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Road Safety

Transports Canada
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Standards and Regulations Division

TEST METHOD 213.1

Infant Restraint Systems

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Standards Research and Development Branch
Road Safety and Motor Vehicle Regulation Directorate
TRANSPORT CANADA
Ottawa, Ontario
K1A 0N5

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LIST OF REFERENCED DOCUMENTS

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 D

American Society for Testing and Materials:

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

1. Introduction

Test Method 213.1 — Infant Restraint Systems (October 2001) is to be used for demonstrating compliance with the requirements of Schedule 4 to the *Motor Vehicle Restraint Systems and Booster Cushions Safety Regulations* (RSSRs).

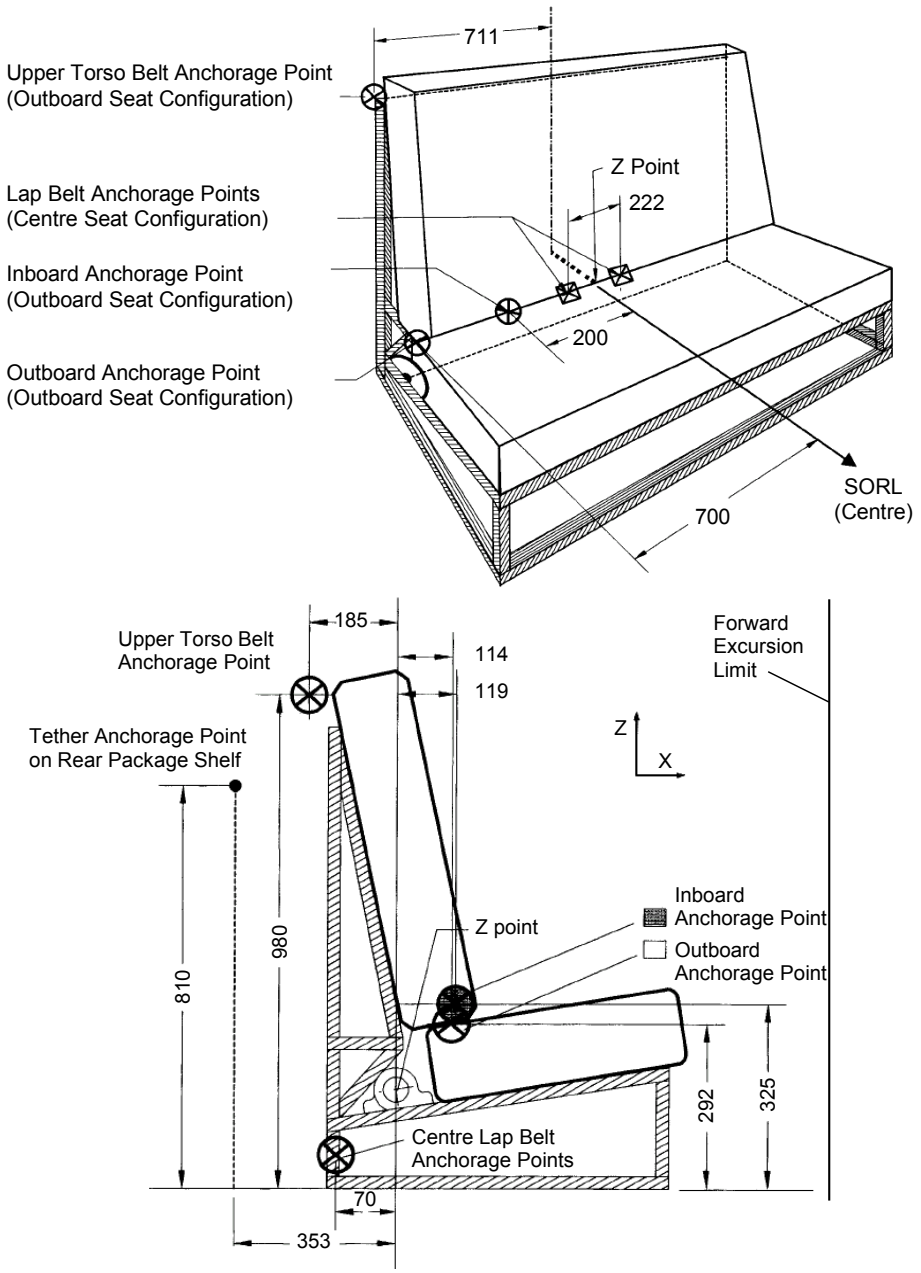
(Original signed by)

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

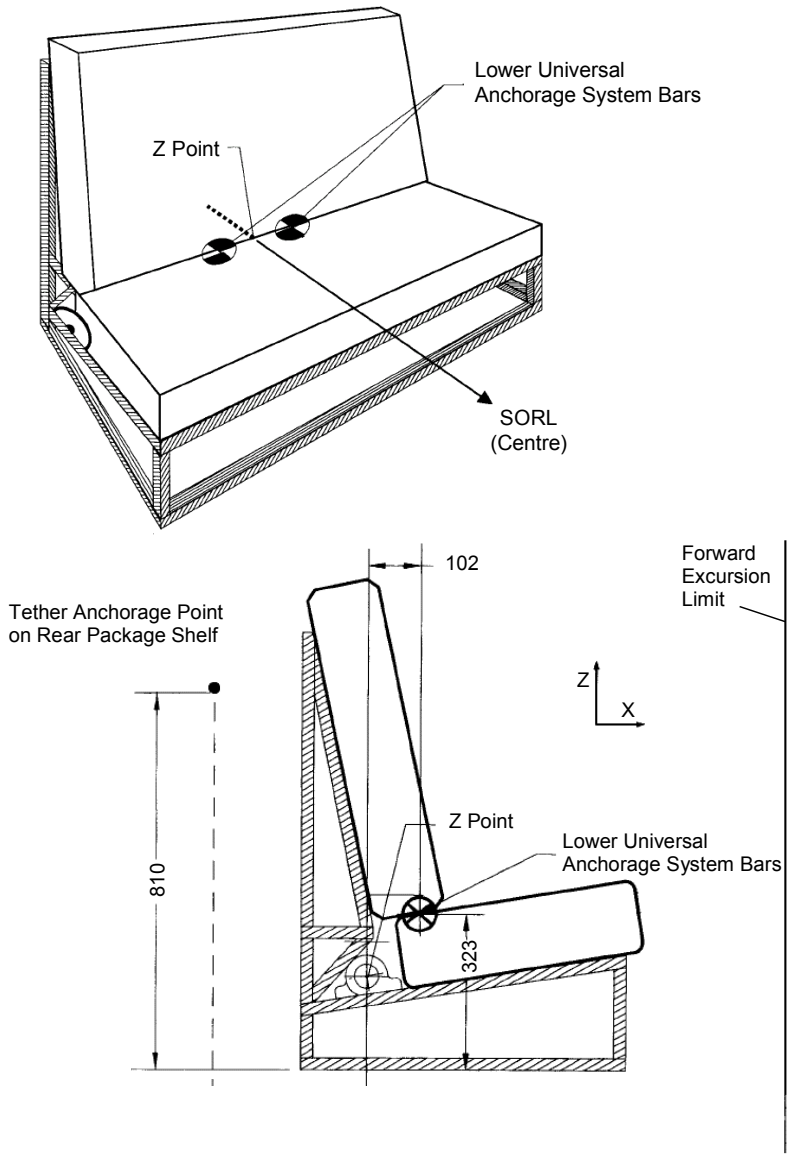
2.1 The seat to be used for the dynamic test prescribed in this test method is the standard seat assembly, as described in Drawing Package NHTSA-SAS–100–1000 and shown in Figure 1(a), which indicates the location of the seat belt anchorage points, and Figure 1(b), which indicates the location of the 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 A Type 1 seat belt assembly that meets 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 unclothed anthropomorphic test device (ATD) that represents a six-month-old infant and conforms to the requirements of the U.S. *Code of Federal Regulations* (October 1, 1996), Title 49, Part 572, Subpart D, 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.

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 infant 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 infant 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.

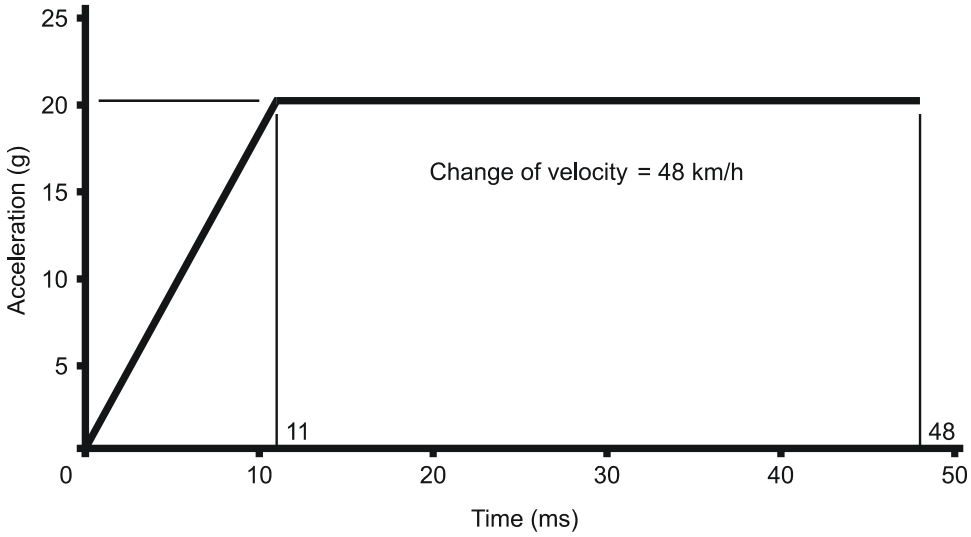


Figure 2 — Test Platform Acceleration Graph

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 4 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 infant restraint system at the centre seating position of the standard seat assembly. 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 Position the ATD specified in subsection 2.4 in accordance with the manufacturer's instructions and as follows:

(a) With the ATD supine on a horizontal surface, and with a hand placed on its torso to prevent it from moving, lift the feet of the ATD until the legs touch the upper torso and the feet touch the head or as far as they will go. Slowly release the legs, allowing them to come to rest of their own accord. Do not return them to the flat surface.

(b) Place the ATD in the infant restraint system so that its back is in contact with the seat back of the system. Attach the belts and harnesses of the system around the ATD.

(c) Tighten 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, if applicable, 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.

(d) Extend the ATD's arms upward horizontally and rotate them downward until they are in contact with a surface of the infant restraint system or the standard seat assembly. The movement of the arms must not be restricted in any but the downward direction.

3.4.3 In accordance with the manufacturer's instructions, attach the infant restraint system, if it is not already installed, to the standard seat assembly using the motor vehicle seat belt; attach the tether strap, if one has been provided; and 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.

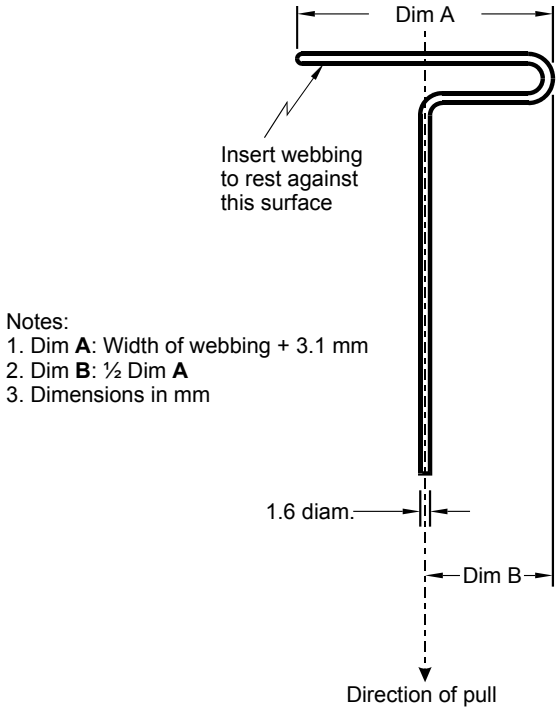


Figure 3 — Webbing Tension Pull Device

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 angle of the seat back and determine the conformance of the infant restraint system to the requirements of section 10 of Schedule 4 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 Place a new infant restraint system at the centre seating position of the standard seat assembly in accordance with the manufacturer's instructions.

3.6.2 Place the ATD specified in subsection 2.4 in the infant restraint system and position it in accordance with the manufacturer's instructions and as follows:

(a) With the ATD supine on a horizontal surface, and with a hand placed on its torso to prevent it from moving, lift the feet of the ATD until the legs touch the upper torso and the feet touch the head or as far as they will go. Slowly release the legs, allowing them to come to rest of their own accord. Do not return them to the flat surface.

(b) Place the ATD in the infant restraint system so that its back is in contact with the seat back of the system. Attach the belts and harnesses of the system around the ATD.

(c) Tighten 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, if applicable, 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.

(d) Extend the ATD's arms upward horizontally and rotate them downward until they are in contact with a surface of the infant restraint system or the standard seat assembly. The movement of the arms must not be restricted in any but the downward direction.

3.6.3 Attach the lower connectors of the restraint system to the lower universal anchorage system and the tether strap, if one has been provided, to the standard seat assembly in the following manner:

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

(b) If a tether strap has been provided, tighten it 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 angle of the seat back and determine the conformance of the infant restraint system to the requirements of subsection 13(1.1) of Schedule 4 to the RSSRs.

3.8 Infant Restraint Systems with a Separate Base

In the case of a system that has a separate, removable base, the seating component of which may be used without the base,

(a) Where lower connectors are supplied on the base only, the tests described in subsections 3.4 and 3.5 are to be conducted for the seating component and the tests described in subsections 3.4 to 3.7 are to be conducted for the base;

(b) Where lower connectors are supplied on both the base and the seating component, the tests described in subsections 3.4 to 3.7 are to be conducted for both the base and the seating component.

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 the system 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 90 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 4 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 4 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 4 to the RSSRs, repeat paragraphs (b) and (c) once again using a pullout force of 44 N.

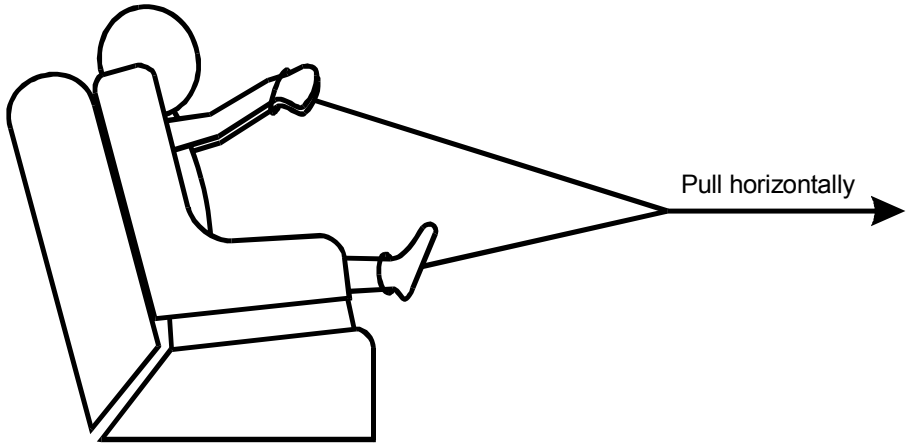


Figure 4 — Self-Adjusting Sling for the Buckle Release Test

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 5 of Schedule 4 to the RSSRs.

6. Inversion Test Procedure

6.1 Each infant 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.

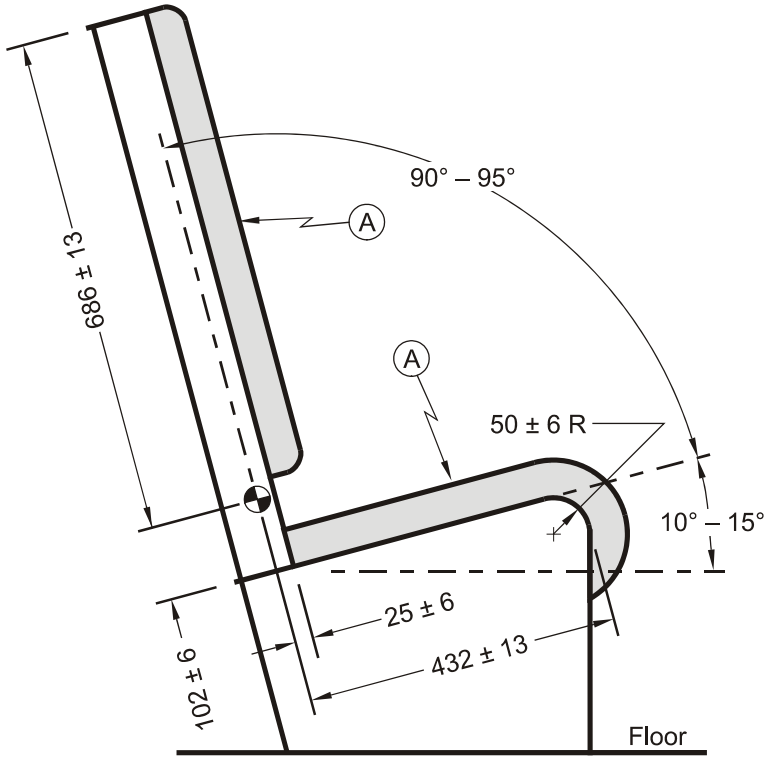
6.3 The infant restraint system must be attached in accordance with the instructions of the manufacturer of the restraint system to the representative aircraft passenger seat using, at the manufacturer's option, any aircraft safety belt approved by the U.S. Federal Aviation Administration or by Transport 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 infant restraint system.

6.5 The combination of representative aircraft passenger seat, infant 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, infant 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