13. (572.219(a)(4))

C. CHEST – The torso string potentiometer shoulder deflection transducers have the dimensions and response characteristics specified in drawing SA572-S38 or SA572-S39 and are mounted to the torso assembly as shown in drawing 020-0100. (572.219(a)(5))

An IR-TRACC thorax deflection transducer should have the dimensions and response characteristics specified in drawing SA572-S37 and be mounted to the torso assembly as shown in drawing 020-0100. (572.219(a)(6))

D. PELVIS – The lumbar spine force and moment transducer has the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572-S8 and is mounted in the torso assembly as shown in drawing 020-0100. (572.219(a)(7))

Angular rate sensors for the fore-aft lumbar flexion and lateral lumbar flexion qualification tests have the dimensions and response characteristics specified in drawing SA572-S58 and are mounted in the head form and on the pendulum as shown in Figures 19 and 20. (572.219(a)(8))

E. TEST FIXTURE – The neck pendulum and thorax probe accelerometers shall have the dimensions and characteristics of drawing SA572-S4.

The Q3s Side Impact Test Dummy shall be placed on a test bench with dimensions shown below in Figure 5.

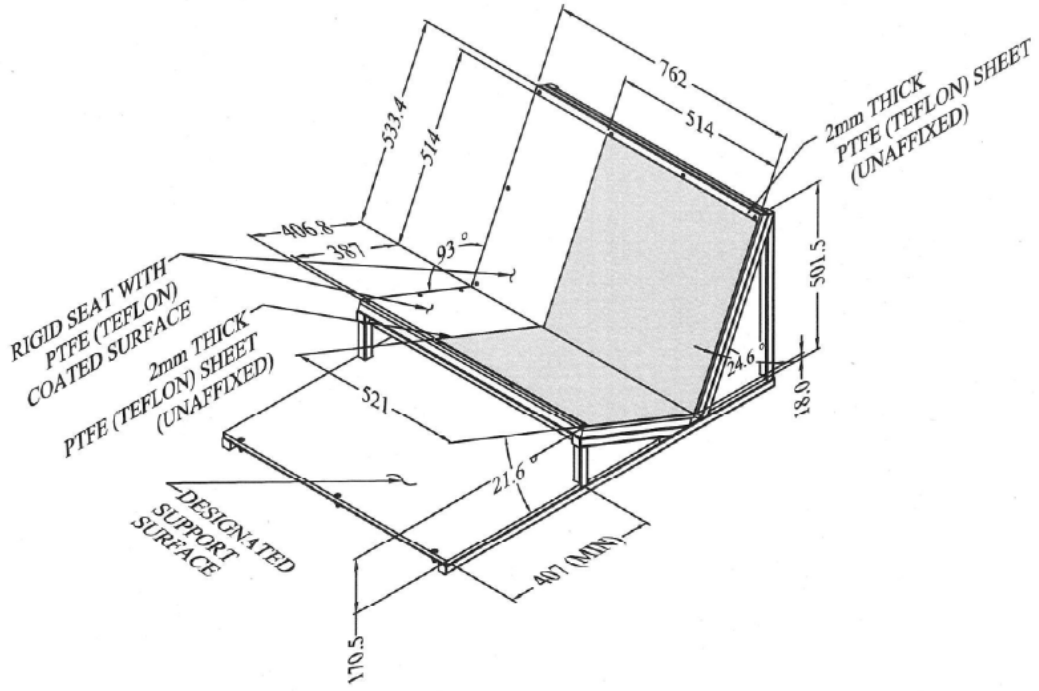


FIGURE 5. Q3s QUALIFICATION BENCH SEAT SPECIFICATIONS

10.2 OTHER TRANSDUCERS (S572.219)

The following transducers are required only when needed for specific test programs as directed by the COR.

A. Optional angular rate sensors for the head shall have the dimensions and response characteristics specified in any of drawings SA572-S55, SA572-S56, SA572-S57 or SA572-S58 and are mounted in the head as shown in drawing 020-0100. (572.219(b)(1))

B. Upper spine accelerometers shall have the dimensions, response characteristics, and sensitive mass locations specified in drawing SA572-S4 and are mounted in the torso assembly as shown in drawing 020-0100. (572.219(b)(2))

C. The addition of pelvis accelerometers shall have the dimensions, response characteristics, and sensitive mass locations specified in drawing SA572-S4 and are mounted in the torso assembly as shown in drawing 020-0100. (572.219(b)(3))

D. The T1 accelerometer shall have the dimensions, response characteristics, and sensitive mass location specified in drawing SA572-S4 and is mounted in the torso assembly as shown in drawing 020-0100. (572.219(b)(4))

E. The lower neck force and moment transducer shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572-S8 and is mounted to the neck assembly as shown in drawing 020-0100. (572.219(b)(5))

F. The tilt sensor shall have the dimensions and response characteristics specified in drawing SA572-S44 and is mounted to the torso assembly as shown in drawing 020-0100. (572.219(b)(6))

G. Pubic force transducers shall have the dimensions and response characteristics specified in drawing SA572-S7 and are mounted in the torso assembly as shown in drawing 020-0100. (572.219(b)(7))

10.3 TRANSDUCER TEST CONDITIONS (S572.219)

A. TRANSDUCER MOUNTS – The mountings for sensing devices shall have no resonance frequency less than 3 times the frequency range of the applicable channel class. (572.219(e))

B. TRANSDUCER SIGN CONVENTION - Coordinate signs for instrumentation polarity are to conform to SAE J1733. (572.219(d))

C. TRANSDUCER OUTPUTS and FILTERING - The outputs of acceleration and force-sensing devices installed in the dummy and in the test apparatus specified by this part are recorded with individual data channels. Each data

channel will be comprised of a sensor, signal conditioner, data acquisition device, and all interconnecting cables, and must conform to the requirements of SAE Recommended Practice J211/1 MAR95, "Instrumentation for Impact Test," with channel classes as follows: (572.219(c))

(1) Pendulum acceleration	CFC 180	(572.219(c)(1))
(2) Pendulum angular rate	CFC 60	(572.219(c)(2))
(3) Neck twist fixture rotation	CFC 60	(572.219(c)(3))
(4) Test probe acceleration	CFC 180	(572.219(c)(4))
(5) Head accelerations	CFC 1000	(572.219(c)(5))
(6) Headform angular rate	CFC 60	(572.219(c)(6))
(7) Neck moments, upper and lower	CFC 600	(572.219(c)(7))
(8) Shoulder deflection	CFC 180	(572.219(c)(8))
(9) Thorax deflection	CFC 180	(572.219(c)(9))
(10) Upper spine accelerations	CFC 180	(572.219(c)(10))
(11) T1 acceleration	CFC 180	(572.219(c)(11))
(12) Pubic force	CFC 180	(572.219(c)(12))
(13) Pelvis accelerations	CFC 1000	(572.219(c)(13))

10.4 IMPACTOR PROBE (S572.219(a)(1))

A. The test probe for shoulder, thorax, and pelvis impacts is of rigid metallic construction, concentric in shape, and symmetric about its longitudinal axis.

B. It has a mass of 3.81 ± 0.02 kg and a minimum mass moment of inertia of 560 kg-cm^2 in yaw and pitch about the CG. One-third (1⁄3) of the weight of the suspension cables and their attachments to the impact probe is included in the calculation of mass, and such components may not exceed five percent of the total weight of the test probe.

C. The impacting end of the probe, perpendicular to and concentric with the longitudinal axis, is at least 25.4 mm long, and has a flat, continuous, and non-deformable 70.0 ± 0.25 mm diameter face with an edge radius between 6.4-12.7 mm.

D. The probe's end opposite to the impact face has provisions for mounting of an accelerometer with its sensitive axis collinear with the longitudinal axis of the probe.

E. No concentric portions of the impact probe may exceed the diameter of the impact face.

F. The impact probe shall have a free air resonant frequency of not less than 1000 Hz.

10.5 GENERAL TEST CONDITIONS

A. Dummy limb joints are set at 1G, 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. (572.219(f))

B. Performance tests of the same component, segment, assembly, or fully assembled dummy are separated in time by not less than 30 minutes unless otherwise specified. (572.219(g))

C. Surfaces of dummy components may not be painted except as specified in this subpart or in drawings subtended by this subpart. (572.219(h))

D. The dummy performance tests are conducted at any temperature from 20.6 and 22.2°C (69 and 72 °F) and at any relative humidity from 10% to 70% after exposure of the dummy to these conditions for a period of not less than 4 hours.

11. CALIBRATION TEST EXECUTION

When conducting calibration tests, complete the data sheets in section 14.

11.1 HEAD CALIBRATION (S572.212)

A. Head Assembly

The head assembly for this test consists of the complete head (drawing 020-1200) with head accelerometer assembly (drawing 020-1013A), and a half mass simulated upper neck load cell (drawing 020-1050).

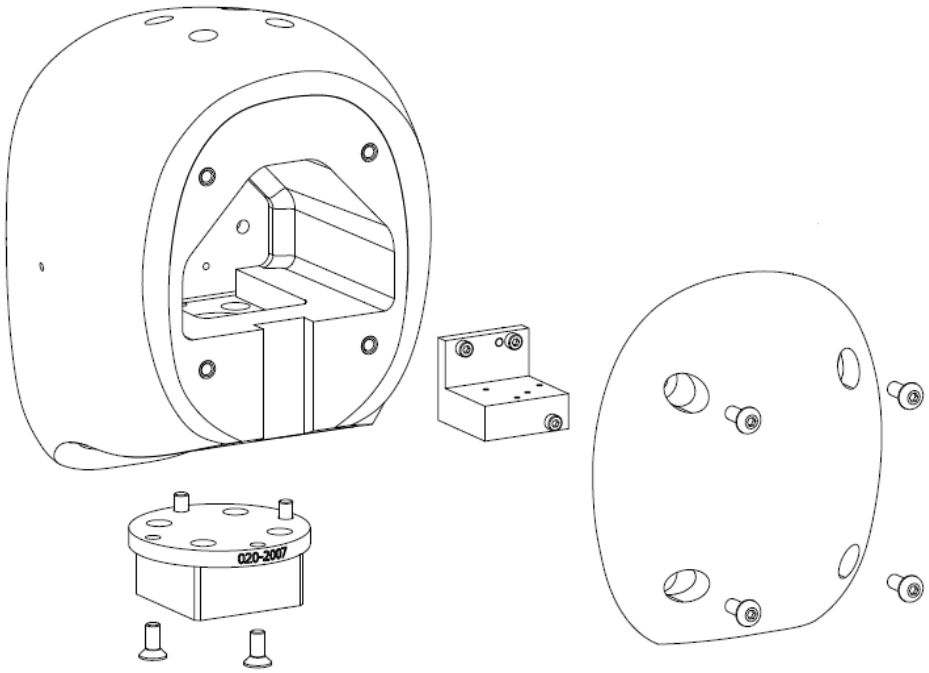


FIGURE 6. Q3s HEAD ASSEMBLY (020-1200)

11.1.1 Frontal Head Qualification Test

A. Requirements

When the head assembly is dropped from a height of 376.0 ± 1.0 mm (14.8 ± 0.04 in), the peak resultant acceleration at the location of the accelerometers at the head CG shall have a value between 255 G and 300 G. The resultant acceleration vs. time history curve shall be unimodal and the oscillations occurring after the main pulse must be less than 10 percent of the peak resultant acceleration. The lateral acceleration shall not exceed ± 15 G (zero to peak).

B. Procedure

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

(2) Prior to the test, clean the impact surface of the skin and the impact plate surface with isopropyl alcohol, trichloroethane, or an equivalent. Both surfaces must be clean and dry for testing.

(3) Suspend and orient the head assembly with the forehead facing the impact surface as shown in Figure 10. The lowest point on the forehead must be 376.0 ± 1.0 mm (14.8 ± 0.04 in) from the impact surface. Adjust

the head angle so that the upper neck load cell simulator is 28 ± 2 degrees forward from vertical while assuring that the head remains horizontal laterally.

(4) Drop the head assembly from the specified height by means that ensure a smooth, instant release onto a rigidly supported flat horizontal steel plate which is 50.8 mm (2 in) thick and 610 mm (24 in) square. The impact surface shall be clean, dry and have a surface finish of not less than 0.2 microns (RMS) and not more than 2.0 microns (RMS).

(5) Allow at least 2 hours between successive tests on the same head.

11.1.2 Lateral Head Qualification Test

A. Requirements

When the head assembly is dropped from a height of 200.0 ± 1.0 mm (7.87 ± 0.04 in), the peak resultant acceleration at the location of the accelerometers at the head CG shall have a value between 114 G and 140 G. The resultant acceleration vs. time history curve shall be unimodal; oscillations occurring after the main pulse must be less than 10 percent of the peak resultant acceleration. The X-component acceleration shall not exceed ± 15 G (zero to peak).

B. Procedure

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

(2) Prior to the test, clean the impact surface of the skin and the impact plate surface with isopropyl alcohol, trichloroethane, or an equivalent. Both surfaces must be clean and dry for testing.

(3) The head is dropped on the aspect that opposes the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A left drop set-up that is used to qualify the dummy for an ensuing full scale left side impact is depicted in Figure 11. A right drop set-up would be the mirror image of that shown in Figure 11.

(4) Suspend and orient the head assembly as shown in Figure 11. The lowest point on the impact side of the head must be 200.0 ± 1.0 mm (7.87 ± 0.04 in) from the impact surface. Adjust the head angle so that the head base plane measured from the base surface of the upper neck load cell simulator is 35 ± 2 degrees forward from the vertical while assuring that the head remains horizontal in the fore-aft direction.

(5) Drop the head assembly from the specified height by means that ensure a smooth, instant release onto a rigidly supported flat horizontal steel plate which is 50.8 mm (2 in) thick and 610 mm (24 in) square. The impact surface shall be clean, dry and have a surface finish of not less than 0.2 microns (RMS) and not more than 2.0 microns (RMS).

(6) Allow at least 2 hours between successive tests on the same head.

11.2 NECK CALIBRATION (S572.213)

11.2.1 Fore-Aft Neck Flexion Qualification Test

A. Neck and Headform Assembly

The neck and headform assembly shown in Figures 12 and 13, consist of the headform (drawing 020-9050, sheet 1) with angular rate sensor installed (drawing SA572-S58), six-channel neck/lumbar load cell (drawing SA572-S8), neck assembly (drawing 020-2400), neck/torso interface plate (drawing 020-9056) and pendulum interface plate (drawing 020-9051) with angular rate sensor installed (drawing SA572-S58).

B. Requirement

When the neck and headform assembly is tested according to the test procedure in paragraph (c) of this section, it shall have the following characteristics:

(1) Plane D, referenced in Figure 12, shall rotate in the direction of pre-impact flight with respect to the pendulum's longitudinal centerline between 69.5 degrees and 81.0 degrees. During the time interval while the rotation is within these angles, the peak moment measured by the neck transducer (drawing SA572-S8) shall have a value between 41.5 N-m (30.6 ft-lb) and 50.7 N-m (37.4 ft-lb).

(2) The decaying headform 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 45 to 55 ms after the time the peak rotation value is reached.

(3) All instrumentation data channels are defined to be zero when the longitudinal centerline of the neck and pendulum are parallel.

(4) The headform rotation shall be calculated by the following formula with the integration beginning at time zero:

Headform rotation (deg) = $\int [(\text{Headform Angular Rate})_y - (\text{Pendulum Angular Rate})_y]\, dt$

(5) $(\text{Headform Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the headform (drawing 020-9050, sheet 1), and $(\text{Pendulum Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the pendulum interface plate (drawing 020-9051).

C. Procedure

(1) Soak the neck 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 neck and headform assembly, shown in Figure 15, so that the midsagittal plane of the headform is vertical and coincides with the plane of motion of the pendulum, and with the neck placement such that the front side of the neck is closest to the honeycomb material as shown in Figure 12.

(3) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.7 ± 0.1 m/s (15.4 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero.

(4) Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 2. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero.

(5) Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material.

11.2.2 Lateral Neck Flexion Qualification Test

A. Neck and Headform Assembly

The neck and headform assembly shown in Figures 12 and 13, consist of the headform (drawing 020-9050, sheet 1) with angular rate sensor installed (drawing SA572-S58), six-channel neck/lumbar load cell (drawing SA572-S8), neck assembly (drawing 020-2400), neck/torso interface plate (drawing 020-9056) and pendulum interface plate (drawing 020-9051) with angular rate sensor installed (drawing SA572-S58).

B. Requirement

When the neck and headform assembly is tested according to the test procedure in paragraph (c) of this section, it shall have the following characteristics:

(1) Plane D, referenced in Figure 13 in, shall rotate in the direction of pre-impact flight with respect to the pendulum's longitudinal centerline between 76.5 degrees and 87.5 degrees. During the time interval while the rotation is within these angles, the peak moment measured by the neck transducer (drawing SA572-S8) shall have a value between 25.3 N-m (18.7 ft-lb) and 32.0 N-m (23.6 ft-lb).

(2) The decaying headform 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 61 to 71 ms after the time the peak rotation value is reached.

(3) All instrumentation data channels are defined to be zero when the longitudinal centerline of the neck and pendulum are parallel.

(4) The headform rotation shall be calculated by the following formula with the integration beginning at time zero:

$$\text{Headform rotation (deg)} = \int [(\text{Headform Angular Rate})_y - (\text{Pendulum Angular Rate})_y]\, dt$$

(5) $(\text{Headform Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the headform (drawing 020-9050, sheet 1), and $(\text{Pendulum Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the pendulum interface plate (drawing 020-9051).

C. Procedure

(1) Soak the neck 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) For the lateral neck flexion test, the test is carried out in the direction opposing the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A right flexion test set-up that is used to qualify the dummy for an ensuing full-scale right-side impact is depicted in Figure 13. A left flexion test set-up would be depicted by a mirror image of all components beneath the pendulum interface plate in Figure 13.

(3) Mount the neck and headform assembly on the pendulum, shown in Figure 15, so that the midsagittal plane of the headform is vertical and

coincides with the plane of motion of the pendulum, and with the neck placement such that the right (or left) side of the neck is closest to the honeycomb material as shown in Figure 13.

(4) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 3.8 ± 0.1 m/s (12.5 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero.

(5) Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 2. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero.

(6) Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material.

11.2.3 Neck Torsion Qualification Test

A. Neck Assembly

The neck assembly shown in Figure 14, consists of the neck twist fixture (drawing DL210-200) with rotary potentiometer installed (drawing SA572-S51), neck adaptor plate assembly (drawing DL210-220), neck assembly (drawing 020-2400), six-channel neck/lumbar load cell (drawing SA572-S8), and twist fixture end plate (drawing DL210-210).

B. Requirement

When the neck assembly is tested according to the test procedure in paragraph (c) of this section, it shall have the following characteristics:

(1) The neck twist fixture (drawing DL210-200), referenced in Figure 14, shall rotate in the direction of pre-impact flight with respect to the pendulum's longitudinal centerline between 74.5 degrees and 91.0 degrees, as measured by the rotary potentiometer (drawing SA572-S51). During the time interval while the rotation is within these angles, the peak moment measured by the neck transducer (drawing SA572-S8) shall have a value between 8.0 N-m (5.9 ft-lb) and 10.0 N-m (7.4 ft-lb).

(2) The decaying neck twist fixture 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 85 to 102 ms after the time the peak rotation value is reached.

(3) All instrumentation data channels are defined to be zero when the zero pins are installed such that the neck is not in torsion.

C. Procedure

(1) Soak the neck 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) For the neck torsion test, the test is carried out in the direction opposing the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A right torsion test set-up that is used to qualify the dummy for an ensuing full-scale right-side impact is depicted in Figure 14. A left flexion test set-up would be a mirror image of that shown in Figure 14.

(3) Mount the neck assembly, defined in paragraph (a)(2) of this section, on the pendulum, described by Figure 15, as shown in Figure 14.

(4) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 3.6 ± 0.1 m/s (11.8 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero.

(5) Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 2. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero.

(6) Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material.

TABLE 2. NECK ASSEMBLY PENDULUM VELOCITY

Time (ms)	Fore-Aft Flexion (m/s)	Time (ms)	Lateral Flexion (m/s)	Time (ms)	Torsion (m/s)
10	1.1 – 2.1	10	1.7 – 2.2	10	0.9 – 1.3
20	2.8 – 3.8	15	2.5 – 3.0	15	1.4 – 2.0
30	4.1 – 5.1	20	3.4 – 3.9	20	2.0 – 2.6

11.3 SHOULDER CALIBRATION (S572.214)

A. Shoulder Assembly

The shoulder assembly for this test consists of the torso assembly (drawing 020-4500) with string pot assembly (drawing SA572-S38 or SA572-S39) installed.

B. Requirement

When the center of the shoulder is impacted laterally by a test probe conforming to 572.219, at 3.6 ± 0.1 m/s (11.8 ± 0.3 ft/s), according to the test procedure in paragraph (c) of this section it shall have the following characteristics:

(1) Maximum lateral shoulder displacement (compression) relative to the spine, measured with the string potentiometer assembly (drawing SA572-S38 or SA572-S39), must not be less than 17.0 mm (0.67 in) and not more than 22.0 mm (0.89 in). The peak force of the impact probe shall have a value between 1123 N (252.5 lbf) and 1437 N (323.1 lbf).

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

C. Procedure

(1) The dummy is clothed in the Q3s suit (drawing 020-8001). No additional clothing or shoes are placed on the dummy.

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

(3) The shoulder test is carried out in the direction opposing the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A left shoulder test set-up that is used to qualify the dummy for an ensuing full scale left side impact is depicted in Figure 16. A right shoulder set-up would be a mirror image of that shown in Figure 16.

(4) Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench.

(5) Position the dummy on the bench as shown in Figure 16, with the ribs contacting the seat back oriented 24.6 degrees relative to vertical, the legs extended forward along the seat pan oriented 21.6 degrees relative to horizontal with the knees spaced 40 mm (1.57 in) apart. Position the arms so that the upper arms are parallel to the seat back (±2 degrees) and the lower arms are parallel to the dummy's sagittal plane and perpendicular to the upper arms. Move the elbows inward (medially) until initial contact occurs between the sleeve and the portion of the suit covering the thorax

while maintaining the relationships between the arms, seat back, and sagittal plane.

(6) The target point of the impact is a point on the shoulder that is 15 mm (0.59 in) above and perpendicular to the midpoint of a line connecting the centers of the bolt heads of the two lower bolts (part #5000010) that connect the upper arm assembly (020-9750) to the shoulder ball retaining ring (020-3533).

(7) Impact the shoulder with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degree), and the centerline of the probe should be within 2 mm (0.08 in) of the target point.

(8) Guide the test probe during impact so that there is no significant lateral, vertical, or rotational movement.

(9) No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, shall contact the dummy during the test.

11.4 THORAX WITH ARM CALIBRATION (S572.215)

A. Thorax Assembly

The thorax assembly for this test consists of the torso assembly (drawing 020-4500) with an IR-TRACC (drawing SA572-S37) installed.

B. Requirement

The thorax of a completely assembled dummy (drawing 020-0100) shall be impacted laterally by a test probe at 5.0 ± 0.1 m/s (16.4 ± 0.3 ft/s) according to the test procedure in section 14 to meet the following requirements:

(1) Maximum lateral thorax displacement (compression) relative to the spine, measured with the IR-TRACC and processed as set out in the PADI (incorporated by reference, see 572.210), shall have a value between 22.5 mm (0.89 in) and 27.5 mm (1.08 in). The peak force, occurring after 5 ms, shall have a value between 1360 N (305.7 lbf) and 1695 N (381.1 lbf).

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

(3) Time zero is defined as the time of contact between the impact probe and the arm. All channels should be at a zero level at this point.

C. Procedure

(1) The dummy is clothed in the Q3s suit (drawing 020-8001). No additional clothing or shoes are placed on the dummy.

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

(3) The test is carried out in the direction opposing the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A left thorax test set-up that is used to qualify the dummy for an ensuing full scale left side impact is depicted in Figure 17. A right thorax set-up would be a mirror image of that shown in Figure 17. Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench.

(4) Position the dummy on the bench as shown in Figure 17, with the ribs contacting the seat back oriented 24.6 degrees relative to vertical, the legs extended forward along the seat pan oriented 21.6 degrees relative to horizontal with the knees spaced 40 mm (1.57 in) apart. On the non-impact side of the dummy, the long axis of the upper arm is positioned parallel to the seat back (±2 degrees). On the impact side, the upper arm is positioned such that the target point intersects its long axis. The long axis of the upper arm is defined by section line A-A in drawing 020-9750. Both lower arms are set perpendicular to the upper arms and parallel to the dummy's sagittal plane. Move the elbows inward (medially) until initial contact occurs between the sleeve and the portion of the suit covering the thorax while maintaining the relationships between the arms, seat back, and sagittal plane.

(5) The target point of the impact is the point of intersection on the lateral aspect of the upper arm and a line projecting from the thorax of the dummy. The projecting line is horizontal, runs parallel to the coronal plane of the dummy, and passes through the midpoint of a line connecting the centers of the bolt heads of the two IR-TRACC mounting bolts. The projected line should intersect the upper arm within 2 mm of its long axis.

(6) Impact the arm with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degrees), and the centerline of the probe should be within 2 mm of the target point.

(7) Guide the test probe during impact so that there is no significant lateral, vertical, or rotational movement.

(8) No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, shall contact the dummy during the test.

11.5 THORAX WITHOUT ARM CALIBRATION (S572.216)

A. Assembly

The thorax assembly for this test consists of the torso assembly (drawing 020-4500) with IR-TRACC (drawing SA572-S37) installed.

B. Requirement

The thorax of a completely assembled dummy (drawing 020-0100) with the arm (drawing 020-9700 or 020-9800) on the impacted side removed shall be impacted laterally by a test probe conforming to § 572.219 at 3.3 ± 0.1 m/s (10.8 ± 0.3 ft/s) according to the test procedure in paragraph (c) of this section and meet the following requirements:

(1) Maximum lateral thorax displacement (compression) relative to the spine, measured with the IR-TRACC (drawing SA572-S37) and processed as set out in the PADI (incorporated by reference, see 572.210), shall have a value between 24.5 mm (0.96 in) and 30.5 mm (1.20 in). The peak force, measured by the impact probe, shall have a value between 610 N (137.1 lbf) and 754 N (169.5 lbf).

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

C. Procedure

(1) The dummy is clothed in the Q3s suit (drawing 020-8001). No additional clothing or shoes are placed on the dummy.

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

(3) The test is carried out in the direction opposing the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A left thorax test set-up that is used to qualify the dummy for an ensuing full scale left side impact is depicted in Figure 18. A right thorax set-up would be a mirror image of that shown in Figure 18. Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench.

(4) Position the dummy on the bench as shown in Figure 18, with the ribs making contact with the seat back oriented 24.6 degrees relative to vertical, the legs extended forward along the seat pan oriented 21.6 degrees relative to horizontal with the knees spaced 40 mm (1.57 in) apart, and the arm on the non-impacted side positioned so that the upper arm is parallel (±2 degrees) to the seat back and the lower arm perpendicular to the upper arm.

(5) The target point of the impact is the midpoint of a line between the centers of the bolt heads of the two IR-TRACC mounting bolts.

(6) Impact the thorax with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degrees), and the centerline of the probe should be within 2 mm of the target point.

(7) Guide the test probe during impact so that there is no significant lateral, vertical, or rotational movement.

(8) No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, shall contact the dummy during the test.

11.6 LUMBAR SPINE CALIBRATION (S572.217)

A. Assembly

The lumbar spine and headform assembly for the fore-aft lumbar flexion and lateral lumbar flexion qualification tests, as shown in Figures 19 and 20, consists of the headform (drawing 020-9050, sheet 2) with angular rate sensor installed (drawing SA572-S58), six-channel neck/lumbar load cell installed (drawing SA572-S8), lumbar spine assembly (drawing 020-6000), lumbar interface plate (drawing 020-9062) and pendulum interface plate (drawing 020-9051) with angular rate sensor installed (drawing SA572-S58).

11.6.1 Fore-Aft Lumbar Flexion Qualification

A. Requirement

When lumbar spine and headform assembly is tested according to the test procedure of this section, it shall have the following characteristics:

(1) Plane D, referenced in figure 19, shall rotate in the direction of pre-impact flight with respect to the pendulum's longitudinal centerline between 47.0 degrees and 58.5 degrees. During the time interval while the rotation is

within these angles, the peak moment measured by the neck/lumbar transducer (drawing SA572-S8) shall have a value between 78.2 N-m (57.5 ft-lb) and 96.2 N-m (71.0 ft-lb).

(2) The decaying headform 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 49 to 59 ms after the time the peak rotation value is reached.

(3) All instrumentation data channels are defined to be zero when the longitudinal centerline of the lumbar spine and pendulum are parallel.

(4) The headform rotation shall be calculated by the following formula with the integration beginning at time zero:

$$\text{Headform rotation (deg)} = \int [(\text{Headform Angular Rate})_y - (\text{Pendulum Angular Rate})_y]\, dt$$

(5) $(\text{Headform Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the headform (drawing 020-9050, sheet 2), and $(\text{Pendulum Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the pendulum interface plate (drawing 020-9051).

B. Procedure

(1) Soak the lumbar spine 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 lumbar spine and headform assembly on the pendulum described Figure 15 so that the midsagittal plane of the headform is vertical and coincides with the plane of motion of the pendulum, and with the lumbar spine placement such that the front side of the lumbar spine is closest to the honeycomb material.

(3) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.4 ± 0.1 m/s (14.4 $\pm$ 0.3 ft/s), measured by an accelerometer mounted on the pendulum as shown in Figure 15 at time zero.

(4) Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 3 below. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero.

(5) Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material.

11.6.2 Lateral Lumbar Flexion Qualification

A. Requirement

When lumbar spine and headform assembly is tested according to the test procedure of this section, it shall have the following characteristics:

(1) Plane D, referenced in Figure 20, shall rotate in the direction of pre-impact flight with respect to the pendulum's longitudinal centerline between 46.1 degrees and 58.2 degrees. During the time interval while the rotation is within these angles, the peak moment measured by the neck/lumbar transducer (drawing SA572-S8) shall have a value between 79.4 N-m (58.6 ft-lb) and 98.1 N-m (72.4 ft-lb).

(2) The decaying headform 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 48 to 59 ms after the time the peak rotation value is reached.

(3) All instrumentation data channels are defined to be zero when the longitudinal centerline of the lumbar spine and pendulum are parallel.

(4) The headform rotation shall be calculated by the following formula with the integration beginning at time zero:

$$\text{Headform rotation (deg)} = \int [(\text{Headform Angular Rate})_y - (\text{Pendulum Angular Rate})_y]\, dt$$

(5) $(\text{Headform Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the headform, and $(\text{Pendulum Angular Rate})_y$ is the angular rate about the y-axis in deg/sec measured on the pendulum interface plate (drawing 020-9051).

B. Procedure

(1) Soak the lumbar spine 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) The test is carried out in the direction opposing the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A right flexion test set-up that is used to qualify the dummy for an ensuing a full-scale right-side impact is depicted in Figure 20. A left flexion test set-up would be depicted by a mirror image of all components beneath the pendulum interface plate in Figure 20.

(3) Mount the lumbar spine and headform assembly on the pendulum described in Figure 15 so that the midsagittal plane of the headform is vertical and perpendicular to the direction of motion of the pendulum, and with the lumbar spine placement such that the right (or left) side of the lumbar spine is closest to the honeycomb material.

(4) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.4 ± 0.1 m/s (14.4 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum as shown in Figure 15 at time zero.

(5) Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 3 below. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero.

(6) Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material.

TABLE 3. LUMBAR ASSEMBLY PENDULUM VELOCITY

Time (ms)	Fore-Aft Flexion (m/s)	Lateral Flexion (m/s)
10	1.3 – 1.7	1.3 – 1.7
20	2.7 – 3.7	2.7 – 3.7
30	4.1 – 4.9	4.0 – 4.8

11.7 PELVIS CALIBRATION (S572.218)

A. Assembly

The pelvis assembly (drawing 020-7500) for this test may include either a uniaxial pubic load cell (drawing SA572-S7) or a pubic load cell structural replacement (drawing 020-7150) installed on the non-impact side of the pelvis.

B. Requirement

When the center of the pelvis of a completely assembled dummy is impacted laterally by a test probe conforming to 572.219 at 4.0 ± 0.1 m/s (13.1 ± 0.3 ft/s) according to the test procedure, the follow conditions must be met:

(1) The calculated peak force, measured by the impact probe, shall have a value between 1587 N (356.8 lbf) and 1901 N (427.4 lbf).

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

C. Procedure

(1) The dummy is clothed in the Q3s suit. No additional clothing or shoes are placed on the dummy.

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

(3) The pelvis test is carried out in the direction opposing the primary load vector of the ensuing full-scale test for which the dummy is being qualified. A left pelvis test set-up that is used to qualify the dummy for an ensuing full scale left side impact is depicted in Figure 21. A right pelvis test set-up would be a mirror image of that shown in Figure 21.

(4) Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench.

(5) Position the dummy on the bench as shown in Figure 21, with the ribs contacting the seat back oriented 24.6 degrees relative to vertical, the legs extended forward along the seat pan oriented 21.6 degrees relative to horizontal with the knees spaced 40 mm (1.6 in) apart. The arms should be positioned so that the arm on the non-impacted side is parallel to the

seat back with the lower arm perpendicular to the upper arm, and the arm on the impacted side is positioned upwards away from the pelvis.

(6) Establish the impact point at the center of the pelvis so that the impact point of the longitudinal centerline of the probe is located 185 mm (7.3 in) from the center of the knee pivot screw (part #020-9008) and centered vertically on the femur.

(7) Impact the pelvis with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degrees), and the centerline of the probe should be within 2 mm (0.08 in) of the center of the pelvis.

(8) Guide the test probe during impact so that there is no significant lateral, vertical, or rotational movement.

(9) No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, shall contact the dummy during the test.

12. POST TEST REQUIREMENTS

The contractor shall verify all instrumentation and check data sheets and photographs. Make sure data is recorded in all data blocks on every performance calibration test data sheet.

13. REPORTS

13.1 APPARENT NONCONFORMANCE

During the posttest calibration verification, any indication of apparent nonconformance to the requirements of Part 572 shall be communicated by telephone to the COR within 24 hours with written notification mailed within 48 hours (Saturdays and Sundays excluded). Written notification shall be submitted with a copy of the particular test data sheet(s) and preliminary data plot(s).

In the event of an apparent nonconformance, a posttest calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COR's discretion and shall be performed without additional costs to the OVSC.

13.2 FINAL PERFORMANCE CALIBRATION REPORTS

A report containing the pre-test calibration and posttest calibration verification data for each Part 572, Subpart P dummy used in the test shall be submitted with the compliance final test report if requested by the COR.

Contractors are required to PROOFREAD all Final Test Reports before submittal to the COR. The OVSC will not act as a report quality control office for contractors. Reports containing a significant number of errors will be returned to the contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

13.2.1 Requirements

Performance calibration report Table of Contents shall include the following:

A. Section 1 — Purpose of Calibration Test

B. Section 2 — Calibration Data Summary

C. Section 3 — Test Data

D. Section 4 — Test Equipment List and Calibration Information

E. Section 5 — Photographs (if applicable)

The test data for each dummy will be presented in separate sections. Each section shall contain a title page, test results summary and the test data. The title page shall include the dummy's serial number and the manufacturer's name. It will also indicate whether the calibration data is pre or posttest. The test results sheets will provide a summary of each test and describe any damage, failures and/or corrective action taken. The test data shall include the pass/fail data sheets, the time histories for each data channel used to determine the pass or fail status, and instrumentation calibration data sheets.

13.2.2 Report Cover Format

The information required on the cover follows:

A. Final Report Title and Subtitle such as

Q3s 3-YEAR-OLD CHILD TEST DUMMY CALIBRATION
IN SUPPORT OF
FMVSS 213A CHILD RESTRAINT SYSTEM SIDE IMPACT TEST(S)

B. DOT symbol, placed between items B and C

C. Contractor's Name and Address such as

COMPLIANCE TESTING LABORATORIES, INC.
4335 West Dearborn Street
Detroit, Michigan 48090

D. Date of Final Performance Calibration Report completion

E. The sponsoring agency's name and address as follows

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NVS-220, W43-481
1200 New Jersey Ave., SE
Washington, DC 20590

14. DATA SHEETS

14.1 DUMMY DAMAGE CHECKLIST

DATA SHEET 1
DUMMY DAMAGE CHECKLIST

Dummy Serial Number _____ Test Date _____

Technician _____

This check sheet is completed as part of the posttest calibration verification.

__Perform general cleaning.

Dummy Item	Inspect for	Comments	Damaged	OK
Outer Skin	Gashes, Rips, Cracks			
Head	Ballast secure			
	General appearance			
Neck & Lumbar	Deformed or torn rubber			
	Upper and lower bracket firmly attached			
	Looseness at the condyle joint			
	Bending or fraying in tension cable			
Upper Torso	Broken or cracked ribcage assembly			
	Broken or bent IR-TRACC bracket			
	Excessive wear on shoulder ball joint			
	Over worn shoulder plunger screw			
	Rips or cracking in molded shoulder assembly			
Lower Torso	Broken of cracked pelvis			
	Broken or bent pubic load cell assembly			
	Excessive wear on hip ball joint			
Arms & Legs	Broken or cracked joints			
	Normal movement and adjustment			

Instrumentation Mountings	Head accelerometer mounting secure			
	IR-TRACC mounting secure			
Other				

If upon visual examination, damage is apparent in any of these areas, the appropriate engineer or engineering technician is to be consulted for a decision on repair or replacement of parts.

Repair or Replacement approved by:

_____ _____

Signature Date

Describe the repair or replacement of parts:

Checked by

_____ _____

Signature Date

14.2 EXTERNAL MEASUREMENTS CHECKLIST

DATA SHEET 2
EXTERNAL MEASUREMENTS
(See the PADI, pages 119 to 128)

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

__1. Assemble the dummy according to the procedures defined in the PADI. Assure that the neck and lumbar cables are set to the proper torque. These dimensions shall be checked without any instrumentation cabling coming from the rear of the dummy as this bundle may affect the measurements.

__2. Remove the dummy's jacket.

3. Stature Measurements:

__3a. Lay the dummy on its back on a stature measurement fixture as shown in Figure 7.
__3b. Rest the heels on the heel spacer.
__3c. Align the upper torso cable guide so that it fully contacts the cable spacer guide. Note that his may compress the buttocks.
__3d. Place the head on the head spacer.
__3e. The upper and lower legs should be parallel. The bottom of the foot should be positioned flat against the foot board.
__3f. **Stature (A):** Measure the height from the bottom of the feet to top of head as shown in Dimension ***A***, Figure 7. A right-angle plate resting on the base plate and positioned against the top of the head may aid in obtaining the measurement.

4. Anthropometry Measurements:

__4a. Seat the dummy on a flat, rigid, smooth, clean, dry, horizontal surface. The seating surface must be at least 360 mm (14.2 in) wide and 200 mm (7.87 in) deep, with a vertical section at least 360 mm (14.2in) wide and 600 mm (23.6 in) high attached to the rear of the seating fixture. In addition, a 35mm thick head location block, a 10mm thick thorax location block, and a 9.5 mm thick pelvis location block are mounted to the seat as indicated in Figure 9.
__4b. Secure the seat to an appropriate surface.
__4c. Seat the dummy so that the dummy's lateral axis is parallel to the seat back.
__4d. Position the spine box vertically so that the cable guide is in full contact with the cable guide spacer block.
__4e. The head should rest against the head spacer, with the dummy looking down at an angle of 27° (see Dimension ***BB*** in Figure 7). Tape can be used to aid in positioning if necessary.

__4f. Align the upper legs so that a line between the knee and hip pivots is horizontal.
__4g. Position the lower legs 90° from the upper legs. The bottom of the feet should be parallel to the seat pan.
__4h. The upper arms are positioned vertically with elbows down; the lower arms are positioned 90° from the upper arms with hands forward. The lower arms are parallel to both the seat pan and the midsagittal plane of the dummy.
__4i. Tape may be used to aid in positioning the dummy in any of the steps above.

__5. Record the dimensions listed in following table.

_____ _____
Signature Date

EXTERNAL DIMENSIONS

Q3s SIDE IMPACT TEST DUMMY, PART 572, SUBPART W EXTERNAL DIMENSIONS					
DIM.	**DESCRIPTION**	**DETAILS**	**ASSEMBLY DIMENSION (mm)**		**ACTUAL MEASUREMENT (mm)**
			Spec.	**Tolerance +/-**	
A	Stature	Top of head to bottom of feet when measured in stature fixture	38.7	0.6	
B	Total Sitting Height	Seat surface to highest point on top of head when back of head is in contact with spacer block (G)	21.9	0.4	
C	Shoulder Height Sitting	Top of upper arm above seat surface	13.7	0.4	
D	Thigh Clearance	Thigh height at highest point above seat	3.3	0.3	
E	Shoulder to Elbow Length	Top of upper arm at shoulder to bottom of upper arm at elbow	7.3	0.4	
F	Elbow to Fingertip Length	Back of upper arm to front of fingertip parallel to long axis of lower arm	9.6	0.4	
G	Head Back to Seat Back	Measurement set by fixture	1.4	0.1	
H	Spine Box Back to Seat Back Line	Measurement set by fixture	0.4	0.1	
I	Knee to seat back Line Seated	Front of knee in line with knee pivot centerline to seat back	12.0	0.5	
J	Knee Height Seated	Top of knee to foot plate measured in line with knee pivot centerline	11.1	0.5	
K	Chest Depth Upper	Top front point of rib cage molding to seat back	5.9	0.3	
L	Abdominal Depth	Forward most point of abdomen to seat back parallel to the seat pan	6.7	0.3	
M	Hip Breadth Sitting	Width of pelvis across the femurs in line with femur centerlines	8.0	0.3	
N	Pelvis Height Above Seat	Measurement set by fixture	0.4	0.1	
O	Foot Length	Length of foot from toes to heel parallel to long axis of the foot	5.8	0.3	
P	Foot Width	Width of foot at widest point perpendicular to long axis of foot	2.4	0.3	

Q3s SIDE IMPACT TEST DUMMY, PART 572, SUBPART W EXTERNAL DIMENSIONS, continued					
DIM.	**DESCRIPTION**	**DETAILS**	**ASSEMBLY DIMENSION (mm)**		**ACTUAL MEASUREMENT (mm)**
			Spec.	**Tolerance +/-**	
Q	Head Width	Width of head at widest point	5.4	0.2	
R	Head Length	Length of head from front to rearmost projection of skull cap along reference line X	7.0	0.3	
S	Waist Width Sitting	Width across waist at widest point at top of pelvis	7.3	0.3	
T	Shoulder Width	Width across arms at shoulder pivot centerline	9.7	0.4	
U	Head Circumference	Circumference of head at head length measurement location	19.6	0.4	
V	Chest Circumference	Circumference of chest at center of the top rib at the reference location for chest circumference	20.8	0.5	
W	Waist Circumference	Circumference of chest at center of the top rib at the reference location for chest circumference	21.2	0.5	
X	Head reference Line	Distance below crown of head for length and circumference measurement	3.2	-	
Y	Reference Location for Chest Circumference	Height above seat for chest circumference measurement	9.7	-	
Z	Reference Location for Waist Circumference	Height above seat for waist circumference measurement	3.5	-	
AA	Head Back-to-Back Line Standing	Set by fixture	1.1	0.1	
BB	Head Reference Line Angle	Measured with protractor and set to correct angle	27°	-	

EXTERNAL DIMENSION MEASUREMENT DESIGNTATIONS

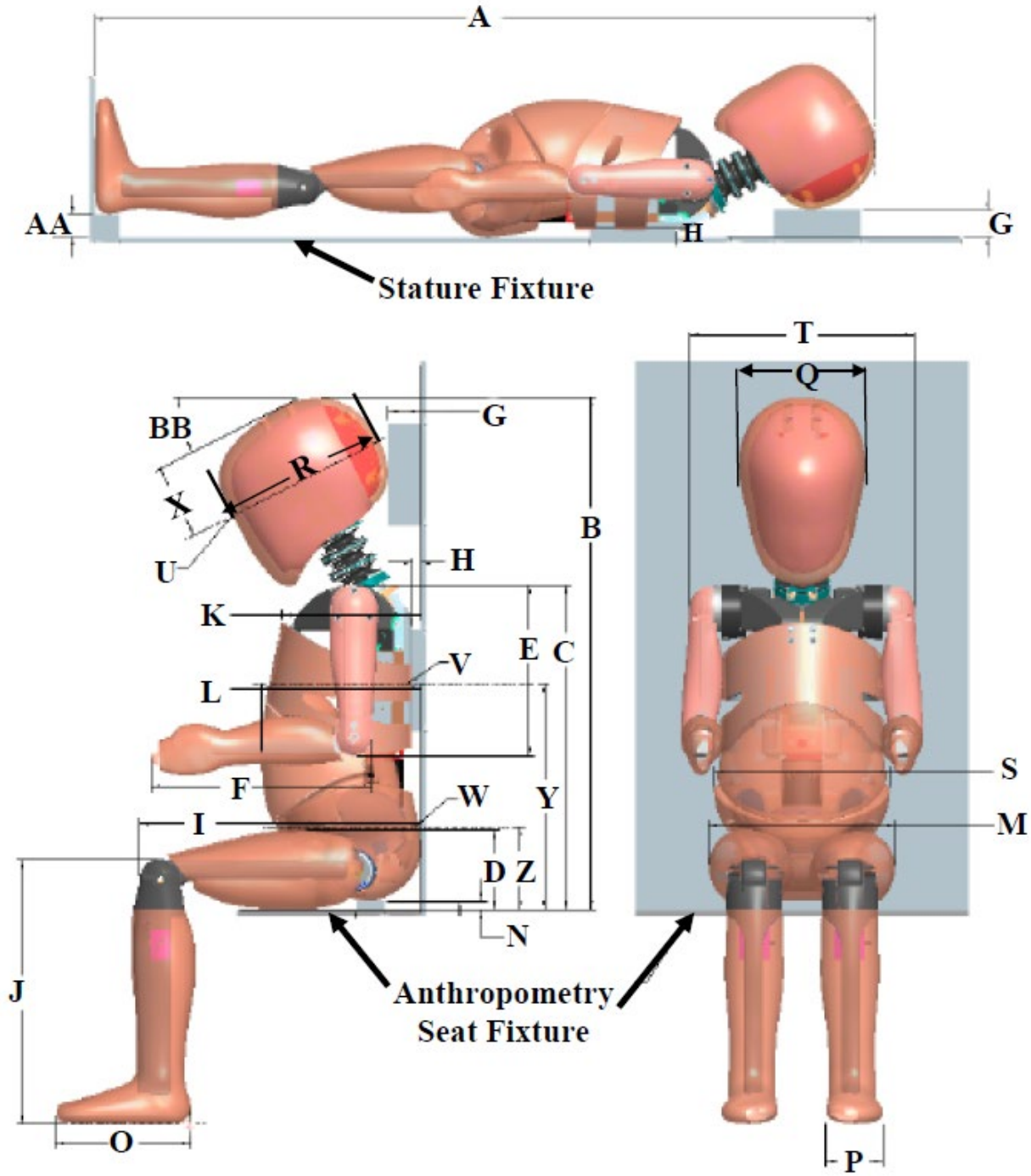


FIGURE 7. Q3s EXTERNAL DIMENSIONS

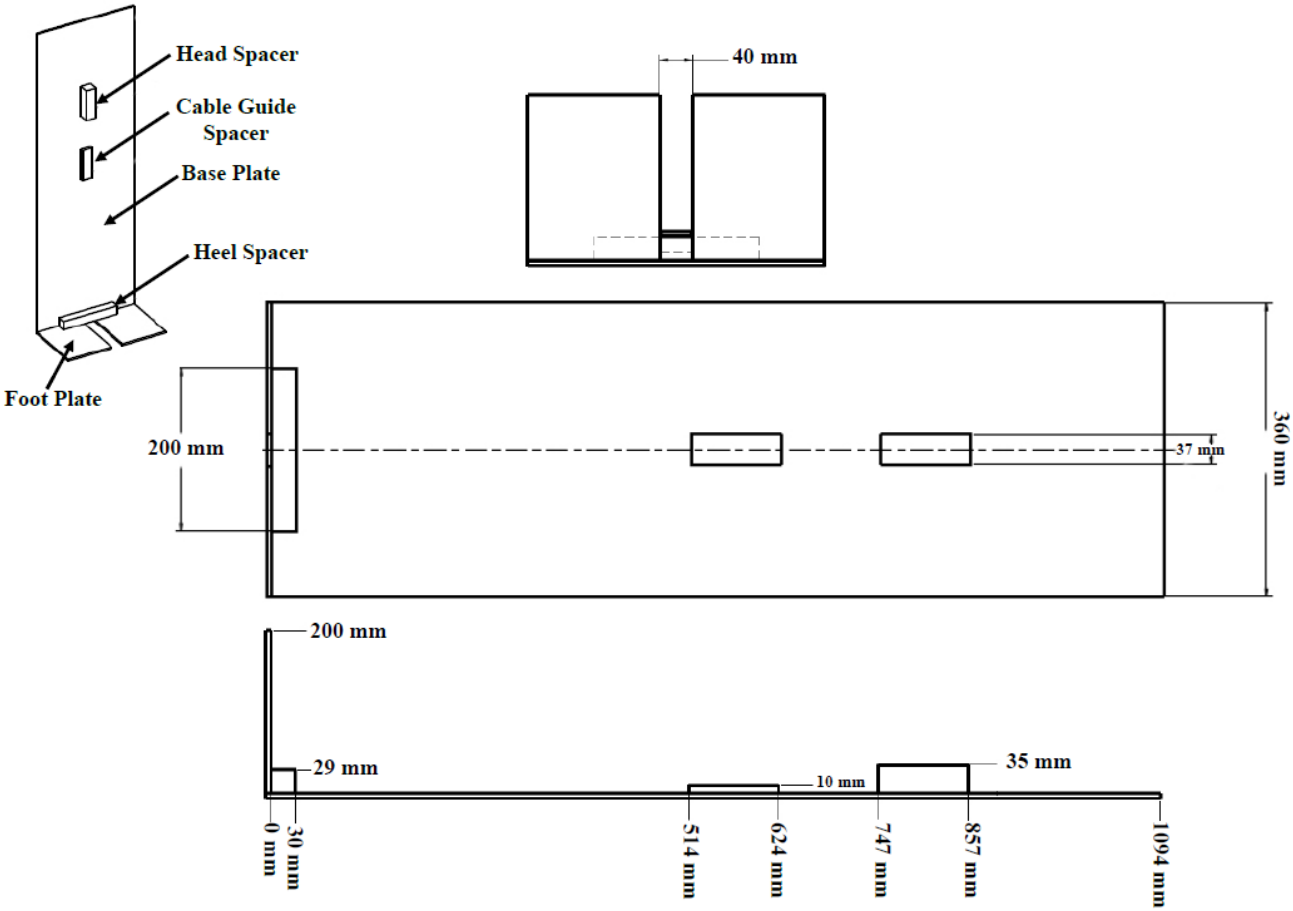


FIGURE 8. STATURE MEASUREMENT FIXTURE

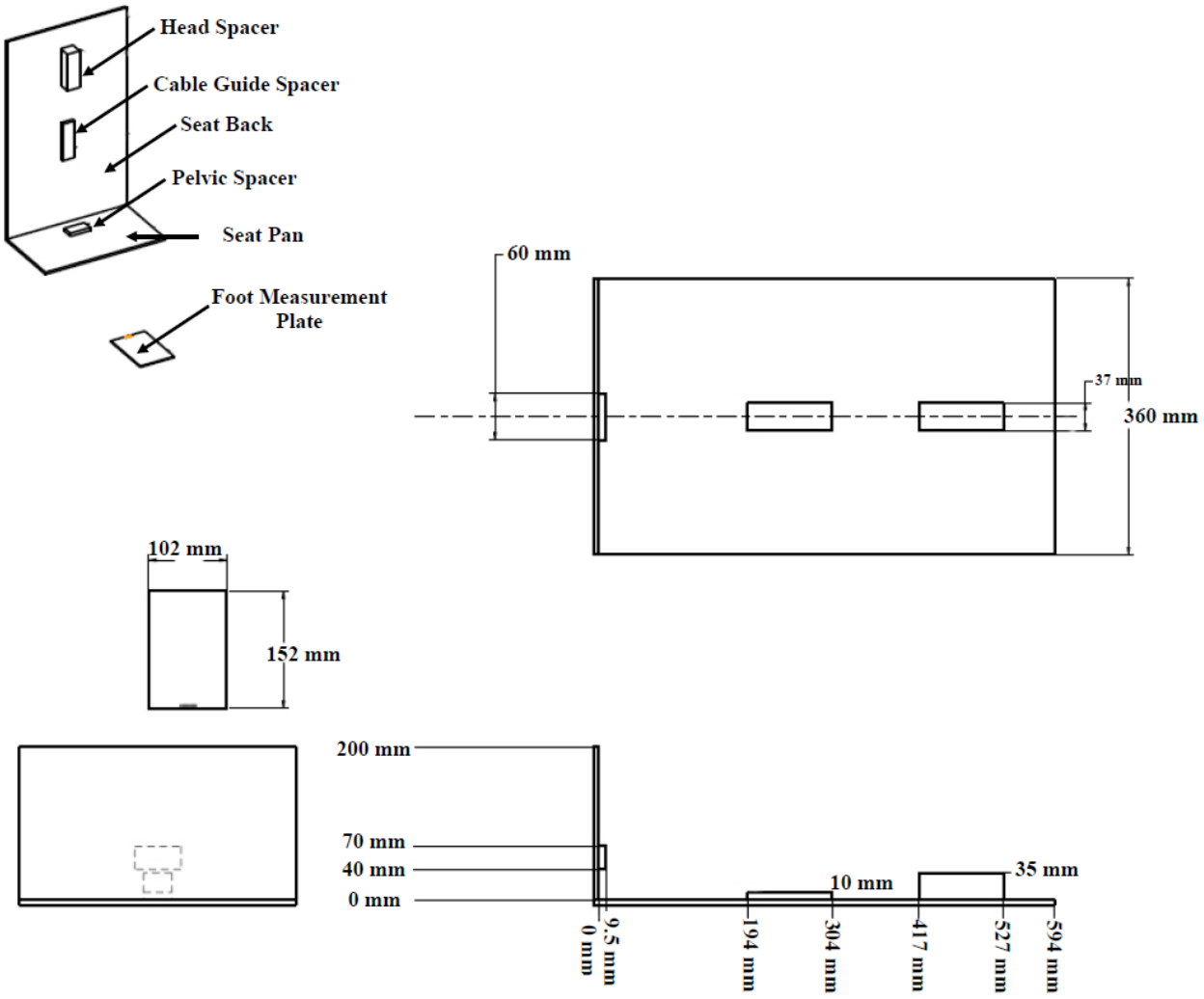


FIGURE 9. ANTHROPOMETRY MEASUREMENT FIXTURE

14.3 HEAD CALIBRATION CHECKLIST

DATA SHEET 3
HEAD DROP TESTS (572.212)

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive head drops are necessary)

__1. It has been at least 2 hours since the last head drop. (572.212(c)(5))
__2. The head assembly for these tests consists of the complete head (drawing 020-1200) with head accelerometer assembly (drawing 020-1013A), and a half mass simulated upper neck load cell (drawing 020-1050).
__3. Accelerometers and their respective mounts are smooth and clean.
__4. The accelerometer mounting block is mounted to the accelerometer bracket (two M2.5-0.45 x 16 SCHS) and torqued to 0.6 N-m (5 ft-lb).
__5. The three head accelerometer bracket screws (two M3-0.5 x 10 SHCS and one M3-0.5 x 40 SHCS) are torqued to 1.1 N-m (10 in-lb).
__6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__7. The head assembly soaked at a temperature between 20.6 and 22.2°C (69 and 72 °F) and a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.212(c)(1))
Record temperature _____
Record humidity _____
__8. Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the low-risk deployment test in which the dummy was an occupant, the damaged area is to be documented with photography and the posttest calibration verification testing completed before any replacement or repairs are made.
Record findings and actions: _____
_____
_____
_____
_____
__9. Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test. (572.212(c)(2))

10. Frontal Head Qualification

__10a. Suspend and orient the head assembly with the forehead facing the impact surface as shown in Figure 10. The lowest point on the forehead must be 376.0 ± 1.0 mm (14.8 ± 0.04 in) from the impact surface.
__10b. Adjust the head angle so that the upper neck load cell simulator is 28 ± 2 degrees forward from vertical while assuring that the head remains horizontal laterally. (572.212(c)(i)
Record the actual distance _____
__10c. The impact surface is clean and dry and has a micro finish in the range of 0.2 microns to 2.0 microns (RMS). (572.212(c)(4))
__10d. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (572.212(c)(4))
__10e. Drop the head assembly from a height of 376.0 ± 1.0 mm (14.8 ± 0.04 inches) by a means that ensures a smooth, instant release onto the impact surface. (572.212(b)(1)) & 572.212(c)(4))
__10f. Plot the x, y, z and resultant acceleration data.
__10g. Record results in Table 5.

11. Lateral Head Qualification

__11a. Suspend and orient the head assembly so that the head is dropped on the aspect that opposes the primary load vector of the ensuing full-scale test for which the dummy is being qualified, as shown in Figure 11. The lowest point on the impact side of the head must be 200.0 ± 1.0 mm (7.87 ± 0.04 in) from the impact surface.
__11b Adjust the head angle so that the head base plane measured from the base surface of the upper neck load cell simulator is 35 ± 2 degrees forward from the vertical while assuring that the head remains horizontal in the fore-aft direction.
Record the actual distance _____
__11c. The impact surface is clean and dry and has a micro finish in the range of 0.2 microns to 2.0 microns (RMS). (572.212(c)(4))
__11d. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (572.212(c)(4))
__11e. Drop the head assembly from a height of 200.0 ± 1.0 mm (7.87 ± 0.04 in) by a means that ensures a smooth, instant release onto the impact surface. (572.212(b)(2)) & 572.212(c)(4))
__11f. Plot the x, y, z and resultant acceleration data.
__11g. Record results in Table 5.
__11h. Repeat test for the opposite side (left or right).

TABLE 4. HEAD QUALIFICATION RESULTS

	Frontal Drop		Left Side Lateral Drop		Right Side Lateral Drop	
Parameter	Spec.	Result	Spec.	Result	Spec.	Result
Peak Resultant Acceleration	255 ≤ x ≤ 300 (g)		114 ≤ x ≤ 140 (g)		114 ≤ x ≤ 140 (g)	
Resultant vs. Time history curve	Unimodal		Unimodal		Unimodal	
Oscillations After the Main Pulse	< 10% of the Peak Resultant		< 10% of the Peak Resultant		< 10% of the Peak Resultant	
Cross Acceleration	y-axis ≤ 15 g		x-axis ≤ 15 g		x-axis ≤ 15 g	

HEAD DROP TEST SET-UP SPECIFICATIONS - FRONTAL

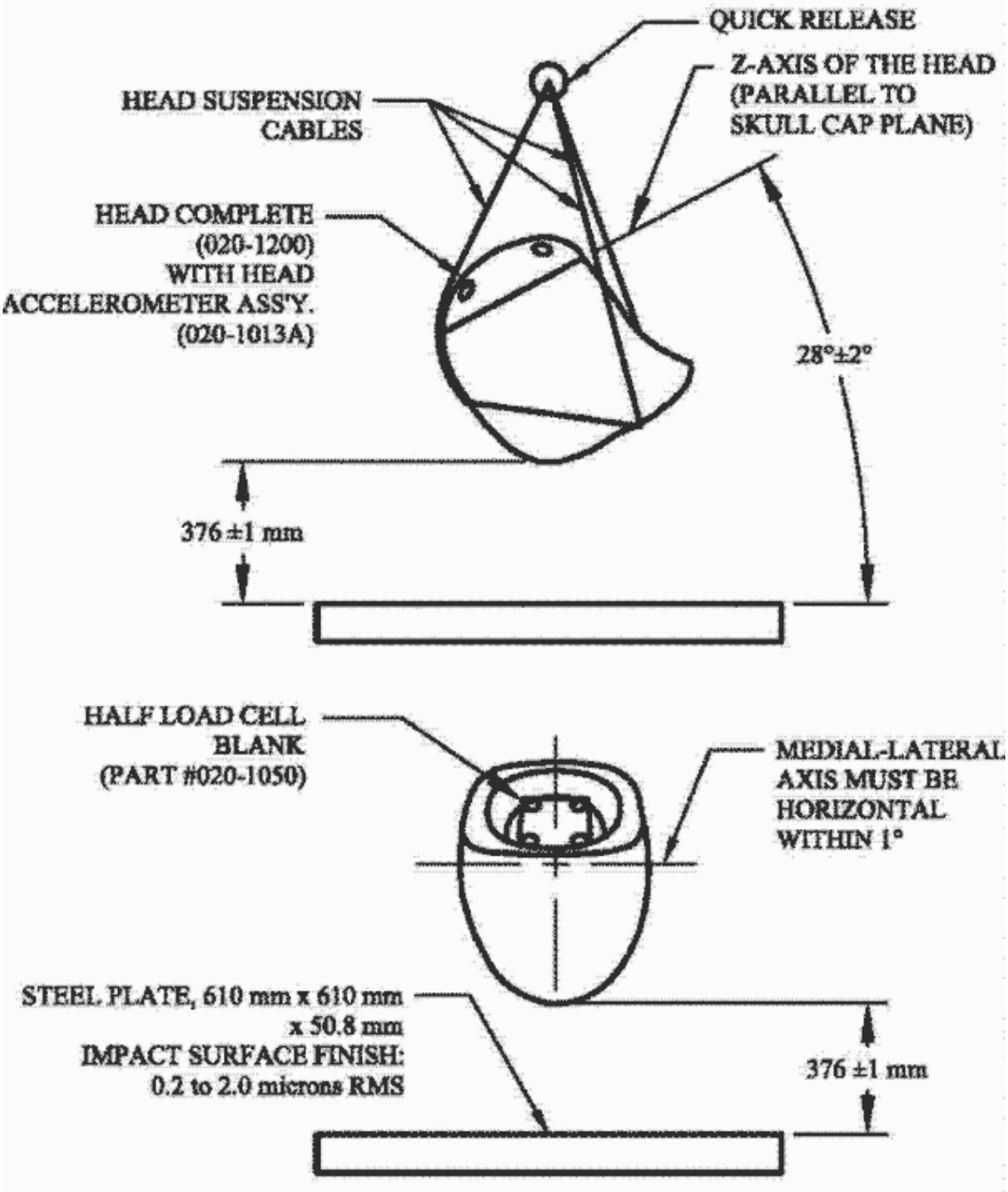


FIGURE 10. FRONTAL HEAD DROP TEST SET-UP SPECIFICATIONS

HEAD DROP TEST SET-UP SPECIFICATIONS - LATERAL

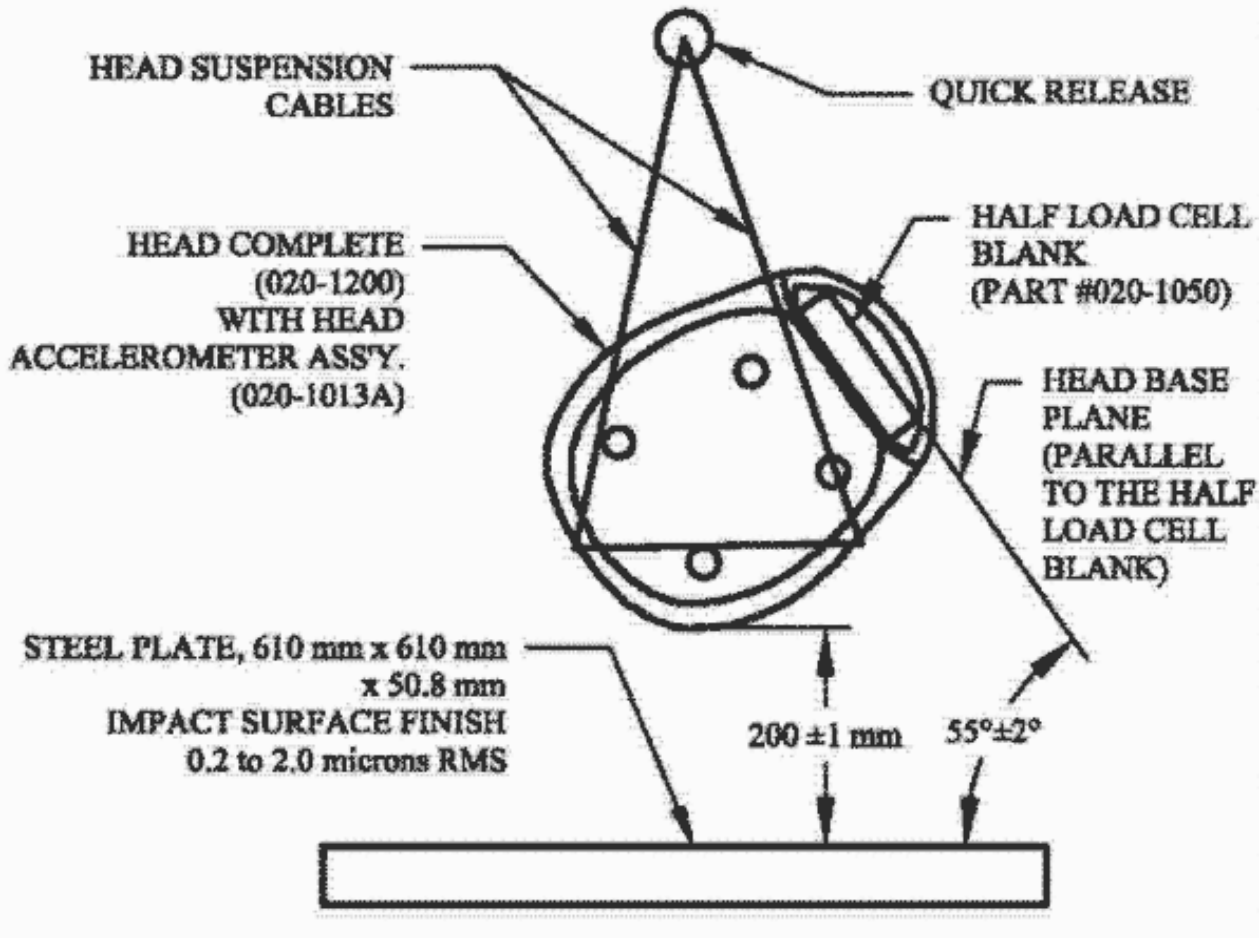


FIGURE 11. LATERAL HEAD DROP TEST SET-UP SPECIFICATIONS

14.4 NECK CALIBRATION CHECKLISTS

DATA SHEET 4
FORE-AFT NECK FLEXION TEST (572.213(b)(1))

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive flexion tests are necessary)

__1. It has been at least 30 minutes since the last neck test.
__2. The components required for the fore-aft neck flexion tests include the neck and headform assembly shown in Figure 12. This assembly consists of the headform (drawing 020-9050, sheet 1) with angular rate sensor installed (drawing SA572-S58), six-channel neck/lumbar load cell (drawing SA572-S8), neck assembly (drawing 020-2400), neck/torso interface plate (drawing 020-9056) and pendulum interface plate (drawing 020-9051) with angular rate sensor installed (drawing SA572-S58). (572.213(a)(1))
__3. The assembly has soaked 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. (572.213(c)(1))
Record temperature _____
Record humidity _____
__4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the low-risk deployment test, the damaged area is to be documented with photography and the posttest calibration verification testing completed before any replacement or repairs are made.
Record findings and actions: _____
_____
_____
_____
_____
__5. Torque the neck cable adjust nut (020-2421) on the neck cable (020-2415) to 0.2 N-m (2 in-lb).
__6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__7. The test fixture pendulum conforms to the specifications in Figure 15. (572.33(c)(3))
__8. Mount the neck and headform assembly so that the midsagittal plane of the headform is vertical and coincides with the plane of motion of the pendulum, and with the neck placement such that the front side of the neck is closest to the honeycomb material as shown in Figure 12. (572.213(c)(2)(i))
__9. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the top horizontal

surface of the neck load cell. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly.

__11. Plane D is perpendicular ± 1° to the centerline of the pendulum.

__12. Set the instrumentation so that the moment and rotation are defined to be zero when the longitudinal centerline of the neck and pendulum are parallel. (572.213(b)(1)(iii))

__13. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.7 ± 0.1 m/s (15.4 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero. (572.213(c)(3)(i))

__14. Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 6. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero. (572.213(c)(3)(ii))

__15. Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.213(c)(3)(iii))

__16. Record results in Table 6:

TABLE 5. FORE-AFT NECK CALIBRATION RESULTS (572.213(b)(1)) & 572.213(c)(3)

Parameter		**Specification**	**Result**
Pendulum Impact Speed		4.6 m/s ≤ speed ≤ 4.8 m/s	
Pendulum ΔV with respect to impact speed	@ 10 ms	1.1 m/s ≤ ΔV ≤ 2.1 m/s	
	@ 20 ms	2.8 m/s ≤ ΔV ≤ 3.8 m/s	
	@ 30 ms	4.1 m/s ≤ ΔV ≤ 5.1 m/s	
Plane D Rotation		Peak moment: 41.5 ≤ moment ≤ 50.7 N-m During the rotation range: 69.5 ≤ angle ≤ 81.0 degrees	____ Nm @ ___ degrees
Negative Moment Decay		Time to decay to zero angle: 45 ≤ time ≤ 55 ms	

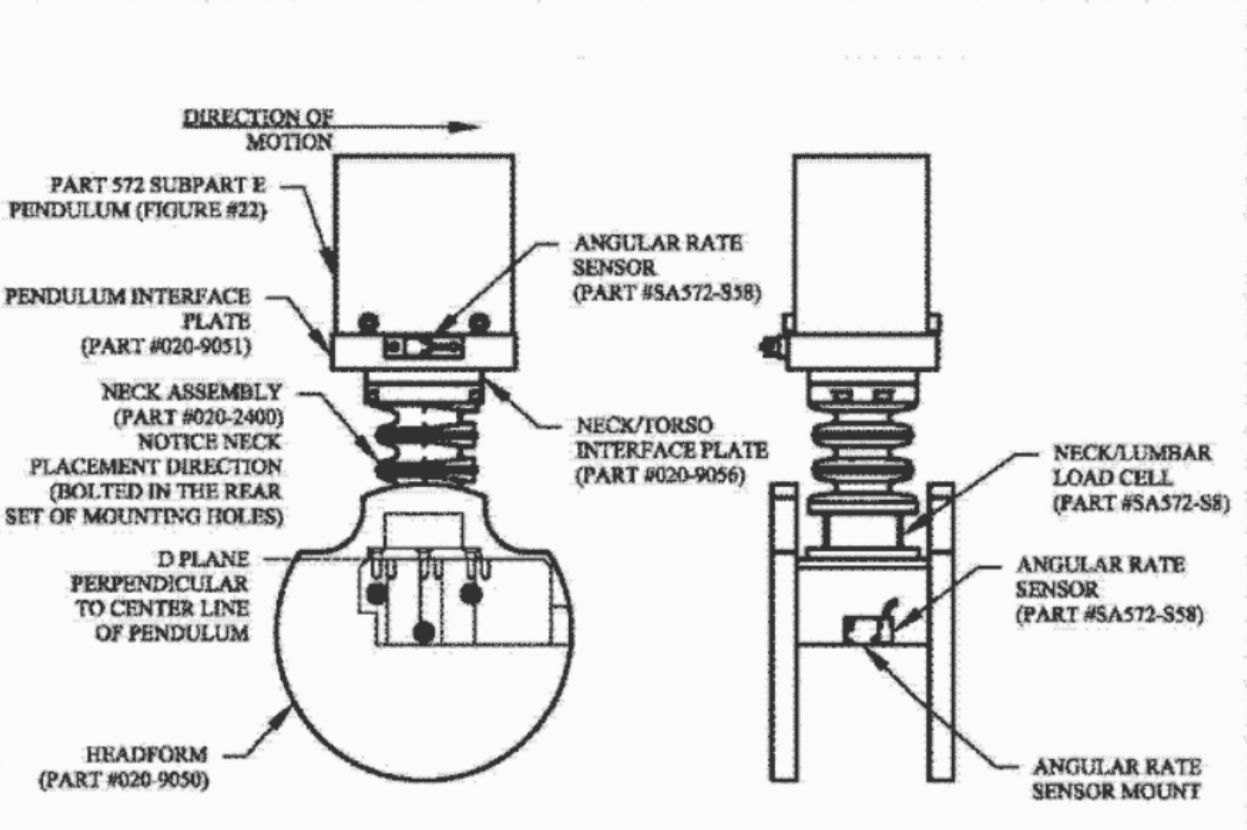


FIGURE 12. NECK FORE-AFT TEST SET-UP SPECIFICATIONS

DATA SHEET 5
LATERAL NECK FLEXION TEST (572.213(b)(2))

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive flexion tests are necessary)

__1. It has been at least 30 minutes since the last neck test.
__2. The components required for the lateral neck flexion tests include the neck and headform assembly shown in Figure 13. This assembly consists of the headform (drawing 020-9050, sheet 1) with angular rate sensor installed (drawing SA572-S58), six-channel neck/lumbar load cell (drawing SA572-S8), neck assembly (drawing 020-2400), neck/torso interface plate (drawing 020-9056) and pendulum interface plate (drawing 020-9051) with angular rate sensor installed (drawing SA572-S58). (572.213(a)(1))
__3. The assembly has soaked 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. (572.213(c)(1))
Record temperature _____
Record humidity _____
__4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the low-risk deployment test, the damaged area is to be documented with photography and the posttest calibration verification testing completed before any replacement or repairs are made.
Record findings and actions: _____
_____
_____
_____
_____
__5. Torque the neck cable adjust nut (020-2421) on the neck cable (020-2415) to 0.2 N-m (2 in-lb).
__6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__7. The test fixture pendulum conforms to the specifications in Figure 15. (572.33(c)(3))
__8. Mount the neck and headform assembly so that the midsagittal plane of the headform is vertical and coincides with the plane of motion of the pendulum, and with the neck placement such that the right (or left) side of the neck is closest to the honeycomb material as shown in Figure 13. (572.213(c)(2)(ii))
__9. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the top horizontal surface of the neck load cell. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly.
__11. Plane D is perpendicular ± 1° to the centerline of the pendulum.

__12. Set the instrumentation so that the moment and rotation are defined to be zero when the longitudinal centerline of the neck and pendulum are parallel. (572.213(b)(2)(iii))
__13. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 3.8 ± 0.1 m/s (12.5 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero. (572.213(c)(3)(i))
__14. Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 7. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero. (572.213(c)(3)(ii))
__15. Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.213(c)(3)(iii))
__16. Repeat for opposite side flexion (right or left).
__17. Record results in Table 7:

TABLE 6. LATERAL NECK CALIBRATION RESULTS (572.213(b)(2)) & 572.213(c)(3)

Parameter		**Specification**	**Result**	
			Left Flexion	**Right Flexion**
Pendulum Impact Speed		3.7 m/s ≤ speed ≤ 3.9 m/s		
Pendulum ΔV with respect to impact speed	@ 10 ms	1.7 m/s ≤ ΔV ≤ 2.2 m/s		
	@ 15 ms	2.5 m/s ≤ ΔV ≤ 3.0 m/s		
	@ 20 ms	3.4 m/s ≤ ΔV ≤ 3.9 m/s		
Plane D Rotation		Peak moment: 23.5 ≤ moment ≤ 32.0 N-m During the rotation range: 76.5 ≤ angle ≤ 87.5 degrees	____ Nm @ ___degrees	____ Nm @ ___degrees
Negative Moment Decay		Time to decay to zero angle: 61 ≤ time ≤ 71 ms		

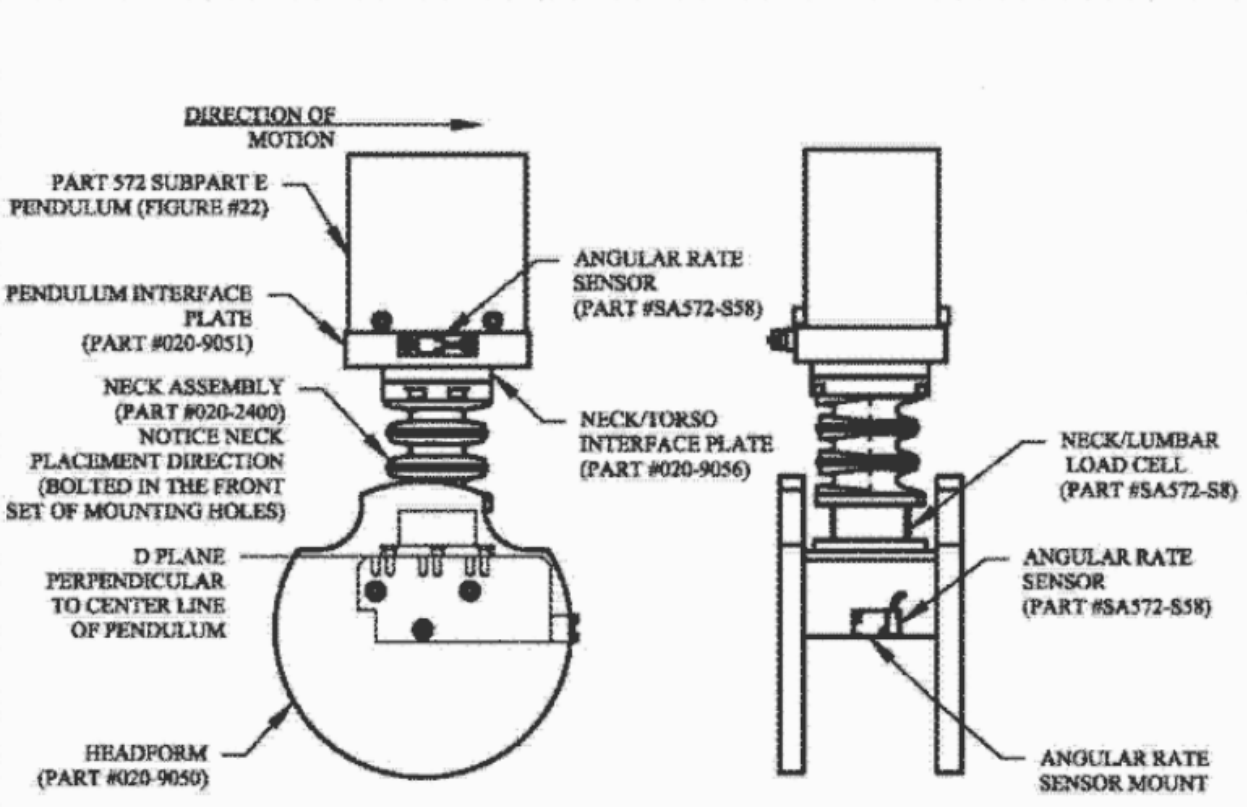


FIGURE 13. NECK LATERAL TEST SET-UP SEPICIFICATIONS

DATA SHEET 6
LATERAL NECK FLEXION TEST (572.213(b)(3))

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive flexion tests are necessary)

__1. It has been at least 30 minutes since the last neck test.
__2. The components required for the neck torsion tests include the neck assembly shown in Figure 14. This assembly consists of the neck twist fixture (drawing DL210-200) with rotary potentiometer installed (drawing SA572-S51), neck adaptor plate assembly (drawing DL210-220), neck assembly (drawing 020-2400), six-channel neck/lumbar load cell (drawing SA572-S8), and twist fixture end plate (drawing DL210-210).
__3. The assembly has soaked 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. (572.213(c)(1))
Record temperature _____
Record humidity _____
__4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the low-risk deployment test, the damaged area is to be documented with photography and the posttest calibration verification testing completed before any replacement or repairs are made.
Record findings and actions: _____
_____
_____
_____
_____
__5. Torque the neck cable adjust nut (020-2421) on the neck cable (020-2415) to 0.2 N-m (2 in-lb).
__6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__7. The test fixture pendulum conforms to the specifications in Figure 15. (572.33(c)(3))
__8. Mount the neck assembly, defined in paragraph (a)(2) of this section, on the pendulum, as shown in Figure 14. (572.213(c)(2)(iii))
__9. Install the transducers or other devices for measuring the pendulum rotation with respect to the pendulum longitudinal centerline. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly.
__10. All instrumentation data channels are defined to be zero when the zero pins are installed such that the neck is not in torsion. (572.213(b)(3)(iii))

__11. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 3.6 ± 0.1 m/s (11.8 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero. (572.213(c)(3)(iii))
__12. Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 8. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero. (572.213(c)(3)(ii))
__13. Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.213(c)(3)(iii))
__14. Repeat for opposite side torsion (right or left).
__15. Record results in Table 8:

TABLE 7. TORSION NECK CALIBRATION RESULTS (572.213(b)(3)) & 572.213(c)(3)

Parameter		**Specification**	**Result**	
			Left Torsion	**Right Torsion**
Pendulum Impact Speed		3.5 m/s ≤ speed ≤ 3.7 m/s		
Pendulum ΔV with respect to impact speed	@ 10 ms	0.9 m/s ≤ ΔV ≤ 1.3 m/s		
	@ 15 ms	1.4 m/s ≤ ΔV ≤ 2.0 m/s		
	@ 20 ms	2.0 m/s ≤ ΔV ≤ 2.6 m/s		
Pendulum Rotation		Peak moment: 8.0 ≤ moment ≤ 10.0 N-m During the rotation range: 74.5 ≤ angle ≤ 91.0 degrees	____ Nm @ ___degrees	____ Nm @ ___degrees
Negative Moment Decay		Time to decay to zero angle: 85 ≤ time ≤ 102 ms		

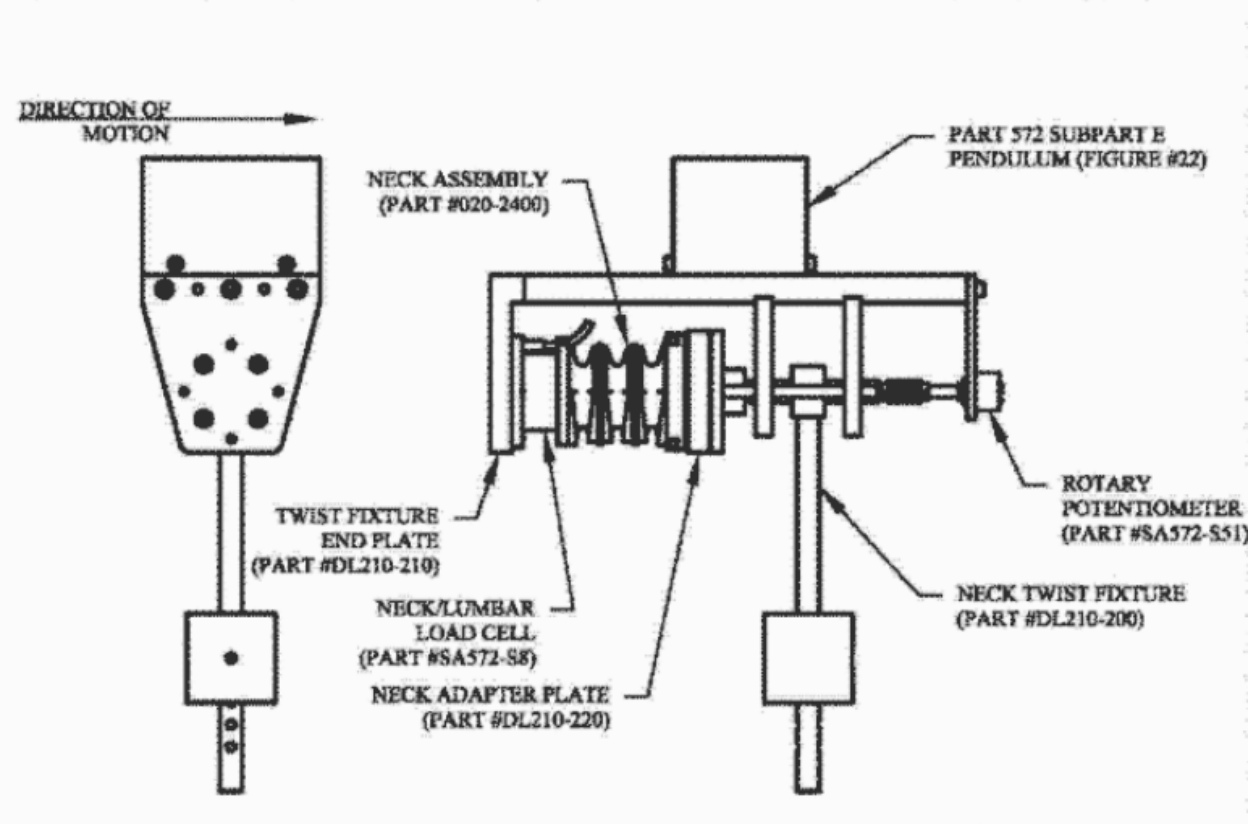


FIGURE 14. NECK TORSION TEST SET-UP SPECIFICATIONS

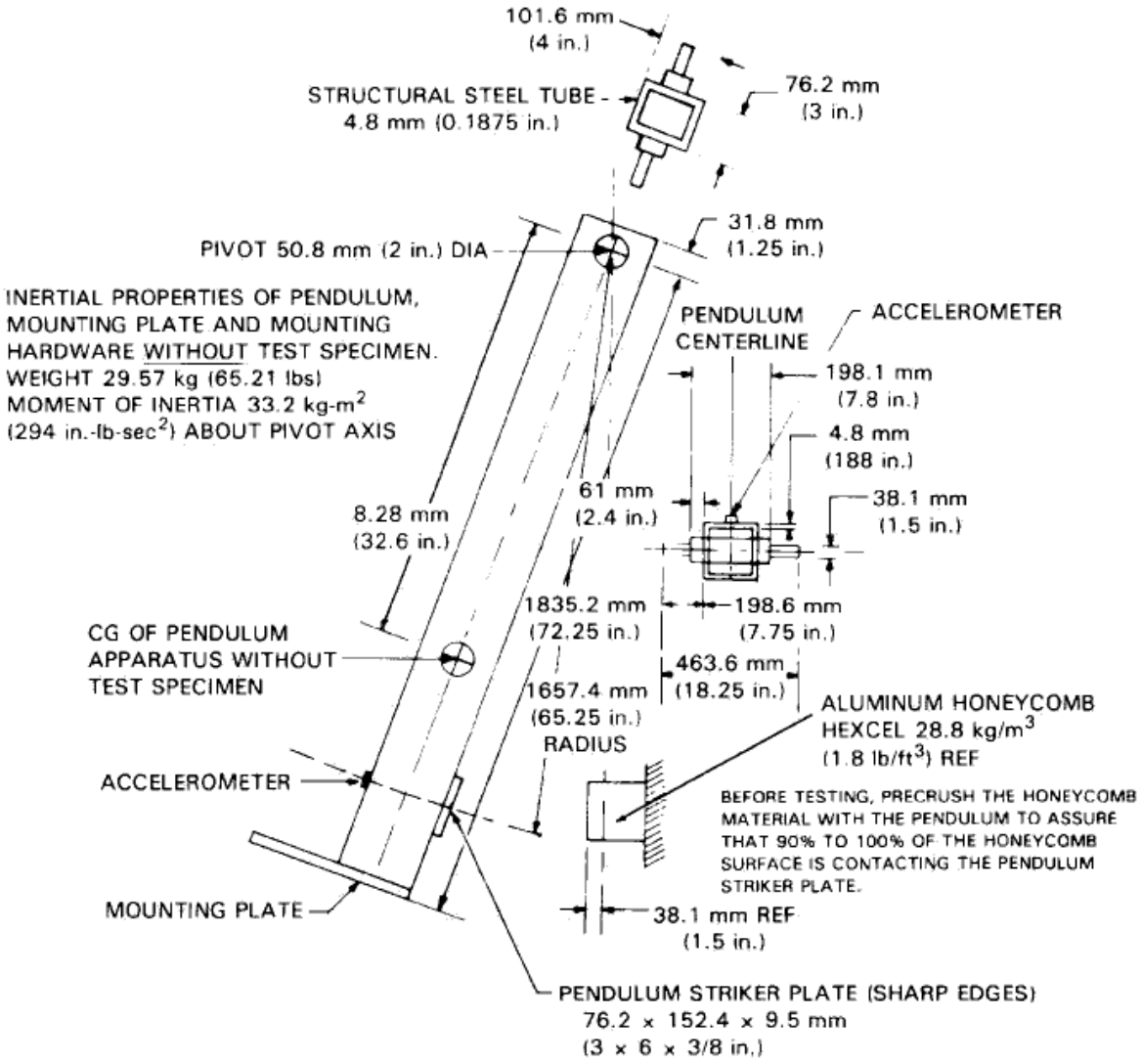


FIGURE 15. NECK CALIBRATION TEST PENDULUM SPECIFICATIONS

14.5 SHOULDER CALIBRATION CHECKLIST

DATA SHEET 7
SHOULDER IMPACT TESTS (572.214)

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive impact tests are necessary)

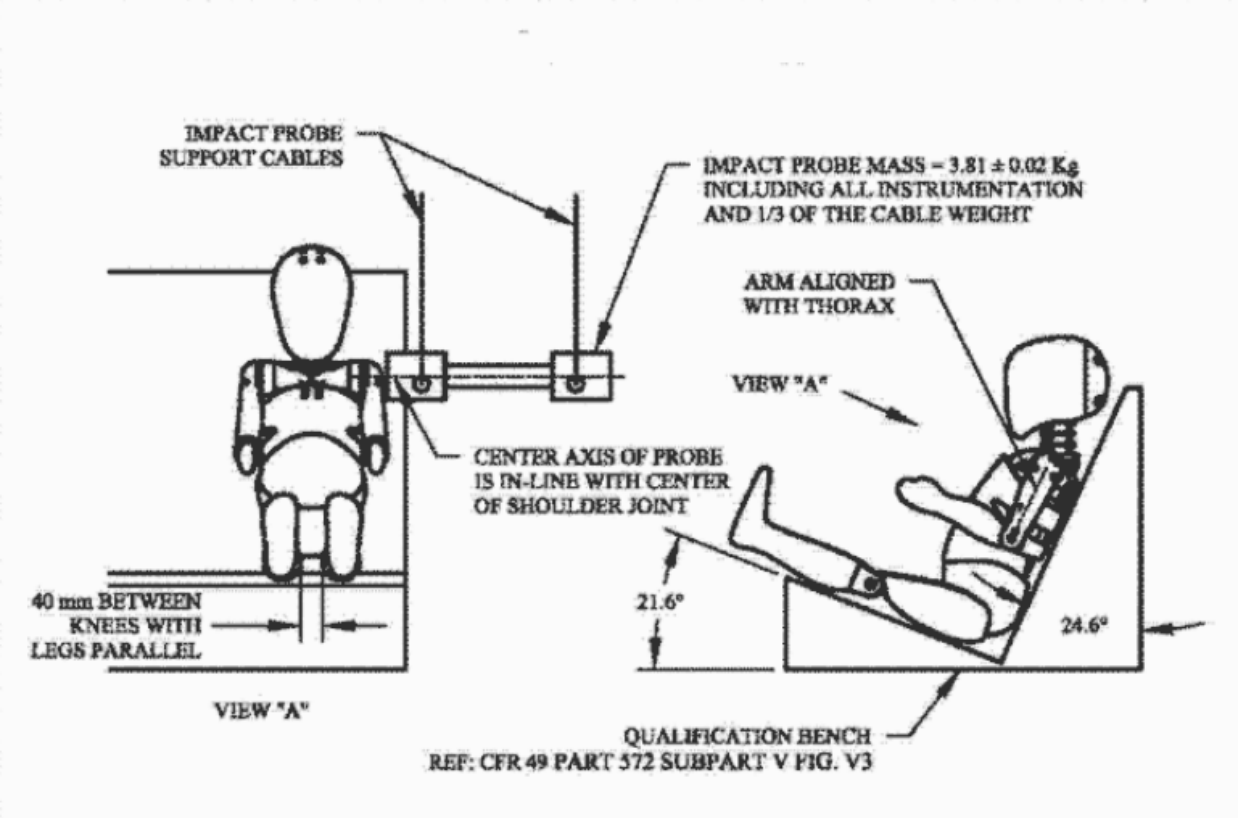
__1. It has been at least 30 minutes since the last shoulder test.
__2. The components required for the shoulder calibration tests consist of the torso assembly (drawing 020-4500) with string pot assembly (drawing SA572-S38 or SA572-S39) installed. (572.214(a))
__3. The assembly has soaked in a controlled 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. (572.214(c)(2))
Record temperature _____
Record humidity _____
__4. The target point of the impact is a point on the shoulder that is 15 mm above and perpendicular to the midpoint of a line connecting the centers of the bolt heads of the two lower bolts (part #5000010) that connect the upper arm assembly (020-9750) to the shoulder ball retaining ring (020-3533). (572.214(c)(5))
__5. Cloth the dummy in the Q3s suit (drawing 020-8001). No additional clothing or shoes are placed on the dummy. (572.214(c)(1))
__6. Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench. (572.214(c)(3))
__7. Position the dummy on the bench as shown in Figure 16 (572.214(c)(4))
__7a. The ribs contact the seat back oriented 24.6 degrees relative to vertical
__7b. The legs are extended forward along the seat pan oriented 21.6 degrees relative to horizontal
__7c. The knees are spaced 40 mm (1.57 in) apart
__7d. The upper arms are parallel to the seat back (±2 degrees)
__7e. The lower arms are parallel to the dummy's sagittal plane and perpendicular to the upper arms.
__7f. Move the elbows inward (medially) until initial contact occurs between the sleeve and the portion of the suit covering the thorax while maintaining the relationships between the arms, seat back, and sagittal plane.
__8. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__9. Install the transducers or other devices for measuring the impact probe force.
__10. Time zero is defined as the time of initial contact between the test probe and the shoulder. Force = impactor mass x acceleration (572.214(b)(2)) & (572.214(b)(3))

__11. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 3.6 ± 0.1 m/s (11.8 ± 0.3 ft/s), measured by an accelerometer mounted on the impact probe. (572.214(b))
__12. Impact the shoulder with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degree), and the centerline of the probe should be within 2 mm (0.08 in) of the target point. (572.214(c)(6))
__13. The probe is guided during impact so that there is no significant lateral, vertical, or rotational movement. (572.214(c)(7))
__14. No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, contact the dummy during the test. (572.214(c)(8))
__15. Repeat for opposite side shoulder (right or left).
__16. Record results in Table 9:

TABLE 8. SHOULDER IMPACT CALIBRATION RESULTS (572.214(b))

Parameter	Specification	Results	
		Left Shoulder	Right Shoulder
Test Probe Speed	3.5 m/s ≤ speed ≤ 3.7 m/s		
Shoulder Compression	17.0 mm ≤ compression ≤ 22.0 mm		
Peak Force	1123 N ≤ peak force ≤ 1437 N		

FIGURE 16. LATERAL SHOULDER IMPACT TEST SET-UP SPECIFICATIONS



14.6 THORAX WITH ARM CALIBRATION CHECKLIST

DATA SHEET 8
THORAX WITH ARM IMPACT TESTS (572.215)

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive impact tests are necessary)

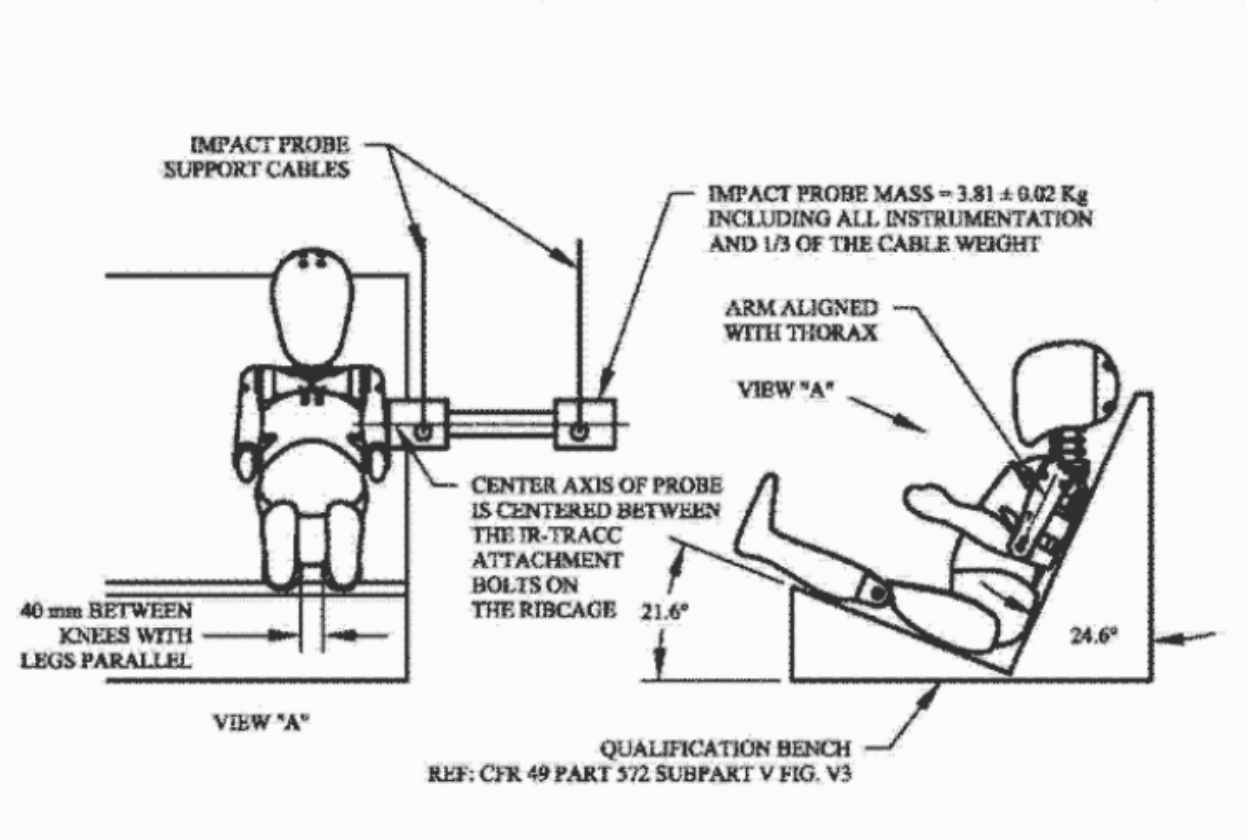
__1. It has been at least 30 minutes since the last shoulder test.
__2. The components required for this thorax test consists of the torso assembly (drawing 020-4500) with an IR-TRACC (drawing SA572-S37) installed. (572.215(a))
__3. The assembly has soaked in a controlled environment at any temperature 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. (572.215(c)(2))
Record temperature _____
Record humidity _____
__4. The target point of the impact is the point of intersection on the lateral aspect of the upper arm and a line projecting from the thorax of the dummy. (572.215(c)(5))
__5. The projecting line is horizontal, runs parallel to the coronal plane of the dummy, and passes through the midpoint of a line connecting the centers of the bolt heads of the two IR-TRACC mounting bolts. The projected line should intersect the upper arm within 2 mm of its long axis. (572.215(c)(5))
__6. Cloth the dummy in the Q3s suit (drawing 020-8001). No additional clothing or shoes are placed on the dummy. (572.215(c)(1))
__7. Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench. (572.215(c)(3))
__8. Position the dummy on the bench as shown in Figure 17 (572.215(c)(4))
__8a. The ribs contact the seat back oriented 24.6 degrees relative to vertical
__8b. The legs are extended forward along the seat pan oriented 21.6 degrees relative to horizontal
__8c. The knees are spaced 40 mm (1.57 in) apart
__8d. The upper arm on the non-impact side of the dummy is positioned parallel to the seat back (±2 degrees).
__8e. The upper arm on the impact side is positioned such that the target point intersects its long axis.
__8f. The lower arms are parallel to the dummy's sagittal plane and perpendicular to the upper arms.
__8g. The elbows are moved inward (medially) until initial contact occurs between the sleeve and the portion of the suit covering the thorax while maintaining the relationships between the arms, seat back, and sagittal plane.

__9. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__10. Install the transducers or other devices for measuring the impact probe force.
__11. Time zero is defined as the time of initial contact between the test probe and the arm. Force = impactor mass x acceleration (572.215(b)(2)) & (572.215(b)(3))
__12. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 5.0 ± 0.1 m/s (16.4 ± 0.3 ft/s), measured by an accelerometer mounted on the impact probe. (572.215(b))
__13. Impact the arm with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degree), and the centerline of the probe should be within 2 mm (0.08 in) of the target point. (572.215(c)(6))
__14. The probe is guided during impact so that there is no significant lateral, vertical, or rotational movement. (572.215(c)(7))
__15. No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, contact the dummy during the test. (572.215(c)(8))
__16. Repeat for opposite side arm (right or left).
__17. Record results in Table 10:

TABLE 9. THORAX WITH ARM IMPACT CALIBRATION RESULTS (572.215(b))

Parameter	**Specification**	**Results**	
		Left Arm	**Right Arm**
Test Probe Speed	4.9 m/s ≤ speed ≤ 5.1 m/s		
IR-TRACC Compression	22.5 mm ≤ compression ≤ 27.5 mm		
Peak Force after 5ms	1360 N ≤ peak force ≤ 1695 N		

FIGURE 17. LATERAL THORAX WITH ARM IMPACT TEST SET-UP SPECIFICATIONS



14.7 THORAX WITHOUT ARM CALIBRATION CHECKLIST

DATA SHEET 9
THORAX WITHOUT ARM IMPACT TESTS (572.216)

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive impact tests are necessary)

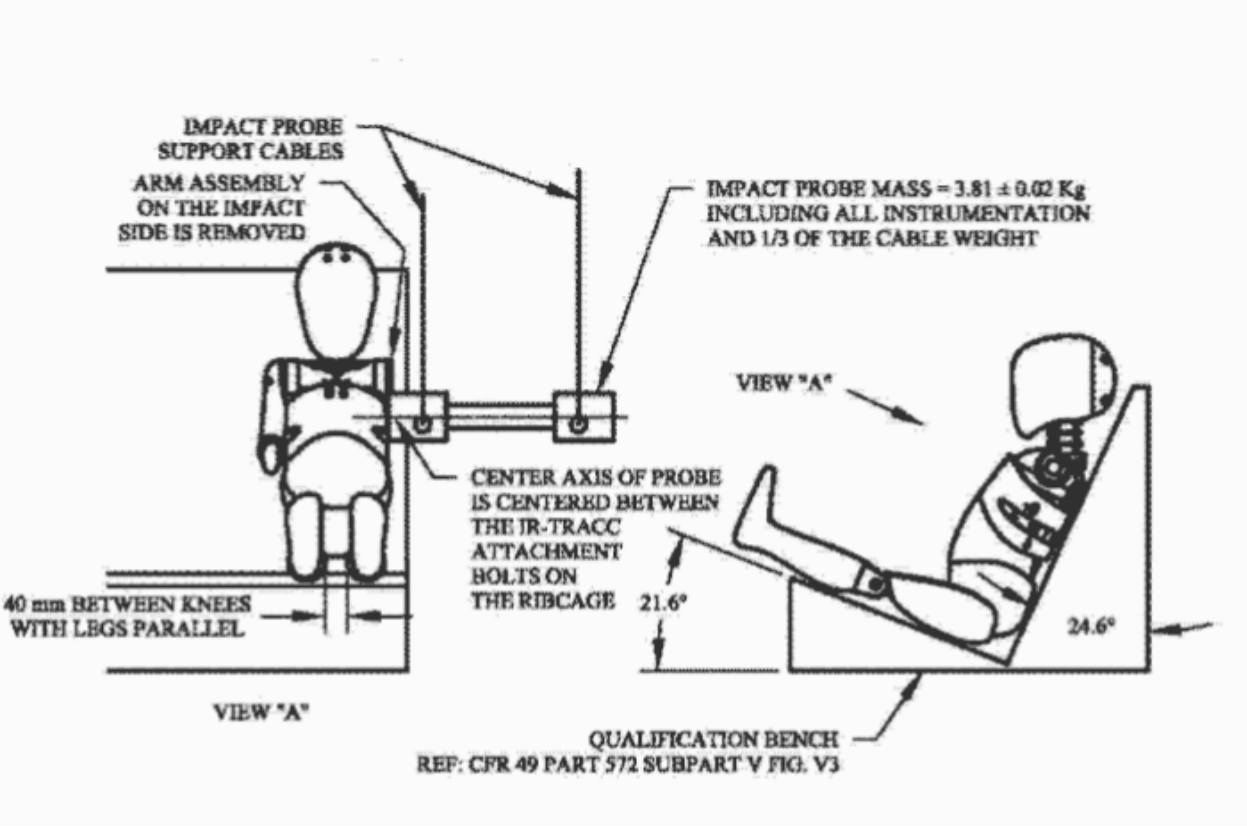
__1. It has been at least 30 minutes since the last shoulder test.
__2. The components required for this thorax test consists of the torso assembly (drawing 020-4500) with an IR-TRACC (drawing SA572-S37) installed and the arm on the impacted side removed. (572.216(a)) & (572.216(b))
__3. The assembly has soaked 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. (572.216(c)(2))
Record temperature _____
Record humidity _____
__4. The target point of the impact is the midpoint of a line between the centers of the bolt heads of the two IR-TRACC bolts. (572.216(c)(5))
__6. Cloth the dummy in the Q3s suit (drawing 020-8001). No additional clothing or shoes are placed on the dummy. (572.216(c)(1))
__7. Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench. (572.216(c)(3))
__8. Position the dummy on the bench as shown in Figure 18 (572.216(c)(4))
__8a. The ribs contact the seat back oriented 24.6 degrees relative to vertical
__8b. The legs are extended forward along the seat pan oriented 21.6 degrees relative to horizontal
__8c. The knees are spaced 40 mm (1.57 in) apart
__8d. The upper arm on the non-impact side of the dummy is positioned parallel to the seat back (±2 degrees).
__8e. The lower arm is perpendicular to the upper arm.
__9. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__10. Install the transducers or other devices for measuring the impact probe force.
__11. Time zero is defined as the time of initial contact between the test probe and the arm. Force = impactor mass x acceleration (572.216(b)(2))
__12. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 3.3 ± 0.1 m/s (10.8 ± 0.3 ft/s), measured by an accelerometer mounted on the impact probe. (572.216(b))

__13. Impact the thorax with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degrees), and the centerline of the probe should be within 2 mm of the target point. (572.216(c)(6))
__14. The probe is guided during impact so that there is no significant lateral, vertical, or rotational movement. (572.216(c)(7))
__15. No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, contact the dummy during the test. (572.216(c)(8))
__16. Repeat for opposite side (right or left).
__17. Record results in Table 11:

TABLE 10. THORAX WITHOUT ARM IMPACT CALIBRATION RESULTS (572.216(b))

Parameter	Specification	Results	
		Left Impact	Right Impact
Test Probe Speed	3.2 m/s ≤ speed ≤ 3.4 m/s		
IR-TRACC Compression	24.5 mm ≤ compression ≤ 30.5 mm		
Peak Force	610 N ≤ peak force ≤ 754 N		

FIGURE 18. LATERAL THORAX WITHOUT ARM IMPACT TEST SET-UP SPECIFICATIONS



14.8 LUMBAR SPINE CALIBRATION CHECKLISTS

DATA SHEET 10
FORE-AFT LUMBAR FLEXION TEST (572.217(b)(1))

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive flexion tests are necessary)

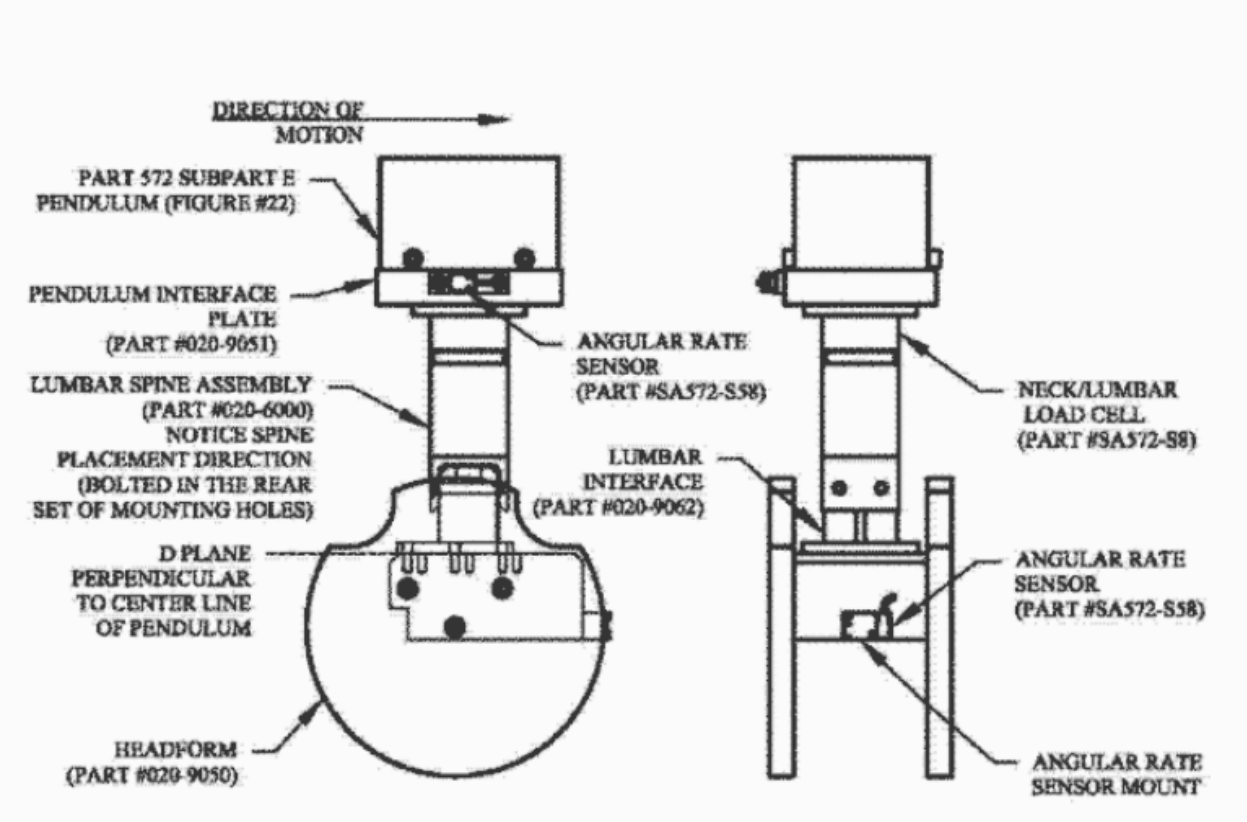
__1. It has been at least 30 minutes since the last neck test.
__2. The components required for the fore-aft lumbar flexion tests include the headform (drawing 020-9050, sheet 2) with angular rate sensor installed (drawing SA572-S58), six-channel neck/lumbar load cell (drawing SA572-S8), lumbar spine assembly (drawing 020-6000), lumbar interface plate (drawing 020-9062) and pendulum interface plate (drawing 020-9051) with angular rate sensor installed (drawing SA572-S58). (572.217(a)(1))
__3. The assembly has soaked 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. (572.217(c)(1))
Record temperature _____
Record humidity _____
__4. Visually inspect lumbar assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the low-risk deployment test, the damaged area is to be documented with photography and the posttest calibration verification testing completed before any replacement or repairs are made.
Record findings and actions: _____
_____
_____
_____
_____
__5. Torque the jam nut on the lumbar cable to 0.2 N-m (2 in-lb).
__6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__7. The test fixture pendulum conforms to the specifications in Figure 15. (572.33(c)(3))
__8. Mount the lumbar spine and headform assembly so that the midsagittal plane of the headform is vertical and coincides with the plane of motion of the pendulum, and with the lumbar spine placement such that the front side of the lumbar spine is closest to the honeycomb material as shown in Figure 19. (572.217(c)(2)(i))
__9. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the top horizontal surface of the neck/lumbar load cell. These measurement devices should be designed to minimize their influence upon the performance of the head-lumbar spine assembly.

__11. Plane D is perpendicular ± 1° to the centerline of the pendulum.
__12. Set the instrumentation so that the moment and rotation are defined to be zero when the longitudinal centerline of the lumbar spine and pendulum are parallel. (572.217(b)(1)(iii))
__13. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.4 ± 0.1 m/s (14.4 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero. (572.217(c)(3)(i))
__14. Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 12. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero. (572.217(c)(3)(ii))
__15. Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.217(c)(3)(iii))
__16. Record results in Table 12:

TABLE 11. FORE-AFT LUMBAR SPINE CALIBRATION RESULTS (572.217(b)(1)) & 572.217(c)(3)

Parameter		**Specification**	**Result**
Pendulum Impact Speed		4.3 m/s ≤ speed ≤ 4.5 m/s	
Pendulum ΔV with respect to impact speed	@ 10 ms	1.3 m/s ≤ ΔV ≤ 1.7 m/s	
	@ 20 ms	2.7 m/s ≤ ΔV ≤ 3.7 m/s	
	@ 30 ms	4.1 m/s ≤ ΔV ≤ 4.9 m/s	
Plane D Rotation		Peak moment: 78.2 ≤ moment ≤ 96.2 N-m During the rotation range: 47.0 ≤ angle ≤ 58.5 degrees	____ Nm @ ___degrees
Negative Moment Decay		Time to decay to zero angle: 49 ≤ time ≤ 59 ms	

FIGURE 19. LUMBAR FORE-AFT FLEXION TEST SET-UP SPECIFICATIONS



DATA SHEET 11
LATERAL LUMBAR FLEXION TESTS (572.217(b)(2))

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive flexion tests are necessary)

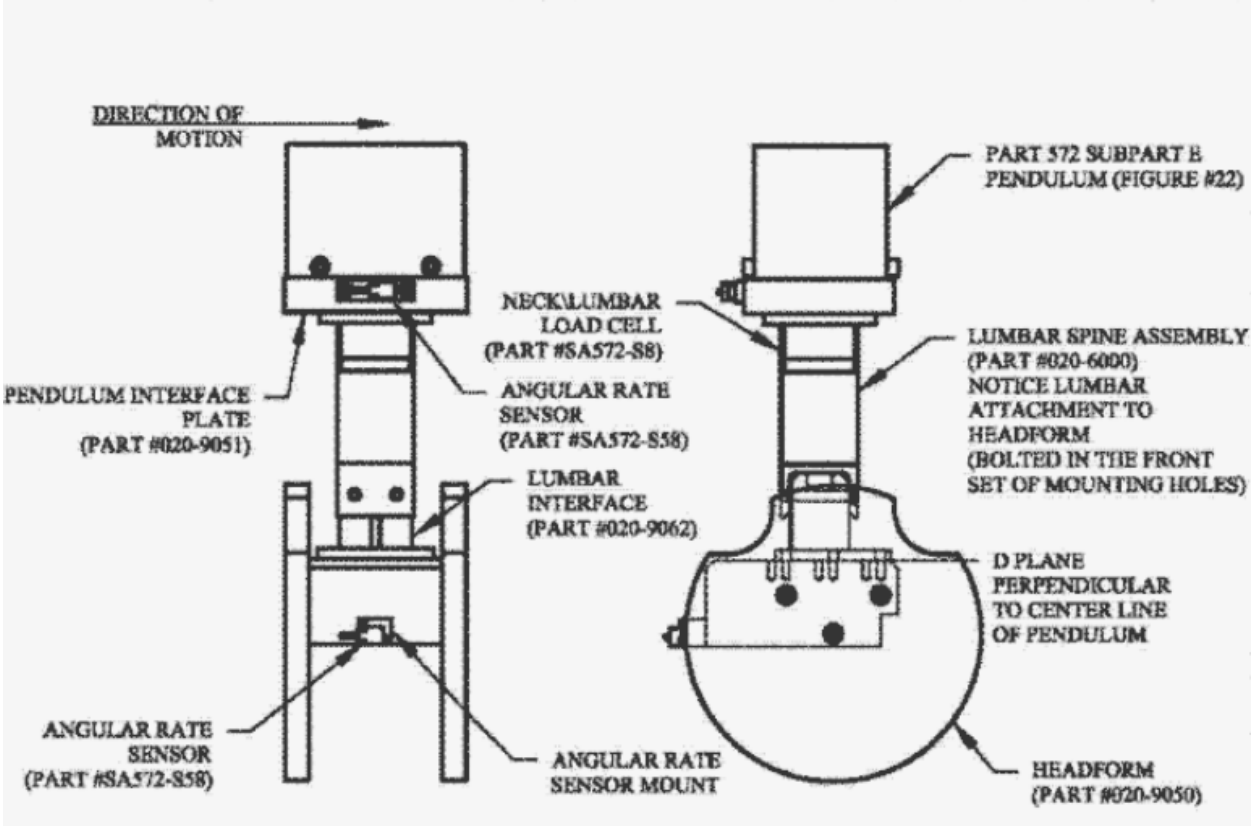
__1. It has been at least 30 minutes since the last neck test.
__2. The components required for the lateral lumbar flexion tests include the headform (drawing 020-9050, sheet 2) with angular rate sensor installed (drawing SA572-S58), six-channel neck/lumbar load cell (drawing SA572-S8), lumbar spine assembly (drawing 020-6000), lumbar interface plate (drawing 020-9062) and pendulum interface plate (drawing 020-9051) with angular rate sensor installed (drawing SA572-S58). (572.217(a)(1))
__3. The assembly has soaked 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. (572.217(c)(1))
Record temperature _____
Record humidity _____
__4. Visually inspect lumbar assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the low-risk deployment test, the damaged area is to be documented with photography and the posttest calibration verification testing completed before any replacement or repairs are made.
Record findings and actions: _____
_____
_____
_____
_____
__5. Torque the jam nut on the lumbar cable to 0.2 N-m (2 in-lb).
__6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__7. The test fixture pendulum conforms to the specifications in Figure 15. (572.33(c)(3))
__8. Mount the lumbar spine and headform assembly on the pendulum described in Figure 20 to so that the midsagittal plane of the headform is vertical and perpendicular to the direction of motion of the pendulum, and with the lumbar spine placement such that the right (or left) side of the lumbar spine is closest to the honeycomb material. (572.217(c)(2)(ii))
__9. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the top horizontal surface of the neck/lumbar load cell. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly.
__11. Plane D is perpendicular ± 1° to the centerline of the pendulum.

__12. Set the instrumentation so that the moment and rotation are defined to be zero when the longitudinal centerline of the lumbar and pendulum are parallel. (572.217(b)(2)(iii))
__13. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.4 ± 0.1 m/s (14.4 ± 0.3 ft/s), measured by an accelerometer mounted on the pendulum at time zero. (572.217(c)(3)(i))
__14. Stop the pendulum from the initial velocity with an acceleration vs. time pulse that meets the velocity change as specified in Table 13. Integrate the pendulum accelerometer data channel to obtain the velocity vs. time curve beginning at time zero. (572.217(c)(3)(ii))
__15. Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.217(c)(3)(iii))
__16. Repeat for opposite side flexion (right or left).
__17. Record results in Table 13:

TABLE 12. LATERAL LUMBAR SPINE CALIBRATION RESULTS (572.217(b)(2)) & 572.217(c)(3)

Parameter		**Specification**	**Result**	
			Left Flexion	**Right Flexion**
Pendulum Impact Speed		4.3 m/s ≤ speed ≤ 4.5 m/s		
Pendulum ΔV with respect to impact speed	@ 10 ms	1.3 m/s ≤ ΔV ≤ 1.7 m/s		
	@ 20 ms	2.7 m/s ≤ ΔV ≤ 3.7 m/s		
	@ 30 ms	4.0 m/s ≤ ΔV ≤ 4.8 m/s		
Plane D Rotation		Peak moment: 46.1 ≤ moment ≤ 58.2 N-m During the rotation range: 79.4 ≤ angle ≤ 98.1 degrees	_____ Nm @ ___degrees	_____ Nm @ ___degrees
Negative Moment Decay		Time to decay to zero angle: 48 ≤ time ≤ 59 ms		

FIGURE 20. LUMBAR LATERAL FLEXION TEST SET-UP SPECIFICATIONS



14.8 PELVIS CALIBRATION CHECKLIST

DATA SHEET 12
PELVIS IMPACT TEST (572.218)

Dummy Serial Number _____ Test Date _____

Technician _____

__Pretest calibration
__Posttest calibration verification

Test attempt no. ____ (when successive impact tests are necessary)

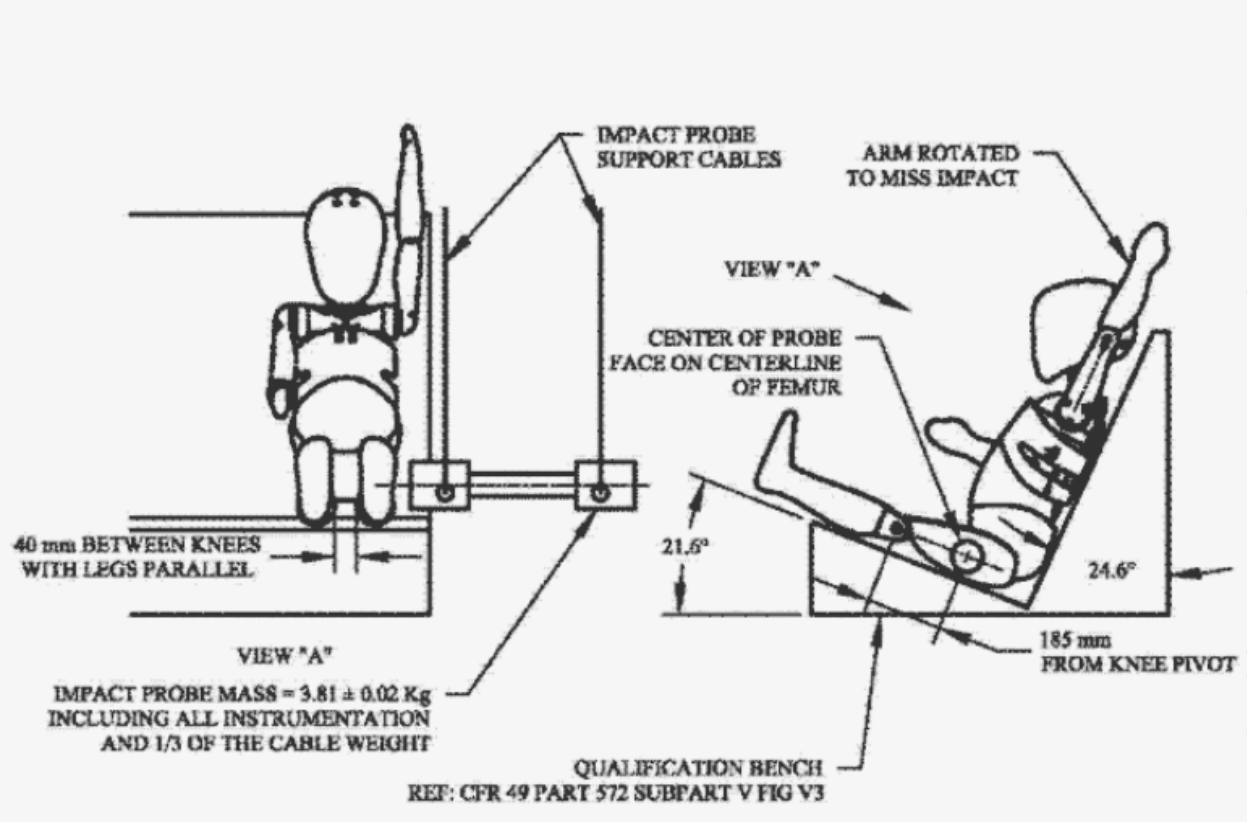
__1. It has been at least 30 minutes since the last impact test.
__2. The components required for this test consists of the pelvis assembly (drawing 020-7500) with either a uniaxial pubic load cell (drawing SA572-S7) or a pubic load cell structural replacement (drawing 020-7150) installed on the non-impact side of the pelvis. (572.218(a))
__3. The assembly has soaked 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. (572.218(c)(2))
Record temperature _____
Record humidity _____
__4. The target point of the impact is located at the center of the pelvis so that the impact point of the longitudinal centerline of the probe is located 185 mm from the center of the knee pivot screw (part #020-9008) and centered vertically on the femur. (572.218(c)(5))
__6. Cloth the dummy in the Q3s suit (drawing 020-8001). No additional clothing or shoes are placed on the dummy. (572.218(c)(1))
__7. Seat the dummy on the qualification bench described in Figure 5, the seat pan and seat back surfaces of which are covered with thin sheets of PTFE (Teflon) (nominal stock thickness: 2 to 3 mm) along the impact side of the bench. (572.218(c)(3))
__8. Position the dummy on the bench as shown in Figure 21 (572.218(c)(4))
__8a. The ribs contact the seat back oriented 24.6 degrees relative to vertical
__8b. The legs are extended forward along the seat pan oriented 21.6 degrees relative to horizontal
__8c. The knees are spaced 40 mm (1.57 in) apart
__8d. The upper arm on the non-impact side of the dummy is positioned parallel to the seat back (±2 degrees).
__8e. The lower arm is perpendicular to the upper arm.
__8e. The arm on the impacted side is positioned upwards away from the pelvis.
__9. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211. (572.219(c))
__10. Install the transducers or other devices for measuring the impact probe force.
__11. Time zero is defined as the time of initial contact between the test probe and the pelvis. Force = impactor mass x acceleration (572.218(b)(2))

__12. Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 4.0 ± 0.1 m/s (13.1 ± 0.3 ft/s), measured by an accelerometer mounted on the impact probe. (572.218(b))
__13. Impact the pelvis with the test probe so that at the moment of contact the probe's longitudinal centerline should be horizontal (±1 degrees), and the centerline of the probe should be within 2 mm of the target point. (572.218(c)(6))
__14. The probe is guided during impact so that there is no significant lateral, vertical, or rotational movement. (572.218(c)(7))
__15. No suspension hardware, suspension cables, or any other attachments to the probe, including the velocity vane, contact the dummy during the test. (572.218(c)(8))
__16. Repeat for opposite side (right or left).
__17. Record results in Table 14:

TABLE 13. PELIVS IMPACT CALIBRATION RESULTS (572.218(b))

Parameter	Specification	Results	
		Left Impact	Right Impact
Test Probe Speed	3.9 m/s ≤ speed ≤ 4.1 m/s		
Peak Force	1587 N ≤ peak force ≤ 1587 N		

FIGURE 21. PELVIS LATERAL IMPACT TEST SET-UP SPECIFICATIONS



14.9 INSTRUMENTATION CALIBRATION

DATA SHEET 13
PART 572 INSTRUMENTATION CALIBRATION

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	CALIBRATION DUE DATE
DUMMY INSTRUMENTATION					
Head Ax					
Head Ay					
Head Az					
Neck Load Cell					
Head/Neck Form Angular Rate Sensor					
Shoulder String Potentiometer					
Chest Ax					
Chest Ay					
Chest Az					
IR TRACC					
Head/Pelvis Form Angular Rate Sensor					
Lumbar Load Cell					
LABORATORY INSTRUMENTATION					
Neck Pendulum Accelerometer					
Neck Pendulum Angular Rate Sensor					
Pelvis Pendulum Angular Rate Sensor					
Impact Pendulum Accelerometer					

LABORATORY TECHNICIAN: _____