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Standards and Regulations Division

TEST METHOD 213

Child Restraint Systems

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Standards Research and Development Branch
Road Safety and Motor Vehicle Regulation Directorate
TRANSPORT CANADA
Ottawa, Ontario
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Drawing Package NHTSA SAS-100-1000

Society of Automotive Engineers Recommended Practice J211, *Instrumentation for Impact Tests* (October 1988)

U.S. *Code of Federal Regulations* (October 1, 1996), Title 49, Part 572, Subpart C

American Society for Testing and Materials:

Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber, Designation No. D 1056-1

Standard Specification for Flexible Cellular Materials—Vinyl Chloride Polymers and Copolymers (Open-Cell Foam), Designation No. D 1565-81 (Reapproved 1990)

Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams, Designation No. D 3574-95

1. Introduction

Test Method 213 — Child Restraint Systems (October 2001) is to be used for demonstrating compliance with the requirements of Schedule 3 to the *Motor Vehicle Restraint Systems and Booster Cushions Safety Regulations* (RSSRs).

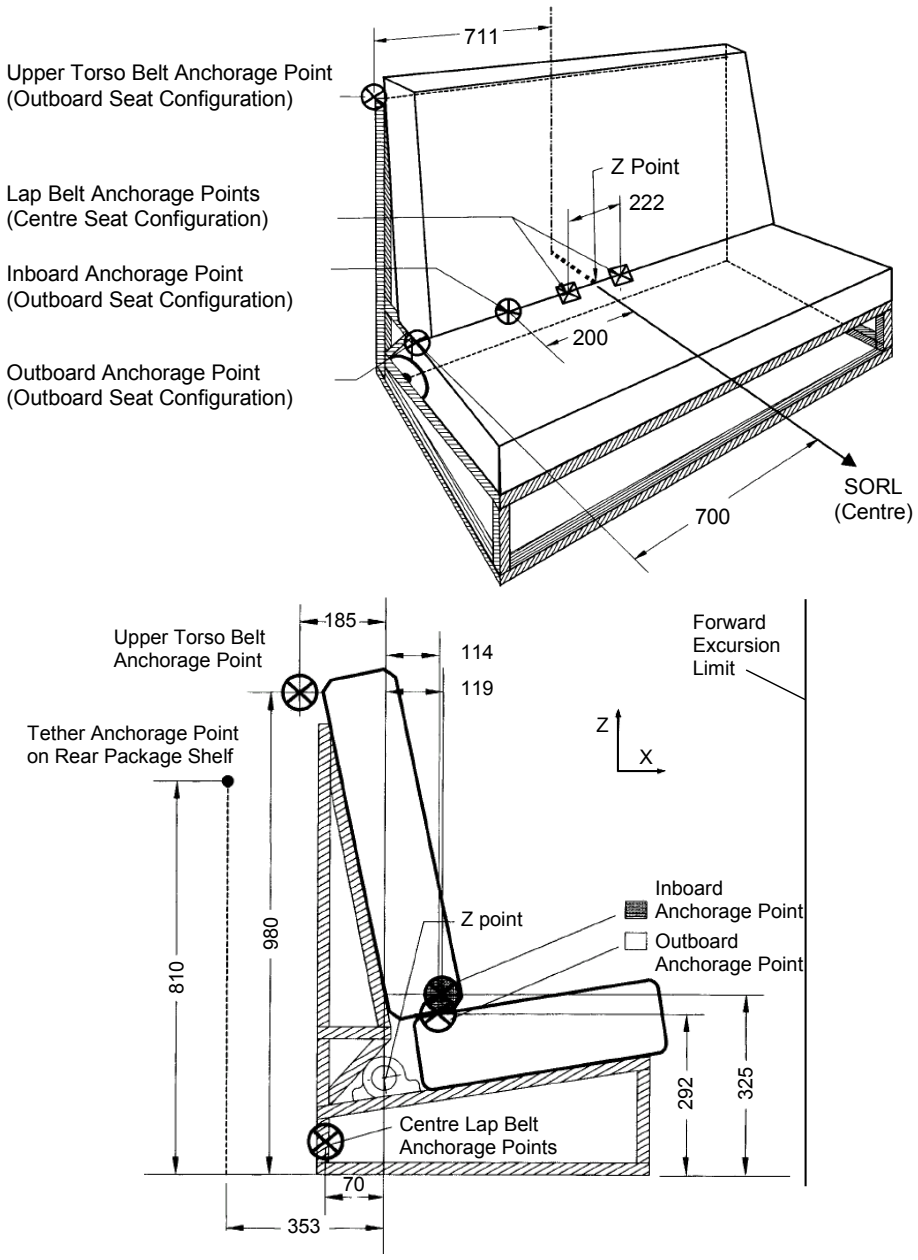
(Original signed by)

Director, Standards Research and Development
for the Minister of Transport
Ottawa, Ontario

2. Test Devices to be Used for the Dynamic Test and the Buckle Release Test

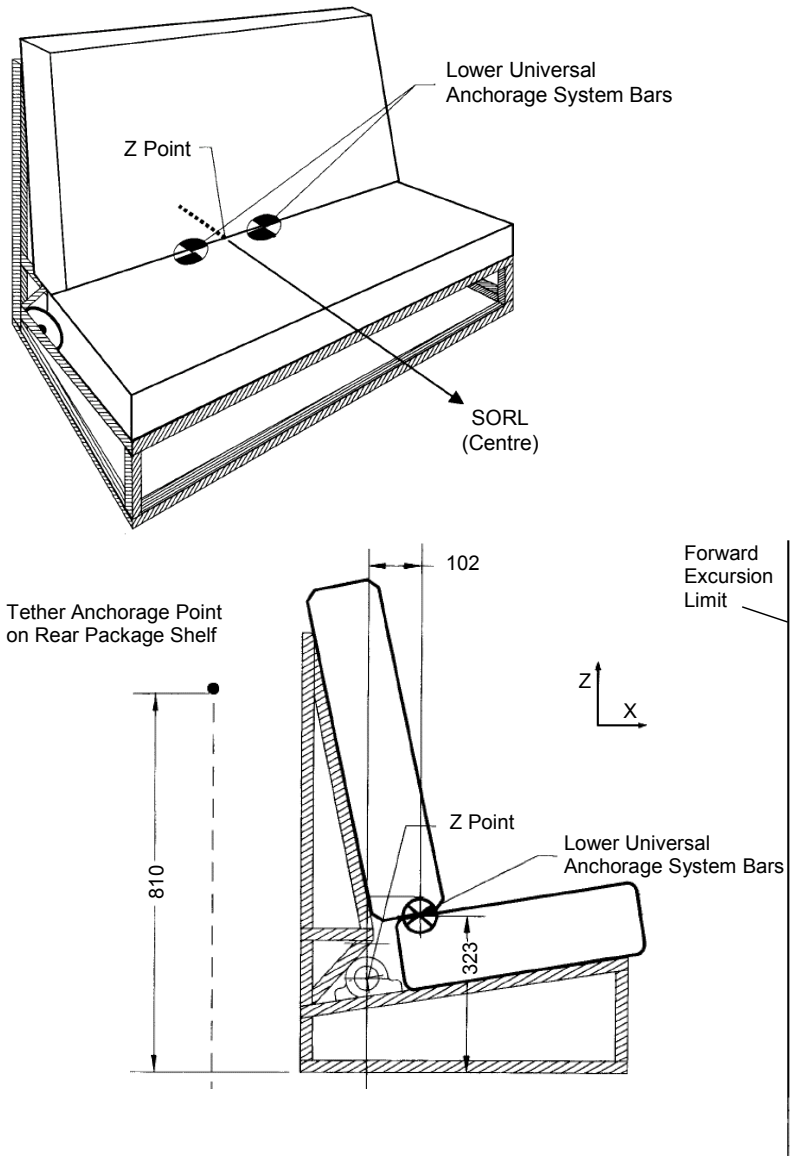
2.1 The seat to be used for the dynamic test prescribed in this test method is the standard seat assembly, as described in Drawing Package NHTSA SAS-100-1000 and shown in Figure 1(a), which indicates the location of the seat belt anchorage points, and Figure 1(b), which indicates the location of the lower universal anchorage system, mounted on a dynamic test platform so that the Seat Orientation Reference Line (SORL) is parallel to the direction of travel of the test platform and so that movement between the base of the assembly and the platform is prevented.

2.1.1 In this test method,"Representative Aircraft Passenger Seat" means, either a production aircraft passenger seat that has been approved by the U.S. Federal Aviation Administration or by Transport Canada's Director, Aircraft Certification, or a simulated aircraft passenger seat that conforms to the requirements of Figure 5.



Notes:
1. Dimensions are in mm, except where otherwise indicated.
2. Drawings are not to scale.
3. Lap belt anchorage points are symmetrically located with respect to the centre SORL.
4. Maximum distance from the seat bight to the end of the buckle is 175 mm.
5. Outboard anchorage point is located 700 mm from the centre SORL.
6. Anchorage point on the rear package shelf is located on the vertical longitudinal plane containing the centre SORL.

Figure 1(a) — Three-dimensional Schematic View and Side View of the Standard Seat Assembly Indicating the Location of the Seat Belt Anchorage Points



Notes:
1. Dimensions are in mm, except where otherwise indicated.
2. Drawings are not to scale.
3. Lower universal anchorage system bars are 6 mm in diameter and 25 mm in length.
4. Transverse horizontal distance between the centre of the bars and the vertical plane containing the SORL at the centre of the seat assembly is 140 mm.
5. Anchorage point on the rear package shelf is located on the vertical longitudinal plane containing the centre SORL.
6. Head excursion limit is 720 mm.
7. Lower universal anchorage system bars are located 102 mm forward of Z Point and 323 mm above the floor.

Figure 1(b) — Three-dimensional Schematic View and Side View of the Standard Seat Assembly Indicating the Location of the Lower Universal Anchorage System

2.2 The test platform must be instrumented with an accelerometer that is linked to a data processing system, and the accelerometer-sensitive axis must be parallel to the direction of travel of the test platform. The data must be filtered with a Class 60 filter, as specified in the Society of Automotive Engineers Recommended Practice (SAE) J211, *Instrumentation for Impact Tests* (October 1988).

2.3 Type 1 or Type 2 seat belt assemblies that meet the requirements of section 209 of the *Motor Vehicle Safety Regulations* and whose webbing is not more than 50 mm wide must be attached, without the use of retractors or reels of any kind, to the seat belt anchorage points provided on the standard seat assembly.

2.4 An anthropomorphic test device (ATD) that represents a three-year-old child and conforms to the requirements of the U.S. *Code of Federal Regulations* (October 1, 1996), Title 49, Part 572, Subpart C, is to be used in the dynamic test and the buckle release test. The ATD must have a target point on each side of the head that is 75 mm from the top surface and 65 mm from the front surface, and it must be clothed in:

(a) thermal knit, waffle-weave polyester and cotton underwear,

(b) a size-4 long-sleeved shirt having a mass of 0.1 kg,

(c) a size-4 pair of long pants having a mass of 0.1 kg and cut off just far enough above the knee to allow the knee target point to be visible, and

(d) size-7M sneakers with rubber toe caps, uppers of dacron and cotton or nylon having a total mass of 0.45 kg.

2.4.1 The clothing of the ATD, other than the shoes, must be machine washed in water that is 70°C to 82°C and machine dried at 48°C to 60°C for 30 minutes.

3. Dynamic Tests

A first dynamic test is to be conducted in accordance with the procedure set out in subsections 3.4 and 3.5 using a new child restraint system that is attached to the standard seat assembly as shown in Figure 1(a) by the seat belt assembly and a tether strap, if one is provided with the system.

A second dynamic test is to be conducted in accordance with the procedure set out in subsections 3.6 and 3.7 using a new child restraint system that is attached to the standard seat assembly as shown in Figure 1(b) by the lower universal anchorage system and a tether strap, if one is provided with the system.

3.1 Test Acceleration

The dynamic tests simulate a frontal impact at 48 km/hr. At all points in time until 48 milliseconds after the start of the pulse, the acceleration of the test platform must be above that indicated by the line shown in Figure 2 and such that the total change of velocity is at least 48 km/h.

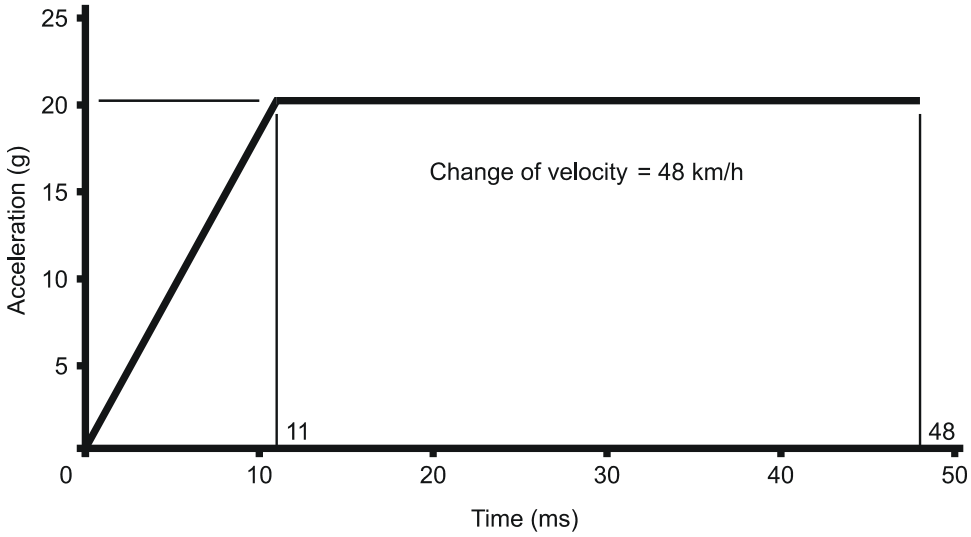


Figure 2 — Test Platform Acceleration Graph

3.2 Test Conditions

For the dynamic tests, the ambient temperature must be from 19°C to 26°C and the relative humidity from 10% to 70%.

3.3 Pre-Test Buckle Release Force Measurement

If the belts of the restraint system are equipped with buckles, the release force of each buckle is to be measured in the following manner before commencing the dynamic tests.

3.3.1 Place the buckle assembly on a hard, level surface.

3.3.2 Apply a pullout force of 9 N to the buckle assembly in a direction that will produce maximum releasing effect, in the case of

(a) A push-button-actuated buckle, at least 3.2 mm from the edge of the push-button access opening of the buckle, or

(b) A lever-actuated buckle, on the centreline of the buckle lever or finger tab.

3.3.3 Measure the force required to release the buckle and determine its conformance to the requirements of Schedule 3 to the RSSRs.

3.4 Positioning of the ATD and Installation of the Restraint System for the Dynamic Test Using the Seat Belt Assembly

3.4.1 In accordance with the manufacturer's instructions, place a new child restraint system at the centre seating position of the standard seat assembly and position each movable surface. If the restraint system is installed by passing the motor vehicle seat belt over the system and under the seated ATD, attach the seat belt to the restraint system, but do not tighten it.

3.4.2 Place the ATD specified in subsection 2.4 in the child restraint system and position it according to the manufacturer's instructions and as follows:

(a) Holding the torso upright until it contacts the seat back of the system, seat the ATD in the child restraint system so that the mid-sagittal plane of its head is coincident with the SORL of the standard seating assembly.

(b) Lift the arms of the ATD as far upward as possible. Extend the legs of the ATD as far forward horizontally as possible, with its feet perpendicular to the centreline of the lower legs.

(c) Using a flat square surface with an area of 2 580 mm^2, apply a force of 180 N perpendicular to the plane of the back of the standard seat assembly, first against the crotch of the ATD and then against the mid-sagittal plane of its thorax.

(d) Attach all the appropriate belts and harnesses on the child restraint system and tighten them as specified in subsection 3.4.3.

(e) Rotate each limb of the ATD downward in a plane parallel to its mid-sagittal plane until the limb touches a surface of the

child restraint system or the standard seat assembly. Position the limbs so that they will not inhibit the movement of the torso or head during the test, and

(i) In the case of a rearward-facing child restraint system for children whose mass is 16 kg or less, if the lower limbs of the ATD contact the seat back of the standard seat assembly, remove the lower limbs at the knees;

(ii) In the case of a rearward-facing child restraint system for children whose mass is 22 kg or less, if the lower limbs of the ATD contact the seat back of the standard seat assembly, remove the lower limbs at the knees and secure each limb on either side of the upper legs of the ATD.

3.4.3 If shoulder and pelvic belts are provided that directly restrain the ATD, they must be adjusted by tightening the belts until a 9-N force applied using a webbing tension pull device (as illustrated in Figure 3) to the webbing at the top of each shoulder and to the pelvic webbing 50 mm on either side of the mid-sagittal plane of the torso pulls the webbing a distance of 7 mm away from the ATD.

3.4.4 In accordance with the manufacturer's instructions, attach the child restraint system, if it is not already installed, to the standard seat assembly using the motor vehicle seat belt and attach the tether strap, if one has been provided. Tighten the seat belt and tether strap to a tension, as measured by a force gauge used on the webbing, of

(a) until August 31, 2002, not less than 31 N and not more than 49 N or, at the option of the manufacturer, not less than 53.5 N and not more that 67 N; and

(b) on or after September 1, 2002, not less than 53.5 N and not more than 67 N.

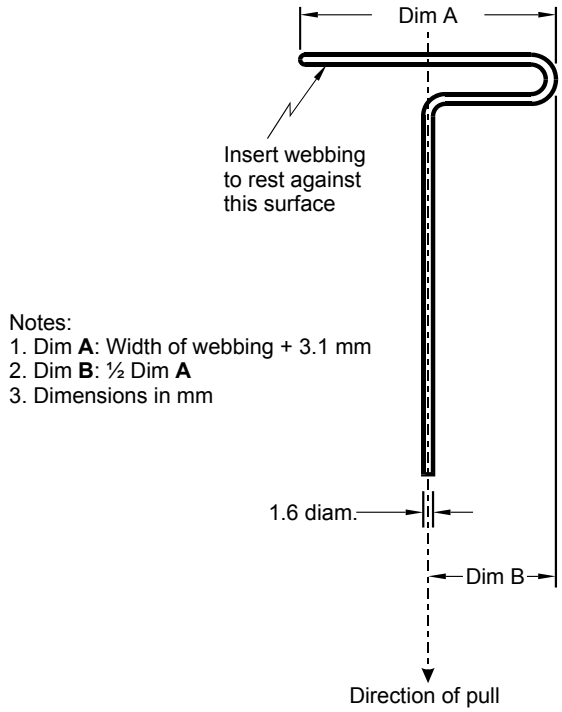


Figure 3 — Webbing Tension Pull Device

3.5 Test Procedure

3.5.1 Accelerate the test platform in accordance with the requirements of subsection 3.1.

3.5.2 Measure the excursion of the ATD and determine the conformance of the child restraint system to the requirements of section 13 of Schedule 3 to the RSSRs.

3.6 Positioning of the ATD and Installation of the Restraint System for the Dynamic Test Using the Lower Universal Anchorage System

3.6.1 In accordance with the manufacturer's instructions, place a new child restraint system at the centre seating position of the standard seat assembly and position each movable surface. As specified in subsection 3.6.4 and in accordance with the manufacturer's instructions, attach the lower connectors of a forward-facing child restraint system to the lower universal anchorage system and attach the tether strap, if one has been provided, to the standard seat assembly, but do not tighten it.

3.6.2 Place the ATD specified in subsection 2.4 in the child restraint system and position it according to the manufacturer's instructions and as follows:

(a) Holding the torso upright until it contacts the seat back of the system, seat the ATD in the child restraint system so that the mid-sagittal plane of its head is coincident with the SORL of the standard seating assembly.

(b) Lift the arms of the ATD as far upward as possible. Extend the legs of the ATD as far forward horizontally as possible, with its feet perpendicular to the centreline of the lower legs.

(c) Using a flat square surface with an area of 2 580 mm^2, apply a force of 180 N perpendicular to the plane of the back of the standard seat assembly, first against the crotch of the ATD and then against the mid-sagittal plane of its thorax.

(d) Attach all the appropriate belts and harnesses on the child restraint system and tighten them as specified in subsection 3.6.3.

(e) Rotate each limb of the ATD downward in a plane parallel to its mid-sagittal plane until the limb touches a surface of the child restraint system or the standard seat assembly. Position the limbs so that they will not inhibit the movement of the torso or head during the test, and

(i) In the case of a rearward-facing child restraint system for children whose mass is 16 kg or less, if the lower limbs of the ATD contact the seat back of the standard seat assembly, remove the lower limbs at the knees;

(ii) In the case of a rearward-facing child restraint system for children whose mass is 22 kg or less, if the lower limbs of the ATD contact the seat back of the standard seat assembly, remove the lower limbs at the knees and secure each limb on either side of the upper legs of the ATD.

3.6.3 If shoulder and pelvic belts are provided that directly restrain the ATD, they must be adjusted by tightening the belts until a 9-N force applied using a webbing tension pull device (as illustrated in Figure 3) to the webbing at the top of each shoulder and to the pelvic webbing 50 mm on either side of the mid-sagittal plane of the torso pulls the webbing a distance of 7 mm away from the ATD.

3.6.4 Attach the lower connectors of a rearward-facing restraint system to the lower universal anchorage system and attach the tether strap, if one has been provided, to the standard seat assembly in accordance with the manufacturer's instructions and in the following manner:

(a) Adjust rigid lower connectors in accordance with the manufacturer's instructions;

(b) Tighten the tether strap of both forward- and rearward-facing restraint systems to a tension of not less than 53.5 N and not more than 67 N, as measured by a force gauge used on the webbing.

3.7 Test Procedure

3.7.1 Accelerate the test platform in accordance with the requirements of subsection 3.1.

3.7.2 Measure the excursion of the ATD and determine the conformance of the child restraint system to the requirements of subsection 13(1.1) of Schedule 3 to the RSSRs.

4. Buckle Release Test Procedure

4.1 The release force of each buckle is to be tested with the ATD specified in subsection 2.4 of this test method retained in the restraint system and both forward- and rearward-facing child restraint systems installed in a forward-facing direction.

4.2 The buckle release force is to be tested as follows:

(a) Tie a self-adjusting sling to the wrists and ankles of the ATD, as illustrated in Figure 4.

(b) While applying a pullout force of 9 N to the buckle assembly in a direction that will produce maximum releasing effect, pull the sling horizontally and parallel to the SORL of the standard seat assembly with a force of 200 N.

Note: If the restraint system is equipped with a T-shield, a force equivalent to its mass must be added to the pullout force. Any shield, if present, may be adjusted to facilitate application of the pullout force, provided that the harness tension is not significantly affected.

(c) In order to determine the buckle's conformance to the requirements of Schedule 3 to the RSSRs, apply the specified force in a direction that will produce maximum releasing effect, in the case of

(i) A push-button-actuated buckle, at least 3.2 mm from the edge of the push-button access opening, or

(ii) A lever-actuated buckle, on the centreline of the buckle lever or finger tab.

(d) If the force required to release the buckle exceeds the requirements of Schedule 3 to the RSSRs, release the harness tension and apply a force of 22 to 44 N to the lowest accessible part of the tongue 2 to 4 times in each of four directions at 90-degree angles to each other.

(e) Repeat paragraphs (b) and (c) above while applying a pullout force on the buckle assembly of 22 N, re-orienting the direction of the sling pull force if necessary so that the arms of the ATD do not load the shield.

(f) If the buckle does not release at the force specified in Schedule 3 to the RSSRs, repeat paragraphs (b) and (c) once again using a pullout force of 44 N.

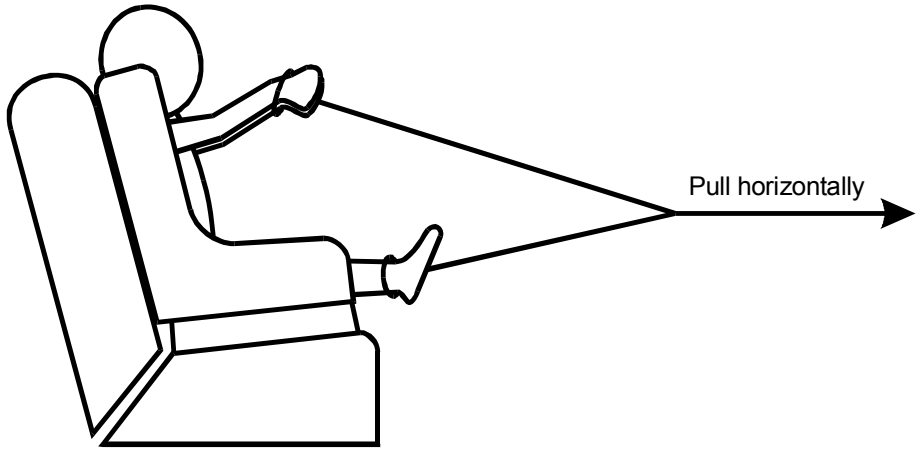


Figure 4 — Self-Adjusting Sling for the Buckle Release Test

5. Energy Absorbing Material Test Procedure

5.1 Prepare and test specimens of energy absorbing material in accordance with the applicable 25% compression-deflection test

described in one of the following American Society for Testing and Materials (ASTM) Standards:

- *Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber*, Designation No. D 1056-91;
- *Standard Specification for Flexible Cellular Materials—Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)*, Designation No. D 1565-81 (Reapproved 1990); or
- *Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams*, Designation No. D 3574-95.

5.2 Determine the conformance of the test specimens to the requirements of section 6 of Schedule 3 to the RSSRs.

6. Inversion Test Procedure

6.1 Each child restraint system must meet and be tested in accordance with the requirements of subsections 6.2 through 6.6 of this test method when adjusted in any position. The manufacturer may use any seat that is a representative aircraft passenger seat within the meaning of subsection 2.1.1.

6.2 A representative aircraft passenger seat must be positioned and adjusted so that its horizontal and vertical orientation and its seat back angle are the same as those shown in Figure 5.

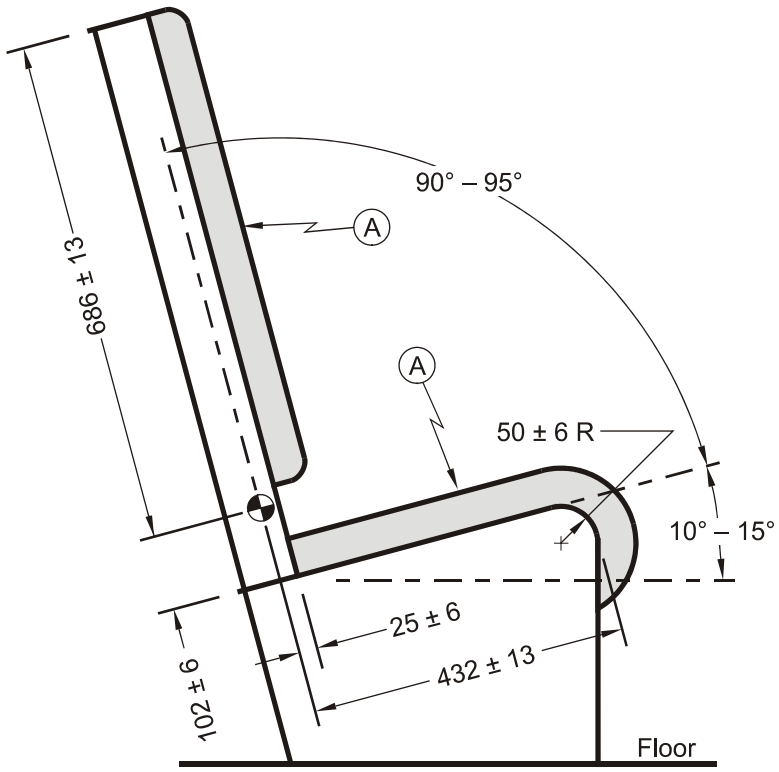
6.3 The child restraint system must be attached in accordance with the instructions of the manufacturer of the restraint system to the representative aircraft passenger seat using, at the manufacturer's option, any aircraft safety belt approved by the U.S. Federal Aviation Administration or by Transport Canada's Director, Aircraft Certification. No supplementary anchorage belts or tether straps may be attached; however, safety belt extensions approved by the U.S. Federal Aviation Administration or by Transport Canada's Director, Aircraft Certification, may be used.

6.4 In accordance with the requirements of subsection 3.3.2, place and restrain the ATD specified in subsection 2.4 in the child restraint system.

6.5 The combination of representative aircraft passenger seat, child restraint system, and ATD must be rotated forward around a horizontal axis that is contained in the median transverse vertical plane of the seating surface portion of the aircraft seat and is located 25 mm below the bottom of the seat frame, at a speed of

35° to 45° per second, to an angle of 180°. The rotation must be stopped when it reaches that angle, and the seat must be held in this position for three seconds. The specified rate of rotation must be attained in not less than one-half second and not more than one second, and the rotating combination must be brought to a stop in not less than one-half second and not more than one second.

6.6 Repeat the procedure set forth in subsections 6.2 through 6.4. The combination of the representative aircraft passenger seat, child restraint system, and ATD must be rotated sideways around a horizontal axis that is contained in the median longitudinal vertical plane of the seating surface portion of the aircraft seat and is located 25 mm below the bottom of the seat frame, at a speed of 35° to 45° degrees per second, to an angle of 180°. The rotation must be stopped when it reaches that angle, and the seat must be held in this position for three seconds. The specified rate of rotation must be attained in not less than one-half second and not more than one second, and the rotating combination must be brought to a stop in not less than one-half second and not more than one second.



Notes:
1. Dimensions are in mm.
2. Drawing is not to scale.
3. **A** represents a 50-mm to 76-mm thick polyurethane foam pad with a density of 24 kg/m³ to 32 kg/m³, over a 0.50-mm thick aluminum pan and covered by marine canvas of 400 g/m² to 480 g/m².
4. The sheet aluminum pan is 508 mm wide and supported on each side by a rigid structure.
5. The seat back is a rectangular frame covered with an aluminum sheet whose mass is between 6.3 kg and 6.8 kg with a centre of mass 330 mm to 406 mm above the seat pivot axis.
6. The mass moment of inertia of the seat back about the pivot axis is between 0.15 kg-m-sec² and 0.18 kg-m-sec².
7. The seat back is free to fold forward about the pivot, but a stop prevents rearward motion.
8. The passenger safety belt anchor points are spaced from 533 mm to 559 mm apart and are located along the seat pivot axis.

Figure 5 — Simulated Aircraft Passenger Seat