SAE INTERNATIONAL

AEROSPACE STANDARD

AS8043 REV. B

Issued 1986-03
Revised 2008-09
Reaffirmed 2014-03

Superseding AS8043A

(R) Restraint Systems for Civil Aircraft

RATIONALE

AS8043B has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

This SAE Aerospace Standard (AS) specifies laboratory test procedures and minimum requirements for the manufacturer of restraint systems for use in civil aircraft. It is intended to establish a minimum level of quality which can be called upon by the designer of those systems. However, compliance with this standard alone may not assure adequate performance of the restraint system under normal and emergency conditions. Such performance requires consideration of factors beyond the scope of this standard, and must be demonstrated by a system evaluation procedure which includes the seat, the occupant, the specific restraint installation and the cabin interior configuration. This standard specifies the requirements for Type 1, Type 2, and Type 3 restraint systems.

Buckles that release automatically or through any means other than the direct action of the fingers or thumb on the buckle are beyond the scope of this standard.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 AATCC Publications

Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC 27709, Tel: 919-549-8141, www.aatcc.org.

Standard Test Method 8-1996 Colorfastness to Crocking: AATCC Crockmeter Method

Standard Test Method 107-1991 Colorfastness to Water

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AS8043B

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM G 23-81 Recommended Practice for Operation of Light and Water-Exposure Apparatus (Carbon Arc Type) for Artificial Weathering Test

ASTM D 756-78 Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions

2.1.3 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

Federal Test Method Standard 191 Method 5906

2.2 Definitions

2.2.1 RESTRAINT SYSTEM

Consists of any strap, webbing or similar device including all buckles or other fasteners, and all integral hardware designed to secure a person in an aircraft with the intention of minimizing injury, including all buckles or other fasteners, and all integral hardware.

2.2.1.1 TYPE 1 RESTRAINT SYSTEM

A restraint system for pelvic restraint, lap belt, commonly referred to as a two point restraint system.

2.2.1.2 TYPE 2 RESTRAINT SYSTEM

A restraint system for pelvic restraint and upper torso restraint where only one diagonal strap across the chest is used, commonly referred to as a three point restraint system.

2.2.1.3 TYPE 3 RESTRAINT SYSTEM

A restraint system for pelvic restraint and upper torso restraint where two shoulder straps are utilized. This restraint system is commonly referred to as a four point restraint or a five point restraint system if a fifth belt is used.

2.2.2 PELVIC RESTRAINT

That portion of a restraint system intended to restrain movement of the pelvis, commonly referred to as a lap belt, safety belt, or seat belt.

2.2.3 UPPER TORSO RESTRAINT

That portion of a restraint system intended to restrain movement of the chest and shoulder region, commonly referred to as a shoulder harness.

2.2.4 HARDWARE

Any part of the restraint system, other than webbing.

2.2.4.1 BUCKLE

A quick release connector which fastens together the individual straps of a restraint system.

2.2.4.1.1 LIFT LEVER BUCKLE

A quick release connector in which the release is accomplished by rotating (lifting) the release mechanism about an axis that lies in a plane essentially parallel to the plane containing the fittings for the attachment of the webbing to the buckle.

2.2.4.1.2 ROTARY BUCKLE

A quick release connector in which the release is accomplished by rotating the release mechanism around an axis that is lies essentially perpendicular to the plane containing the fittings for the attachment of the webbing to the buckle.

2.2.4.1.3 PUSH BUTTON: BUCKLE

A quick release connector in which the release is accomplished by depressing the release mechanism.

2.2.4.1.4 BUCKLES EXCLUDED

Buckles that require the use of the thumb or a gripping action by the hand for release or, buckles that require more than one simple action for release.

2.2.4.2 ATTACHMENT HARDWARE

Any hardware other than retractors designed for terminating the webbing of a restraint system.

2.2.4.3 ADJUSTMENT HARDWARE

Any hardware designed for adjusting the size of a restraint system to fit the user, including such hardware that may be integral with a buckle, attachment hardware, or retractor.

2.2.4.4 RETRACTOR

A device for storing webbing in a restraint system.

2.2.4.4.1 AUTOMATIC LOCKING RETRACTOR

A retractor incorporating adjustment hardware by means of a positive self-locking mechanism which is capable, when locked, of withstanding restraint forces.

2.2.4.4.2 EMERGENCY LOCKING RETRACTOR (INERTIA REEL)

A retractor incorporating adjustment hardware by means of a locking mechanism that is activated by aircraft acceleration, webbing movement relative to the aircraft, or other automatic action during an emergency and is capable, when locked, of withstanding restraint forces. Emergency locking retractors may be equipped with mechanisms that allow the user to manually lock the reel.

2.2.4.4.3 NON-LOCKING RETRACTOR

Any retractor that does not interrupt the extraction or retraction of the webbing.

2.2.4.5 PRETENSIONER

A device which may be used to remove the slack or introduce a small load into the restraint system prior to the restraint system being loaded to minimize occupant movement. This specification does not establish requirements for this device nor does it prohibit the use of this device.

2.2.4.6 WEBBING LOCK

A device other than a retractor which once automatically activated will prevent webbing movement by such means as clamping or gripping the webbing.

2.2.4.7 STATIC ADJUSTER

A device which may be used to install or attach webbing by threading the loose end of the webbing through slots on the adjuster and around either attachment hardware, seat structure or airframe structure. This device is not intended as an adjustment device for the occupant.

2.2.4.8 LOAD LIMITERS

A device which may be used to control or limit load by allowing controlled displacement of the occupant. Special care in the specific installation of a restraint system with this device shall be taken. This specification does not establish requirements for this device nor does it prohibit the use of this device.

2.2.4.9 EXTENDER BELT

An extender belt is a length of seat belt webbing with matching latching plate and buckle intended to accommodate the girth of a larger occupant.

2.2.4.10 FIFTH BELT (CROTCH OR ANTI-SUBMARINING STRAP/BELT)

Webbing which is attached to the buckle and is attached to seat or aircraft structure which provides a reaction load to the buckle from loading introduced by shoulder harness on Type 3 restraint system. This reduces the occurrence of the occupant from sliding out under the lap belt or the relative motion of the buckle riding up the stomach/chest during loading.

2.2.5 WEBBING

A narrow fabric woven with continuous filling yarns and finished selvages.

2.2.6 STRAP

A narrow non-woven material used in a restraint system in place of webbing.

2.2.7 LOOP LOAD

The algebraic sum of the applied loads at the anchorages of a restraint system segment. A balanced loop load is achieved when the reaction loads at each lap belt anchorage are equal.

2.2.8 LABORATORY AMBIENT CONDITIONS

18 to 24 °C (65 to 75 °F) and 45 to 55% humidity.

2.2.9 SYSTEM DESIGNATION

A unique part number which identifies the restraint system and its separable sub-assemblies

3. GENERAL REQUIREMENTS

3.1 Single Occupancy

A restraint system shall be designed for use by one person at any one time.

3.2 Restraint System

Restraint system components shall meet the appropriate requirements of Sections 3 to 6 inclusive.

3.2.1 Pelvic Restraint

The pelvic portion of a restraint system shall provide pelvic restraint whether or not an upper torso restraint is used. A pelvic restraint system shall not incorporate emergency locking retractors (inertia reels).

3.3 Hardware

All hardware parts shall be free from burrs and sharp edges, and shall be designed and located to minimize the possibility of injury to the occupant.

3.4 Release

A restraint system shall be provided with a single buckle having a single motion release which is readily accessible to the occupant to permit easy and rapid egress by the occupant from the assembly. The buckle release mechanism shall be designed to minimize the possibility of inadvertent release.

3.5 Adjustment

A restraint system shall be capable of snug adjustment, by the occupant, by a means easily within reach of that person and easily operable, or shall be provided with a locking retractor. The system shall maintain the adjusted position during flight.

Non-locking retractors shall not be used.

3.6 Webbing

All webbing shall be made from synthetic materials. The ends of webbing shall be protected or treated to prevent raveling, and shall not separate from the adjustment hardware.

3.7 Strap

A strap used in a restraint system to sustain restraint forces shall comply with the requirements for webbing in Section 4, and if the strap is made from a rigid material it shall comply with applicable requirements in Sections 4 to 6.

3.8 Marking

Each restraint system and its separable sub-assembly shall be permanently and legibly marked or labeled with year of manufacture, system designation, name and address of manufacturer or distributor, rated strength and AS8043.

3.9 Workmanship

The quality of workmanship shall be in accordance with standard aircraft practices.

3.10 Flammability

Except for small parts which would not significantly contribute to the propagation of a fire, all materials used in the restraint system must be at least flame resistant when tested in accordance with the procedure of Section 10, where the average burn rate of the specimen when tested horizontally, shall not exceed 63.5 mm (2.5 in) per minute.

3.11 Load Duration

Applied test loads shall be maintained for at least 3 s.

3.12 Installation Instructions

Installation instructions shall be provided to the installer.

4. REQUIREMENTS FOR WEBBING

4.1 Width

The width of the webbing in a restraint system shall not be less than 45.7 mm (1.8 in) except for portions that do not touch an occupant. The width of the webbing shall not vary more than ±5%.

4.2 Breaking Strength

The webbing in a restraint system shall have a breaking strength not less than 22.2 kN (5000 lb) for pelvic restraint and 17.8 kN (4000 lb) for upper torso restraint when tested by the procedures specified in 7.2. Breaking strength after the abrasion tests of 9.5 shall not be less than 16.7 kN (3750 lb) for pelvic restraint webbing and 13.3 kN (3000 lb) for upper torso restraint webbing when tested by the procedure specified in 7.2.

4.3 Elongation

The webbing elongation in a restraint system shall be less than 20% at 11.1 kN (2500 lb) when tested in accordance with 7.3.

4.4 Resistance to Light

The webbing in a restraint system, after testing by the procedure specified in 7.4, shall have a breaking strength not less than 13.3 kN (3000 lb) for pelvic restraints or 10.7 kN (2400 lb) for upper torso restraints.

4.5 Colorfastness to Crocking

The webbing in a restraint system shall not transfer color to a crock cloth, either wet or dry, to a greater degree than Class 3 on the AATCC Chart for Measuring Transference of Color, when tested by the procedure specified in 7.5.

4.6 Colorfastness to Staining

The webbing in a restraint system shall not stain to a greater degree than Class 3 on AATCC Chart for Measuring Transference of Color, when tested by the procedure specified in 7.6.

5. REQUIREMENTS FOR HARDWARE

5.1 Corrosion Resistance

Hardware parts of a restraint system, after being subjected to the conditions specified in 8.1, shall be free of base metal corrosion on significant surfaces. Buckles and retractors shall conform to applicable requirements in 5.7 to 5.11 inclusive after being subjected to the test conditions of 8.1.

A significant surface is defined as any surface that may be touched with a 0.750 in diameter sphere.

5.2 Nonmetallic Hardware

5.2.1 Temperature Resistance

Nonmetallic hardware parts of a restraint system, and all retractors, when subjected to the conditions specified in 8.2.1, shall not warp or otherwise deteriorate to cause the assembly to operate improperly or fail to comply with applicable requirements in Sections 5 and 6.

5.2.2 Solvent Resistance

Hardware parts of a restraint system, after being subjected to the conditions specified in 8.2.2, shall conform to the applicable requirements in 5.7 to 5.11 inclusive.

5.3 Non-Self-Aligning Attachment Hardware

Non-self-aligning attachment hardware shall be tested in accordance with the procedure in 8.3. Attachment hardware for pelvic restraint shall be capable of carrying loads to 13.3 kN (3000 lb) and attachment hardware for upper torso restraint shall be capable of carrying 11.1 kN (2500 lb).

5.4 Buckle Release

5.4.1 Release Force

5.4.1.1 Lift Lever Buckles

The buckle shall release when a force of not more than 130 N (30 lb) is applied to the release mechanism when tested as prescribed in 8.4.1.

5.4.1.2 Rotary Buckles

The buckle shall release when a force of not more than 130 N (30 lb) is applied to the release mechanism when tested as prescribed in 8.4.2.

5.4.1.3 Push Button Buckles

The buckle shall release when a force of not more than 130 N (30 lb) is applied to the release mechanism when tested as prescribed in 8.4.3.

5.4.2 Release Access

5.4.2.1 Lift Lever Buckles

The buckle handle shall have adequate access for two or more fingers of either hand to actuate the release.

5.4.2.2 Rotary Buckles

The buckle handle shall have adequate access for two or more fingers of either hand to actuate the release.

5.4.2.3 Push Button Buckles

The buckle area to activate the release mechanism shall have a minimum contact area of 4.5 cm^2 (0.7 in^2) with a minimum dimension of 1.5 cm (0.6 in).

5.5 Adjustment Force

The force required to decrease the length of a restraint system shall not exceed 49 N (11 lb) when measured by the procedure specified in 8.5.

5.6 Tilt-Lock Adjustment

The adjustment hardware of a restraint system having tilt-lock adjustment shall lock the webbing when tested by the procedure specified in 8.6 at an angle of not less than 0.52 rad (30°) between the base of the adjustment hardware and the anchor webbing.

5.7 Buckle-Latch

The buckle-latch of a restraint system, when tested by the procedure specified in 8.7, shall not fail, gall, or wear to an extent that normal latching and unlatching are impaired. The buckle shall also separate when in any position of partial engagement by a force of not more than 22 N (5 lb).

5.8 Automatic Locking Retractor

The webbing of a restraint system equipped with an automatic locking retractor shall not move more than 25.4 mm (1 in) between locking positions of the retractor, and shall be retracted with a force of not less than 2.7 N (0.6 lb) when measured by the procedure specified in 8.8.

5.9 Emergency Locking Retractor

An emergency locking retractor shall lock before the webbing extends 25.4 mm (1 in), and shall exert a retraction force of not less than 2.2 N (0.5 lb), when tested by the procedure specified in 8.9.

5.10 Performance of Retractor

A retractor shall comply with applicable requirements in 5.8, 5.9, 6.1, and 6.2, after completing the tests specified in 8.10, except that the retraction force shall be not less than 50% of its original retraction force.

5.11 Retractor Strength

A pelvic restraint automatic locking retractor shall withstand a load of 13.3 kN (3000 lb) in the fully extended position and with 305 mm (12 in) of webbing remaining on the reel. An emergency locking retractor (not for use in a pelvic restraint system) shall withstand a load of 11.1 kN (2500 lb) in the fully extended position and with 305 mm (12 in) of webbing remaining on the reel.

6. REQUIREMENTS FOR ASSEMBLY PERFORMANCE

6.1 Torso Restraint System

The components of a restraint system shall comply with following requirements when tested by the procedure specified in Section 9.

6.1.1 Pelvic Restraint

The structural components in the pelvic restraint shall withstand a force of not less than 13.3 kN (3000 lb).

6.1.2 Upper Torso Restraint

The structural components in the upper torso restraint shall withstand a force of not less than 11.1 kN (2500 lb).

6.1.3 Pelvic Restraint Elongation

The length of the pelvic restraint between anchorages shall not increase more than 305 mm (12 in) when subjected to a loop lead of 26.6 kN (6000 lb) as specified in 9.2.

6.1.4 Web Cutting

No cutting of the longitudinal (warp) yarns shall occur during testing.

6.2 Torso Restraint System Webbing Abrasion

Restraint systems using manual adjusters for establishing the length of the assembly shall be preconditioned through 2500 cycles according to the webbing abrasion conditioning procedure of 9.5 prior to conducting the adjustment force test of 8.5, the tilt lock adjustment test of 8.6, and the webbing breaking strength test of 7.2.

6.3 Manual Adjuster/Webbing Slip

Webbing slippage through manual adjusters shall not exceed 25.4 mm (1 in) when tested under the procedure outlined in Section 9.

7. WEBBING TEST PROCEDURE

Webbing shall be conditioned to laboratory ambient conditions for at least 24 h prior to each test unless other wise noted.

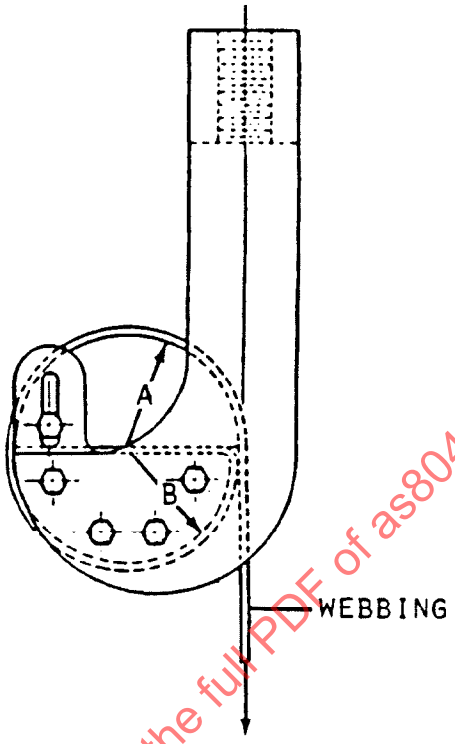
7.1 Reserved

7.2 Breaking Strength

Webbing shall be tested for breaking strength in a testing machine of suitable capacity verified to have a load measurement error of not more than 1% in the range of the breaking strength of the webbing. The machine shall be equipped with split drum grips illustrated in Figure 1, having a diameter between 50 to 100 mm (2 to 4 in). After placing the specimen in the grips and preloading the specimen to 200 to 245 N (45 to 55 lb), the webbing shall be stretched continuously at separation rate of between 50 to 100 mm (2 to 4 in) per minute to failure. Breaking strength shall not be less than the applicable requirement in 4.2.

7.3 Elongation

Elongation shall be measured during the breaking strength test described in 7.2. The elongation between preload and 11.1 kN (2500 lb) shall be calculated to the nearest 0.5%.



A	25 TO 50 MM (1 TO 2 IN.)
B	A - 1.5 MM (0.06 IN) (DIMENSION "A" MINUS WEB THICKNESS)

FIGURE 1 - WEBBING GRIPS - SPLIT DRUM TYPE

7.4 Resistance to Light

Three specimens of webbing at least 508 mm (20 in) in length shall be suspended vertically on the inside of the specimen rack in type E carbon-arc light exposure apparatus described in ASTM G 23-81. The apparatus shall be operated without water spray at an air temperature of 60 °C ± 2 °C (140 °F ± 3.6 °F) measured at a point 25 mm ± 5 mm (1 in ± 0.2 in) outside the specimen rack and midway in the height. The temperature sensing element shall be shielded from radiation. The specimens shall be exposed to the light from the carbon-arc for 100 h and then conditioned at laboratory ambient conditions for at least 24 h. The breaking strength of the specimens shall be determined by the procedure prescribed in 7.2.

7.5 Colorfastness to Crocking

Three specimens of webbing shall be tested by the procedure specified in AATCC Standard Test Method 8-1996.

7.6 Colorfastness to Staining

Three specimens of webbing shall be tested by the procedure specified in AATCC Standard Test Method 107-1991 with the following modifications: distilled water shall be used, perspiration tester shall be used, the drying time in paragraph 4 of the AATCC procedure shall be 4 h, and the section entitled, “Evaluation Method for Staining (3)” shall be used to determine colorfastness on the AATCC Chart for Measuring Transference of Colors.

8. TEST PROCEDURE FOR HARDWARE

Three samples of hardware or retractors shall be used for each test unless other wise specified.

8.1 Corrosion Resistance

Hardware and retractors shall be tested by ASTM B 117-73. The test shall consist of one period of 24 h exposure to salt spray followed by 1 h drying. In the salt spray test chamber, samples shall be oriented differently, selecting those orientations most likely to develop corrosion on the larger areas. At the end of the test, the hardware shall be washed with water to remove the salt. After drying, the hardware shall be examined for corrosion. Retractors shall be tested for corrosion resistance after 2500 cycles of operation as prescribed in 8.10.

8.2 Non-Metallic Hardware

8.2.1 Temperature Resistance

Non-metallic hardware or retractors shall be subjected to the conditions prescribed in Procedure D of ASTM D 756-78, except that the measurements described in Section 7 of that procedure are not required. Buckles shall be unlatched and retractors shall be fully retracted during conditioning.

8.2.2 Solvent Resistance

Allow non-metallic hardware components to be stabilized under laboratory ambient conditions for 6 to 12 h. Expose the samples to solvent vapors for at least 6 h and 21 to 27 °C (70 to 80 °F). Use separate assemblies for exposure to each of the following solvents:

a. Lacquer thinner

b. Methyl ethyl ketone

c. Acetone

Place assemblies 25 mm ± 12 mm (1 in ± 0.5 in) above container solvent level. Solvent depth to be at least 12 mm (0.5 in). Suspend items on 3 mm (0.125 in) wire mesh such that vapor has access to all components. Cover container with flat, vented plate.

8.3 Attachment Hardware

Attachment hardware designed for bolted connection (not retractors) shall be subjected to tensile loads applied through webbing. The angle between the plane of the hardware and the webbing shall be 0.52 rad (30°).

8.4 Buckle Release

Samples shall be tested to determine compliance with the maximum buckle release force requirements during the assembly test in Section 9. The buckle release force shall be measured by applying a force on the buckle in a manner and direction typical of that which would be employed by an occupant.

8.4.1 Lift Lever Buckles

The force to release the buckle shall be applied on the centerline of the buckle lever or finger tab in such a direction as to produce the maximum release effect. A hole 2.5 mm (0.1 in) in diameter may be created through the buckle tab or lever on the centerline between 3 to 3.3 mm (0.12 to 0.13 in) from its edge, for attaching a flexible link between the buckle tab or lever and the force measuring device.

8.4.2 Rotary Buckles

The force to release the buckle shall be applied tangent to the center axis of the buckle handle as to produce the maximum rotary or torque effect. An adapter suited to interface the buckle handle to a torque wrench may be utilized to apply and record the force required to release the fittings. The force to release the fittings shall be calculated by taking the maximum torque value and dividing it by the distance from the center of the buckle handle rotation to 3.2 mm (0.125 in) in from the outer edge where the finger(s) would be placed on the buckle to activate the buckle.

8.4.3 Push Button Buckles

The force to release the buckles shall be applied on the centerline of the buckle release button in such a direction as to produce the maximum releasing effect. The force shall be applied using a spherical form with a radius of 2.5 mm (0.10 in).

8.5 Adjustment Force

Samples shall be tested for adjustment force on the webbing at the manual adjusting device normally used to adjust the size of the assembly. With no load on the anchor end, the webbing shall be drawn through the adjusting device at a rate of 500 mm ± 50 mm (20 in ± 2 in) per minute and the maximum force shall be measured to the nearest 1.1 N (0.25 lb) after the first 25 mm (1 in) of webbing movement. The webbing shall be precycled 10 times prior to measurement.

8.6 Tilt-Lock Adjustment

This test shall be made on manual adjusting devices having tilt-lock adjustment with webbing intended for use in the adjusting device. The base of the adjustment mechanism and the anchor end of the webbing shall be oriented in planes normal to each other with the webbing vertical. The adjuster base shall be horizontal and downward at the start of the test. The webbing shall be drawn through the adjustment mechanism in a direction to increase belt length at a rate of 500 mm ± 50 mm (20 in ± 2 in) per minute, while the plane of the base is rotated at a speed of 1 rpm ± 0.2 rpm in a direction to lock the webbing. Rotation shall be stopped when the webbing locks and resists at least 89 N (20 lb) pull on the webbing. The locking angle between the anchor end of the webbing and the base of the adjustment mechanism shall then be measure to the nearest degree. The webbing shall be precylced 10 times prior to measurement.

8.7 Buckle Latch Operation

8.7.1 Reliability

Buckles shall be fully latched with their metal mating plates and unlatched at least 10 times. Then the buckle, with the metal mating plate withdrawn from the buckle, shall be clamped or firmly held against a solid surface so as to permit normal movement of buckle parts without movement of the buckle assembly. The release mechanism shall be moved 200 times through the maximum possible travel against its stop with a force of 130 N ± 13 N (30 lb ± 3 lb) at a rate not to exceed 30 cpm, actuating the mechanism in a manner which simulates actual usage. After completion of this portion of the test, the 130 N (30 lb) force shall be reduced to a force of just sufficient magnitude to assure full travel to the stop for an additional 10,000 cycles.

8.7.2 Security

Buckle design shall be scrutinized to determine whether partial engagement is possible by means of any technique representative of actual use. If partial engagement is possible, the maximum force of separation when in such partial engagement shall be determined.

8.8 Automatic Locking Retractor

Retractors shall be tested in a manner to permit the retraction forces to be determined exclusive of the gravitational forces on hardware or webbing being retracted. The webbing shall be fully extended from the retractor. While the webbing is being retracted, the average force of retraction with 305 mm ± 50 mm (12 in ± 2 in) of webbing on the spool shall be determined and the webbing movement between adjacent locking segments shall be measured in the same region of extension.

8.9 Emergency Locking Retractors (Inertia Reels)

Retractors shall be tested in a manner to permit the retraction forces to be determined exclusive of the gravitational forces on the hardware or webbing being retracted. The webbing shall be fully extended from the retractor. While the webbing is being retracted, the average force of retraction with 305 mm ± 50 mm (12 in ± 2 in) of webbing on the spool shall be determined. Webbing extension to lock up shall be measured while the webbing is accelerated to a maximum of 1.5 g within 50 ms in the direction of webbing withdrawal from the reel, and with 305 mm ± 50 mm (12 in ± 2 in) of webbing on the spool. This test will be performed with the base of the retractor frame and webbing horizontal.

Webbing extension to lockup shall also be measured in retractors that are sensitive to aircraft acceleration by accelerating the retractor, along the sensitive axis, to 1 g with 50 ms, with the end of the webbing fixed so that initially 305 mm ± 50 mm (12 in ± 2 in) of webbing is on the spool. One cycle of full extension and retraction shall be applied to the assembly before initiating a test to measure webbing extension to lockup.

8.10 Performance of Retractors

After completion of the tests required in 8.2, the retractor shall be mounted in an apparatus capable of extending the webbing fully, applying a force of 89 N (20 lb) at full extension, and allowing the webbing to retract freely and completely. The webbing shall be withdrawn from the retractor and allowed to retract repeatedly in this apparatus until 2500 cycles are completed. The retractor and webbing shall then be subjected to the corrosion test prescribed in 8.1. After the corrosion test, the webbing shall be extended fully and allowed to dry at least 16 h. The performance of the retractor after the corrosion test shall be determined by withdrawing the webbing manually allowing the webbing to retract for 25 cycles.

Automatic locking retractors shall be subjected to 5000 additional cycles of webbing withdrawal and retraction, and emergency locking retractors shall be subjected to 22,500 additional cycles of webbing withdrawal and retraction as previously described. The locking mechanism of an emergency locking retractor shall be actuated at least 5000 times during the 25,000 cycles. At the end of the test, compliance of the retractors with applicable requirements in 5.8 to 5.10 shall be determined.

9. TEST PROCEDURE FOR ASSEMBLY PERFORMANCE

9.1 Installation

All components of three restraint systems shall be tested using a rigid test block as shown in Figures 2 and 3, using the procedures in 9.2 (all restraint system types), 9.3 (Type 3), or 9.4 (Type 2) as appropriate. Install the restraint system on the test block as shown in Figure 2. The pelvic restraint should be adjusted to a length of 1220 to 1270 mm (48 to 50 in), or as near as possible. An automatic locking or emergency locking retractor should be locked at the start of the test with a force on the webbing just sufficient to keep the retractor locked.

If a fifth belt is used in a Type 3 restraint system (dual shoulder belts), and if the fifth belt is not released from the buckle during normal operation, the fifth belt shall be attached at the 1.66 to 1.83 rad (95 to 105°) angle shown in Figure 2, adjusted so that no load exists in the belt prior to beginning the test procedure described in 9.3.

On a Type 2 restraint system (single shoulder belt), the shoulder belt attachment point to the pelvic restraint shall be positioned on the body block in a location representative of its position on an occupant during normal operation of the system.

9.2 Pelvic Restraint Test

Measure the length of the pelvic restraint between anchorages. Apply at least a 26.6 kN (6000 lb) balanced loop load to the pelvic restraint portion of the restraint system. Measure the length of the pelvic restraint between the anchorages while under this load. Reduce pelvic restraint loads to a balanced loop load of at least 760 N (170 lb). Maintain this load while measuring webbing slippage through manual adjusters (if used), then measure the force required to release the buckle. Examine the webbing for cuts from the hardware.

9.3 Assembly Test of Type 3 Restraint Systems (Dual Shoulder Belts)

Preload the pelvic restraint portion of the system at lease 15.5 kN (3500 lb) balanced loop load, then apply at least 11.1 kN (2500 lb) total load to the upper anchorages of the upper torso restraint. If more than one upper anchorage is used, divide the load equally between the anchorages. If necessary, increase the pelvic restraint load to achieve at least 26.6 kN (5000 lb) total loop load after applying the upper torso restraint load. Relieve all loads on upper torso restraint, then reduce pelvic restrain loads to a balanced loop load of at least 760 N (170 lb). Maintain this load while measuring webbing slippage through manual adjusters (if used), then measure the force required to release the buckle. Examine the webbing for cuts from the hardware.

9.4 Assembly Test of Type 2 Restraint Systems (Single Shoulder Belts)

Preload the pelvic restraint portion of the restraint system to at least 15.5 kN (3500 lb) balanced loop load, apply the 11.1 kN (2500 lb) to the upper anchorage of the upper torso restraint. If necessary, increase the load applied to the longer segment of the pelvic restraint to achieve a load applied to the longer segment of the pelvic restraint to achieve a total loop load of at least 22.2 kN (5000 lb) in the pelvic restraint after applying the upper torso restraint load. The load in the shorter segment of the pelvic restraint should be allowed to seek its own level as the other segment loads are applied. Relieve all loads on upper torso restraint, then reduce pelvic restraint loads to a balanced loop load of at least 760 N (170 lb). Maintain this load while measuring webbing slippage through manual adjusters (if used), then measure the force required to release the buckle. Examine the webbing for cuts from the hardware.

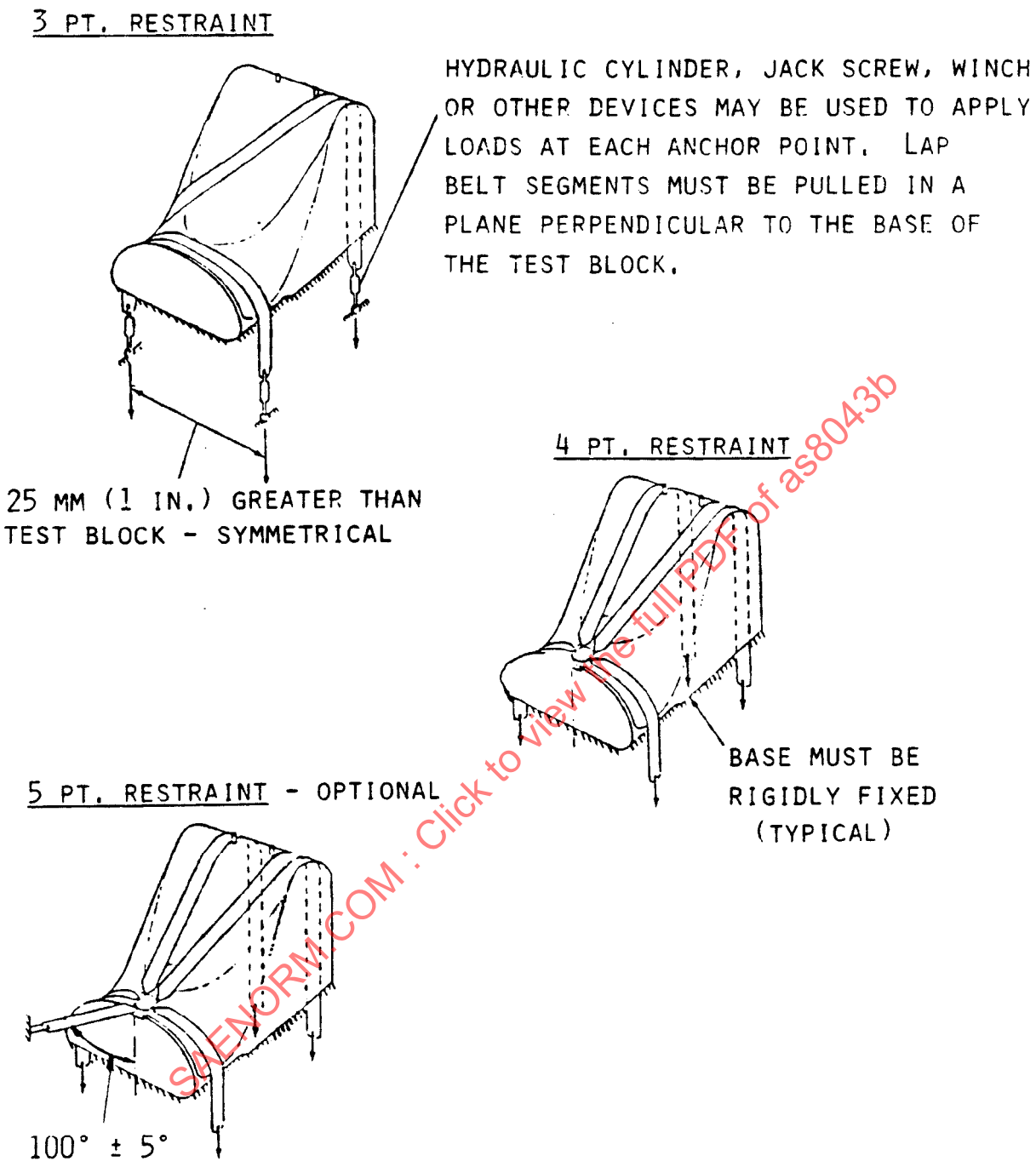


FIGURE 2 - BELT INSTALLATION ASSEMBLY TESTS