TABLE 1 TO PARAGRAPH (A)—ES–2RE NECK CERTIFICATION PENDULUM VELOCITY COR-RIDOR—Continued

Upper boundary		Lower boundary	
Time (ms)	Velocity (m/s)	Time (ms)	Velocity (m/s)
3.0	−0.25	2.5	−0.375
14.0	−3.20	13.5	−3.7
		17.0	−3.7

(c) *Performance criteria.* (1) The pendulum deceleration pulse is to be characterized in terms of decrease in velocity as determined by integrating the filtered pendulum acceleration response from time-zero.

(2) The maximum rotation in the lateral direction of the reference plane of the headform (175–9000) as shown in Figure U2–B in appendix A to this subpart, shall be 49 to 59 degrees with respect to the longitudinal axis of the pendulum occurring between 54 and 66 ms from time zero. Rotation of the headform-neck assembly and the neck angle with respect to the pendulum shall be measured with potentiometers specified in § 572.189(c), installed as shown in drawing 175–9000, and calculated per procedure specified in Figure U2–B in appendix A to this subpart;

(3) 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 53 ms to 88 ms after the time the peak translation-rotation value is reached.

[71 FR 75331, Dec. 14, 2006, as amended at 73 FR 33921, June 16, 2008]

§ 572.184 Shoulder assembly.

(a) The shoulder (175–3000) is part of the body assembly shown in drawing 175–0000. When subjected to impact tests specified in paragraph (b) of this section, the shoulder assembly shall meet performance requirements of paragraph (c) of this section.

(b) *Test procedure.* (1) Soak the dummy assembly, without suit and shoulder foam pad (175–3010), in a test environment as specified in § 572.189(n);

(2) The dummy is seated, as shown in Figure U3 in appendix A to this subpart, on a flat, horizontal, rigid surface covered by two overlaid 2 mm thick Teflon sheets and with no back support

of the dummy's torso. The dummy's torso spine backplate is vertical within ±2 degrees and the midsagittal plane of the thorax is positioned perpendicular to the direction of the plane of motion of the impactor at contact with the shoulder. The arms are oriented forward at 50±2 degrees from the horizontal, pointing downward. The dummy's legs are horizontal and symmetrical about the midsaggital plane with the distance between the innermost point on the opposite ankle at 100 ±5 mm. The length of the elastic shoulder cord (175–3015) shall be adjusted so that a force between and including 27.5 and 32.5 N applied in a forward direction at 4 ±1 mm from the outer edge of the clavicle in the same plane as the clavicle movement, is required to initiate a forward motion of 1 to 5 mm;

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

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

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

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

§ 572.185 Thorax (upper torso) assembly.

(a) The thorax assembly of the dummy must meet the requirements of both (b) and (c) of this section. Section 572.185(b) specifies requirements for an individual rib drop test, and § 572.185(c) specifies requirements for a full-body thorax impact test.

(b) *Individual rib drop test.* For purposes of this test, the rib modules (175–4002), which are part of the thorax assembly (175–4000), are tested as individual units. When subjected to test procedures specified in paragraph (b)(1) of this section, the rib modules shall meet performance requirements specified in paragraph (b)(2) of this section.

Each rib is tested at both the 459 mm and 815 mm drop height tests described in paragraphs (b)(1)(v)(A) and (B) of this section.

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

(ii) Mount the rib module rigidly in a drop test fixture as shown in Figure U7 in appendix A to this subpart with the impacted side of the rib facing up;

(iii) The drop test fixture contains a free fall guided mass of 7.78±0.01 kg that is of rigid construction and with a flat impact face 150±1.0 mm in diameter and an edge radius of ±0.25 mm;

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

(v) The impacting mass is dropped from the following heights:

(A) 459 ±5 mm

(B) 815 ±8 mm

(vi) A test cycle consists of one drop from each drop height specified in paragraph (b)(1)(v) of this section. Allow a period of not less than five (5) minutes between impacts in a single test cycle. Allow a period of not less than thirty (30) minutes between two separate cycles of the same rib module.

(2) *Performance criteria.*

(i) Each of the rib modules shall deflect as specified in paragraphs (b)(2)(i)(A) and (B) of this section, with the deflection measurements made with the internal rib module position transducer specified in § 572.189(d):

(A) Not less than 36 mm and not more than 40 mm when impacted by the mass dropped from 459 mm; and,

(B) Not less than 46 mm and not more than 51mm when impacted by the mass dropped from 815 mm.

(c) *Full-body thorax impact test.* The thorax is part of the upper torso assembly shown in drawing 175–4000. For this full-body thorax impact test, the dummy is tested as a complete assembly (drawing 175–0000) with the struck-side arm (175–3500, left arm; 175–3800, right arm) removed. The dummy's thorax is equipped with deflection potentiometers as specified in drawing SA572–S69. When subjected to the test procedures specified in paragraph (c)(1)

of this section, the thorax shall meet the performance requirements set forth in paragraph (c)(2).

(1) *Test Procedure.* (i) Soak the dummy assembly (175–0000), with struck-side arm (175–3500, left arm; 175–3800, right arm), shoulder foam pad (175–3010), and neoprene body suit (175–8000) removed, in a test environment as specified in § 572.189(n);

(ii) The dummy is seated, as shown in Figure U4 in appendix A to this subpart, on a flat, horizontal, rigid surface covered by two overlaid 2 mm thick Teflon sheets and with no back support of the dummy's torso. The dummy's torso spine backplate is vertical within ±2 degrees and the midsagittal plane of thorax is positioned perpendicular to the direction of the plane of motion of the impactor at contact with the thorax. The non-struck side arm is oriented vertically, pointing downward. The dummy's legs are horizontal and symmetrical about the midsagittal plane with the distance between the innermost point on the opposite ankle at 100 ±5 mm;

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

(iv) The impactor is guided, if needed, so that at contact with the thorax its longitudinal axis is within ±0.5 degrees of horizontal and perpendicular ±0.5 degrees to the midsagittal plane of the dummy and the centerpoint of the impactor's face is within 5 mm of the impact point on the dummy's middle rib shown in Figure U4 in appendix A to this subpart;

(v) The impactor impacts the dummy's thorax at 5.5 m/s ±0.1 m/s.

(vi) Time zero is defined in § 572.189(k).

(2) *Performance Criteria.* (i) The individual rib modules shall conform to the following range of deflections:

(A) Upper rib not less than 34 mm and not greater than 41 mm;

(B) Middle rib not less than 37 mm and not greater than 45 mm;

(C) Lower rib not less than 37 mm and not greater than 44 mm.

(ii) The impactor force shall be computed as the product of the impact probe acceleration and its mass. The peak impactor force at any time after 6 ms from time zero shall be not less

than 5100 N and not greater than 6200 N.

[71 FR 75331, Dec. 14, 2006, as amended at 73 FR 33921, June 16, 2008]

§ 572.186 Abdomen assembly.

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

(b) *Test procedure.*

(1) Soak the dummy assembly (175–0000), without suit (175–8000) and shoulder foam pad (175–3010), as specified in § 572.189(n);

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

(3) The abdomen impactor is the same as specified in § 572.189(a) except that on its rectangular impact surface is affixed a special purpose block whose weight is 1.0 ±0.01 kg. The block is 70 mm high, 150 mm wide and 60 to 80 mm deep. The impact surface is flat, has a minimum Rockwell hardness of M85, and an edge radius of 4 to 5 mm. The block's wide surface is horizontally oriented and centered on the longitudinal axis of the probe's impact face as shown in Figure U5–A in appendix A to this subpart;

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

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

(6) Time zero is defined in § 572.189(k).

(c) Performance criteria.

(1) The maximum sum of the forces of the three abdominal load sensors, specified in 572.189(e), shall be not less than 2200 N and not more than 2700 N and shall occur between 10 ms and 12.3 ms from time zero. The calculated sum of

the three load cell forces must be concurrent in time.

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

§ 572.187 Lumbar spine.

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

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

(2) Attach the lumbar spine-headform assembly to the Part 572 pendulum test fixture per procedure in § 572.183(b)(2) and as shown in Figure U2–A in appendix A to this subpart. Torque the lumbar hex nut (p/n 9000057) on to the lumbar cable assembly (175–5506) to 50 ±5 in-lb;

(3) Release the pendulum from a height sufficient to allow it to fall freely to achieve an impact velocity of 6.05 ±0.1 m/s measured at the center of the pendulum accelerometer (Figure 22) at the time the pendulum makes contact with its decelerating mechanism. The velocity-time history of the pendulum falls inside the corridor determined by the upper and lower boundaries specified in Table 1 to paragraph (b) of this section;

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

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

TABLE 1 TO PARAGRAPH (b)—ES–2RE LUMBAR SPINE CERTIFICATION PENDULUM VELOCITY CORRIDOR

Upper boundary		Lower boundary	
Time (ms)	Velocity (m/s)	Time (ms)	Velocity (m/s)
1.0	0.00	0.0	−0.05
3.7	−0.24	2.7	−0.425
27.0	−5.80	24.5	−6.50

143