ETSO-C127c

ED Decision 2022/018/R

ROTORCRAFT, TRANSPORT AEROPLANE, AND SMALL AEROPLANE SEATING SYSTEMS

1 Applicability

This ETSO provides the Minimum Performance Standards (MPSs) that rotorcraft, large (transport) aeroplane, and small aeroplane seating systems of the following designated types that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

The standards of this ETSO apply to equipment intended to be utilised as aircraft seating systems of the following classifications:

(1) Seat Type and applicable Aircraft Category:

(a) Type A Aeroplane. Aircraft Category: Transport

(b) Type B Rotorcraft. Aircraft Category: Large (Transport) or Small (Normal)

(c) Type C Small Aeroplane. Aircraft Category:

(CS-23 up to Amendment 4) Normal, Utility, Acrobatic, or Commuter;

(CS-23 Amendment 5 and subsequent amendments) Normal Level 1, Normal Level 2, Normal Level 3, Normal Level 4.

(2) Seat Subtype:

(a) Subtype 1 Passenger

(b) Subtype 2 Flight Attendant

(c) Subtype 3 Observer

(d) Subtype 4 Pilot/Co-pilot

(3) Seat Orientation:

(a) Forward facing — Installation of forward-facing seating systems in the aircraft at up to an angle of 18° relative to the aircraft longitudinal axis.

(b) Rearward facing — Installation of rearward-facing seating systems in the aircraft at up to an angle of 18° relative to the aircraft longitudinal axis.

(c) Side facing — Installation of side-facing seating systems in the aircraft at between 80° and 100° relative to the aircraft longitudinal axis.

(d) Oblique facing — Installation of forward-facing seating systems in the aircraft, at greater than 18° and no greater than 45° relative to the aircraft longitudinal axis.

2 Procedures

2.1 General

The applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

None.

3 Technical Conditions

3.1 Basic

The standards of this ETSO apply to equipment intended to be utilised as aircraft seating systems.

3.1.1 Minimum Performance Standard

New models of rotorcraft, large (transport) aeroplane, and small aeroplane seating systems identified and manufactured on or after the effective date of this ETSO must meet the requirements in the following standards:

— SAE AS8049C, 'Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated August 2015, as modified by Appendix 1 to this ETSO;

— SAE AS8049/1B, 'Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated December 2016, as modified by Appendix 1 to this ETSO;

— SAE ARP5526D, 'Aircraft Seat Design Guidance and Clarifications', dated July 2015, as modified by Appendix 1 of this ETSO;

— SAE AS6316, 'Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft', dated June 2017, as modified by Appendix 1 to this ETSO;

— SAE ARP6337, 'Design, Manufacturing, and Performance Standard for Composite Materials Used on Aircraft Seat Structures', dated November 2020, as modified by Appendix 1 of this ETSO, and by Appendix 2 to this ETSO for specific elective requirements.

3.1.1.1 Functional Qualification

Demonstrate the required functional performance under the test conditions specified in:

— SAE AS8049C, 'Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated August 2015, as amended by Appendix 1 of this ETSO for forward- and aft-facing seats;

— SAE AS8049/1B, 'Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated December 2016, as modified by Appendix 1 to this ETSO for side-facing seats;

— SAE AS6316, 'Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft', dated June 2017, as modified by Appendix 1 to this ETSO for oblique-facing seats;

— SAE ARP5526D, 'Aircraft Seat Design Guidance and Clarifications', dated July 2015, as amended by Appendix 1 to this ETSO;

— SAE ARP6337, 'Design, Manufacturing, and Performance Standard for Composite Materials Used on Aircraft Seat Structures', dated November 2020, as modified by Appendix 1 to this ETSO; and

— Appendix 2 of this ETSO for specific elective requirements.

3.1.2 Environmental Standard

Not applicable.

3.1.3 Software

Not applicable.

3.1.4 Airborne Electronic Hardware

Not applicable.

3.2 Specific

3.2.1 Failure Condition Classification

There is no standard minimum failure condition classification for this ETSO. The failure condition classification appropriate for the article will depend on the intended use of the article in a specific aircraft. The loss of function and the malfunction failure condition classifications for which the equipment is designed should be documented.

4 Marking

4.1 General

The permanent and legible marking of at least one major component is required, with all the information as detailed in CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

The markings must also include the serial number and the following:

(1) The specific seat MPS complied with as abbreviated by paragraphs 4.2(1)(a) to 4.2(1)(e) below. Separate each applicable identifier with a dash.

For example, a large (transport) aeroplane passenger seat that may be used as a forward facing or rearward facing seat and that meets the step load on the baggage bar standard and the higher static loads must be marked as: Type A-T-1-FF-RF-a-d.

(a) The seat type, use: 'Type A' for Aeroplane, 'Type B' for Rotorcraft, or 'Type C' for Small Aeroplane.

(b) The seat type shall be followed by the aircraft category, use: 'T' for Transport, 'N' for Normal, 'U' for Utility, 'A' for Acrobatic, or 'C' for Commuter. If the seat is intended to be used on aircraft compliant with CS-23 Amendment 5 or later amendments, the seat type must be followed by the aircraft category, use 'NL' for Normal and 1, 2, 3, 4 for the aircraft certification level, for example 'NL1' for Normal category Level 1, 'NL2' for Normal category Level 2, etc.

(c) The aircraft category must be followed by the appropriate seat subtype, use: '1' for Passenger, '2' for Flight Attendant, '3' for Observer, or '4' for Pilot/Co-pilot.

(d) The subtype must be followed by the appropriate seat-facing designation, use: 'FF' for Forward Facing, 'RF' for Rearward Facing, 'SF for Side Facing, or 'OB' for Oblique Facing.

(e) The seat-facing designations must be followed by the applicable paragraph letter of the elective criteria defined in appendix 2 of this ETSO, use: 'a' for

Step Load on Baggage Bars, ‘b’ for Electrically Actuated Features, ‘c’ for Secondary Structure Abuse Loads, ‘d’ for Testing to Higher Static Loads, ‘e’ for Hand Holds, ‘f’ for Lithium Containing Batteries, ‘g’ for Flammability — Non-Traditional, Large, Non-metallic Parts.

(2) The seating system, safety belt restraint system, and seat cushion part numbers.

(3) The document reference that contains the installation instructions and limitations.

(4) For Type A and Type B-Transport passenger, flight attendant and observer seating systems, mark each seat cushion to be qualified with ‘Meets the provisions of CS-25, Appendix F, Part II’.

Also, mark permanently and legibly the following, with at least the manufacturer’s name, subassembly part number, and the ETSO number:

(1) each component that is easily removable (without hand tools); and

(2) each subassembly of the article that you determined may be interchangeable.

5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/11]
[Amdt ETSO/17]

APPENDIX 1 TO ETSO-C127c – MPS FOR ROTORCRAFT, TRANSPORT AEROPLANE, AND SMALL AEROPLANE SEATING SYSTEMS

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1.0. Forward- and aft-facing seating systems must meet the requirements of Table 1 of this Appendix. This Appendix prescribes the EASA modifications to the MPS for SAE International's Aerospace Standard (AS) 8049C, '*Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft*', dated August 2015. When the SAE section *recommends (or suggests, advises, etc.)* something, and it is part of the MPS, the recommendation becomes a *requirement*. In addition, modify AS8049C as follows:

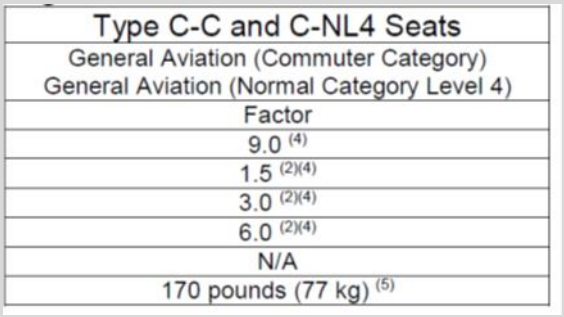
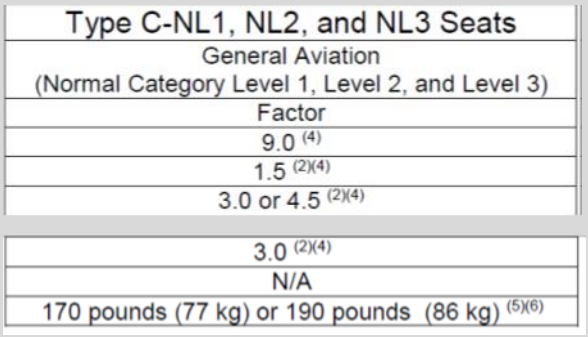
Table 1 — SAE AS8049C

When reading AS8049C	Do the following:
Section 1	Disregard
Section 2	Disregard
Section 3	Apply all the subsections unless disregarded or modified as shown below: --- On page 6, replace subsection 3.2.15 by the following: *3.2.15 Except for rearward-facing seats and seats equipped with multiple anchorage point pelvic restraints (e.g. Y-belts), the pelvic restraint system must be designed such that the vertical angle between the pelvic restraint centre line and the seat reference point (SRP) waterline must range from 35° to 55°. The SRP waterline is a line/plane passing through the SRP parallel to the floor waterline. The pelvic restraint centre line is formed by a line from the pelvic restraint anchorage to a point located 9.75 inches (250 mm) forward of the SRP and 7.0 inches (180 mm) above the SRP waterline. In addition, the pelvic restraint anchorage point(s) must be located no further than 2.0 inches (51 mm) forward of the SRP (ref. ARP5526D). See AC 21-34 for additional guidance on acceptable seat belt geometries.* --- On page 6, replace subsection 3.2.17 by the following: *3.2.17 Safety belt restraint systems must meet the requirements of E/TSO-C22g 'Safety Belts' or E/TSO-C114 'Torso Restraint Systems' (or later EASA/FAA revisions), and each must be equipped with a metal-to-metal latching device.* --- On page 7, for Type B seats, replace subsection 3.3.1 by the following: *3.3.1 The materials must be suitable and durable for use in aircraft seats, as established by tests or experience, accounting for statistical variability in the material and the effects of environmental conditions such as the temperature and humidity expected in service. Materials which could affect the safety of the aircraft or the occupants must be controlled to ensure the strength and other properties defined in the design data. Special factors must be developed for application per subsection 4.1 for each part of the structure whose strength is:* *(1) uncertain;* *(2) likely to deteriorate in service before normal replacement; or*

When reading AS8049C	Do the following:
	(3) subject to appreciable variability due to uncertainties about: *i. the manufacturing processes; or* *ii. the inspection methods.* *The use of materials such as fibre-reinforced materials (i.e. composites) used to fabricate components of the seat within the primary load path (to include seat backs and pans) requires unique considerations for material and process control, generation of design values, consideration of the environmental and variability factors, identification and substantiation of potential damage, developing criteria to assess the post-impact structural integrity, and creating instructions for continued airworthiness (ICAs). Applicants may follow the relevant guidance in AC 20-107B when addressing these concerns.* *Test plans to develop design allowable data and special factors or alternative justification for the use of service history must be approved in advance by EASA.* *Note: An ETSO approval does not include installation approval in an aircraft, and special conditions may be required to gain installation approval if the design includes new and novel materials and processes (e.g. composite materials, bonded joints, or additive manufacturing) in the primary load path.* *Applicants for seat installations under CS-27 and CS-29 should ensure that all the composite seat components comply with the relevant regulatory requirements for material and process control, and that the manufacturing and service instructions are adequate to ensure that the seat complies with the crashworthiness requirements throughout its life.* --- On page 7, for Type A-T, Type C seats (all the aircraft categories detailed in 1(1)c of this ETSO), replace subsection 3.3.1 by the following: *3.3.1 The materials must be suitable and durable for use in aircraft seats, as established by tests or experience, accounting for statistical variability in the material and the effects of environmental conditions such as the temperature and humidity expected in service. Materials which could affect the safety of the aircraft or the occupants must be controlled to ensure the strength and other properties defined in the design data. Special factors must be developed for application per subsection 4.1 for each part of the structure whose strength is:* *(1) uncertain;* *(2) likely to deteriorate in service before normal replacement; or* *(3) subject to appreciable variability due to uncertainties about:* *i. the manufacturing processes; or* *ii. the inspection methods.* *For the use of materials such as fibre-reinforced materials (i.e. composites) used to fabricate components of the seat within the primary load path (to include seat backs and pans) apply Table 5 of Appendix 1 of this ETSO.* *Note: An ETSO approval does not include installation approval in an aircraft, and special conditions may be required to gain installation approval if the design includes new and novel materials and processes (e.g. composite materials, bonded joints, or additive manufacturing) in the primary load path.*

When reading AS8049C	Do the following:
	Applicants for seat installations under CS-23 and CS-25 should ensure that all the composite seat components comply with the relevant regulatory requirements for material and process control, and that the manufacturing and service instructions are adequate to ensure that the seat complies with the crashworthiness requirements throughout its life. --- On page 7, replace subsection 3.3.2 by the following: *3.3.2 The methods and processes used for fabrication and assembly must produce consistently sound seats. If a fabrication process requires close control to reach this objective, the process must be performed in accordance with the design data (e.g. process specification).* --- On page 7, add subsection 3.3.4 as follows: *3.3.4 Each part of the seat structure must be protected against deterioration or loss of strength in service due to any cause (such as corrosion, wear, impact damage, environmental degradation, etc.) and have provisions for ventilation and drainage where necessary for protection.* --- On page 7, replace subsection 3.4.1 by the following: *3.4.1 All the materials used on seats must meet the requirements of subsection 3.4.1.1, 3.4.1.2, 3.4.1.3, or 3.4.1.4. The definition and use of parts that are considered small parts that would not contribute significantly to the propagation of a fire must be approved in advance by EASA. When inflatable materials are used (i.e. material used in the fabrication of inflatable restraints, airbags, etc.), the inflatable material must meet the flammability requirements of CS-25, Appendix F, Part I (a)(iv).* *Note: Inflatable materials used in devices to increase occupant safety are a novel or unusual design feature that may be subject to special conditions and additional certification requirements for installation approval. The fire protection properties of the material may be demonstrated by following FAA Policy Statement PS* *ANM-25.853-01 R2, 'Flammability Testing of Interior Materials' (dated 3 July 2013) or tested in accordance with the applicable chapter of the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12.* --- Add subsections 3.4.1.1, 3.4.1.2, 3.4.1.3, and 3.4.1.4 as follows: *3.4.1.1 All the materials used on Type A-T and Type B-T seats must be tested in accordance with the procedures, and meet the fire protection requirements, of CS-25, Appendix F, Part I, except where the material properties, size and quantity would not create or propagate a cabin fire. The fire protection properties of the material may also be demonstrated by following FAA Policy Statement PS-ANM-25.853-01 R2, 'Flammability Testing of Interior Materials' (dated 3 July 2013) or tested in accordance with the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 1 or 3.* *3.4.1.2 All the materials used on Type B-N, Type C-N, Type C-NL1, Type C-NL2, Type C NL3, Type C-U, and Type C-A seats must have flame-resistant properties.*

When reading AS8049C	Do the following:
	The materials must be tested to and must meet the requirements of paragraph 8.b of FAA Advisory Circular (AC) 23-2A Change 1, 'Flammability Tests' (dated 15 February 2013). *3.4.1.3 All the materials used on Type C-C seats must be tested in accordance with the test procedures of CS-23, Appendix F, Part I (Amendment 5) or the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 1 or 3, and must meet the following flammability performance requirements:* *3.4.1.3.1 The panels, walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must be self extinguishing. The average burn length may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.* *3.4.1.3.2 Floor coverings, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, electrical conduits, transparencies, moulded and thermoformed parts, and trim strips (decorative and chafing) that are constructed of materials not covered in subsection 3.4.1.3.3 must be self-extinguishing. The average burn length may not exceed 8 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.* *3.4.1.3.3 Acrylic windows and signs, parts constructed in whole or in part of elastomeric materials, seatbelts, and shoulder harnesses may not have an average burn rate greater than 2.5 inches per minute.* *3.4.1.3.4 Except for electrical wire cable insulation, and for small parts where the material properties, size, and quantity would not create or propagate a cabin fire, the materials in items not specified in subsections 3.4.1.3.1 through 3.4.1.3.3 may not have a burn rate greater than 4.0 inches per minute.* *3.4.1.4 All the materials used on Type C-NL4 seats must be self-extinguishing and tested in accordance with the test procedures of CS-23, Appendix F (Amendment 4), or the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 1.* --- On page 8, replace subsection 3.4.2 by the following: *Cushion systems on Type A-T and Type B-T passenger, flight attendant and observer seats must meet the fire protection requirements of CS-25, Appendix F, Part II. The fire protection properties of the material may also be demonstrated by following FAA AC 25.853-1, 'Flammability Requirements for Aircraft Seat Cushions' (dated 17 September 1986), tested in accordance with the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 7 and, where applicable, FAA Policy Statement ANM 115 07-002, 'Policy Statement on Certification for Flammability of Lightweight Seat Cushions' (dated 16 April 2009).* --- On page 8, replace subsection 3.4.3 by the following:

When reading AS8049C	Do the following:
	The insulation on electrical wires and cables on all Type A, Type B and Type C seats must meet the fire protection requirements of CS-25, Appendix F, Part I, (a)(3), or the Aircraft Materials Fire Test Handbook — DOT/FAA/AR-00/12, Chapter 4.
Section 4	Apply all the subsections unless disregarded or modified as shown below: --- On page 14, revise column 5 in Table 4A as follows:  --- On page 14, add an additional column in Table 4A as follows:  --- On page 14, replace Note (6) in Table 4A by the following: *Use a 190-pound occupant weight to account for the weight of a parachute.* --- On page 14, replace Note (4) in Table 4A by the following: *For Type C seats, the load factors may need to be increased according to CS 23.562(d), or CS 23.2270, Amendment 5.* --- On page 14, replace Note (2) in Table 4A by the following: *Elective: Increase these load factors as necessary for aircraft-model-specific flight and ground loads. All the seat adjustment positions and occupancy variations, including those used in flight, must be evaluated when using these increased load factors. Load factors at directions other than those prescribed by Table 4A as modified by this Appendix may be tested. Document the increased load factors and report them. You must also mark them on the ETSO placard (see Appendix 2, paragraph (d) of ETSO-C127c).*

Type C-C and C-NL4 Seats
General Aviation (Commuter Category) General Aviation (Normal Category Level 4)
Factor
9.0 (4)
1.5 (2)(4)
3.0 (2)(4)
6.0 (2)(4)
N/A
170 pounds (77 kg) (5)

Type C-NL1, NL2, and NL3 Seats
General Aviation (Normal Category Level 1, Level 2, and Level 3)
Factor
9.0 (4)
1.5 (2)(4)
3.0 or 4.5 (2)(4)
3.0 (2)(4)
N/A
170 pounds (77 kg) or 190 pounds (86 kg) (5)(6)

When reading AS8049C	Do the following:
	--- On page 17, replace Note (1) in Table 4C by the following: *Applicable only to Type C-N, C-NL1, C-NL2, C-NL3, C-NL4, Type C-U, Type C-C, and Type C-A seats.*
Section 5	Apply all the subsections unless disregarded or modified as shown below: --- On page 18, replace Section 5.0 by the following: *The initial qualification of a seat shall be performed by static and dynamic tests. Computer modelling analytical techniques may be used as established by AC 20-146, Revision A, paragraph 2.5. The use of computer modelling analytical techniques must be established by the applicant and accepted by EASA.* --- On page 22, replace subsection 5.1.9 by the following: *The load due to any item of mass, including the seat that is not restrained by the occupant restraint system, must be applied in a representative manner at the CG of the mass, or with a corrective factor applied in a conservative manner relative to the CG of the item of mass.* *Note: If the retention of an item of mass attached to the seat is demonstrated by the dynamic qualification tests of subsection 5.3, no further demonstration of retention for the forward and downward static conditions is required; however, a demonstration of retention of items of mass for the side, up, and aft static conditions is still required.* --- On page 24, replace subsection 5.3 by the following: *5.3 Dynamic Qualification Tests* *This section specifies the dynamic tests to satisfy the requirements of this document.* *For Type A seats: You may demonstrate compliance with the dynamic test procedures and documentation of subsection 5.3.1 'Dynamic Impact Test Parameters' to subsection 5.3.9.2 'Impact Pulse Shape' of SAE AS8049C by the equivalent procedures of FAA AC 25.562-1B, Change 1. The equivalent method must be included in the document that contains the installation instructions and limitations, and must be used consistently when evaluating all the variations of the seat and any subsequent changes to the seat design.* *For Type A seats: You can also use the simplified procedures for head injury criteria (HIC) outlined in AC 25.562-1B, Change 1, instead of the test conditions in AS8049C subsection 5.3.6.2.* *Except for Hybrid III ATDs (49 CFR Part 572, Subpart E) modified in accordance with SAE Technical Paper 1999-01-1609, the use of an equivalent ATD must be established by the applicant and accepted by EASA.* --- Add subsection 5.3.1.5 as follows: *5.3.1.5 Sensor-driven restraint systems*

When reading AS8049C	Do the following:
	If a sensor-driven restraint system (e.g. an airbag, inflatable restraint, seatbelt pre tensioner, deployable panel) is used as part of the seating system, additional threshold testing must be conducted to ensure that the structural and occupant injury criteria continue to be met when the sensor-driven restraint system does not activate. The threshold test must test the seating system at an inertial load no less than the maximum dynamic impact acceleration allowed by the sensor-driven restraint system without activating. *For seats with sensor-driven restraint systems, it must be shown that the system will activate and provide protection under emergency landing conditions where it is necessary to prevent serious injury to the occupants. The system must provide a consistent approach to injury protection throughout the range of occupants (2-year-old child to 95th percentile male) whether it is designed to manage injury parameters (e.g. HIC, Nij, neck rotation, etc.) or occupant motion. The system must be included in each test. If sensor driven restraint systems influence the test results, they must be active during the test.* *Seats that require a sensor-driven restraint system to meet the requirements of this ETSO must include the detailed design definition of the system and any other information required for installation as part of the document that contains the installation instructions and limitations.* *Sensor-driven restraint systems may be used to control occupant motion. The intended function of the system must be demonstrated during each applicable test.* --- On page 35, replace subsection 5.3.3.5(i) by the following: *(i) The side-facing seat requirements are defined in Table 3 of the Appendix to this ETSO.* --- On page 35, add subsection 5.3.3.5(j) as follows: *(j) The oblique-facing seat requirements are defined in Table 4 of the Appendix to this ETSO.* --- On page 39, replace subsection 5.3.4.1(a) by the following: *(a) Sled or drop tower vehicle acceleration data measurements must be in accordance with the Channel Class 60 requirements.* --- On page 42, replace subsection 5.3.6.3 by the following: *5.3.6.3 If a non-symmetrical upper torso restraint system (such as a single diagonal shoulder belt) is used in a system, it must be installed in the test fixture in a position representative of that in the aircraft.* *For a forward-facing seat equipped with a single diagonal shoulder belt, the Test 2 yaw direction must be selected to address the direction which would increase the likelihood of the occupant not being restrained (typically over the trailing shoulder) and assessment of the maximum upper torso restraint load, which requires testing in the critical structural direction. In some cases, this may require testing in both directions of yaw.*

When reading AS8049C	Do the following:
	For a Type A seat, testing per AC-25.562-1B, Change 1, paragraph 3.b(3), may be used. --- On page 44, replace subsection 5.3.8.3(a) by the following: *(a) Prior to seating the ATD, all the seat adjustments and controls must be set as indicated in 5.3.6.4. To the extent that they influence the injury criteria, all the seat adjustments and controls should be in the design position intended for a 50th percentile male occupant. If seat restraint systems are being tested that are to be used in applications where special requirements dictate their position for landing or take-off, those positions should be used in the tests.* --- On page 44, replace subsection 5.3.8.3(d) and (e) by the following: *(d) Once all lifting devices have been removed from the ATD, it should be rocked slightly to settle it in the seat.* *(e) The ATD's knees should be separated by approximately 4 inches (100 mm).* --- On page 47, replace subsection 5.3.9.4 by the following: *5.3.9.4 Head Injury Criteria (HIC)* *Head Injury Criterion (HIC) data for determining the HIC needs to be collected during the tests discussed in this document only if the ATD's head is exposed to impact on aircraft interior features (not including the floor or the ATD's own leg) during the test. The HIC is calculated according to the following equation:* $$\mathrm{HIC} = \left[(t_2 - t_1) \left\{ \frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt \right\}^{2.5} \right]_{\max}$$ *where t1 and t2 are any two points in time (in seconds) during the head impact, and a(t) is the resultant head acceleration (expressed in g) during the head impact.* *The HIC is a method for defining an acceptable limit, i.e. the maximum value of the HIC must not exceed 1000 for head impact against interior surfaces in a crash. The HIC is invariably calculated by computer-based data analysis systems, and the discussion that follows outlines the basic method for computation. The HIC is based on data obtained from three mutually perpendicular accelerometers installed in the head of the ATD in accordance with the ATD specification. Data from these accelerometers is obtained using a data system conforming to Channel Class 1000, as described in SAE J211. Only the data taken during head impact with the aircraft interior needs to be considered; this is usually indicated by a rapid change in the magnitude of the acceleration data. Film of the test may show head impacts that can be correlated with the acceleration data by using the time base common to both the electronic and photographic instrumentation. Simple contact switches that do not significantly alter the surface profile could also be used to define the initial contact time.* *In many cases, a full system sled test to evaluate specific occupant injury conditions may not be needed to evaluate a redesign of the seat system that affects only the HIC. In such cases, the photometric head path data can be*

When reading AS8049C	Do the following:
	gathered and used to ensure that no contact will occur, or to define the head angle and velocity at impact. This data can then be used in a component test of severity comparable to the whole-system sled test. Other factors, such as the inertial response of the impact target, must be accounted for in the component test conditions so that the impact condition is representative. The component testing methods used for HIC measurements must be demonstrably equivalent to whole-system sled test HIC measurements. *Additionally, a seat may be designed for use in multiple locations where head contact against a range of unknown bulkhead targets is anticipated (e.g. front-row seats). For these seats, the HIC may be measured using a representative impact target mounted in front of the seat at the installation setback, or a range of setbacks. This target will represent typical fixtures such as galleys, partitions, lavatories, and closets, and its stiffness will be representative for those monuments. If contact occurs, the HIC must not exceed 1000.* *When the seat is evaluated against unknown bulkhead targets using a representative impact target, the detailed design definition of the impact target, and any other information required for the installation (e.g. the stiffness), must be included as part of the document that contains the installation instructions and limitations.* *When considering multiple seat pitches or setbacks from interior components, or considering a range of occupant statures, the HIC evaluation should be made when a solid head strike occurs during the dynamic test. Regardless of whether the head contact is a solid strike or a glancing blow, the HIC value must be calculated and must not exceed 1000.* *The ATD head should not sweep by the seat back/interior component with no apparent interruption in the head path movement, even though there may have been contact on the top of the head.* *The following evaluations of the test data can be used to determine whether a solid head strike has occurred:* *a. A review of the dynamic test videos and evaluation of the ATD head path movement, head contact, and head reaction at contact should be made. There should be a noticeable change in the head movement at the time of contact.* *b. A review of the post-test photographs and an evaluation of the ATD head contact markings should be made. The contact marks (see subsection 5.3.8.4) should show that the area of the ATD head contact was not only across the top of the head.* *c. A review and evaluation of the ATD head acceleration plots (x, y, z and resultant) should be made. The resultant ATD head acceleration plot during the time period in which the critical HIC calculation was made should show an abrupt change in the head acceleration. In addition, the individual direction ATD head acceleration plots should be evaluated to determine which component direction contributes primarily to the resultant head acceleration. A primary contribution of the x-component indicates more of a solid head strike occurring. A primary contribution of the z-component indicates more of a top of the head contact and the top of the head moving forward into the seat/interior component as the head is sweeping by the seat/interior component.*

When reading AS8049C	Do the following:
	--- On page 49, replace subsection 5.3.9.9 by the following: *5.3.9.9 Femur load (type A-T seats): Data for measuring femur loads can be collected in the tests discussed in this document if the ATD's legs contact seats or other structures. The maximum compressive load in the femur can be obtained directly from a plot or listing of each femur load transducer output. If the value of peak acceleration measured in the test exceeds the level given in Figure 6, 7A, or 7B, the femur load measured in the test may be adjusted by no more than 10 % by multiplying the measured values by the ratio of the peak acceleration given in Figure 6, 7A, or 7B, divided by the measured peak acceleration, if necessary. Data need not be recorded in each individual test if a rational comparative analysis is available for showing compliance. For large clearance installations (distance from the seat reference point (SRP) to the strike target is greater than 40 inches (100 cm) nominally), no data is necessary to substantiate the femur loads; however, appropriate limitations must be included in the document that contains the installation instructions and limitations.* *Extensive seat testing has shown that the femur loading criterion is not usually exceeded; therefore, recording femur loads may not be necessary during the test if you can show compliance by rational comparative analysis using data from previous tests. However, the rational analysis must show that the testing applies to the seat design, and you must include appropriate limitations in the document that contains the installation instructions and limitations.* --- On page 49, replace subsection 5.3.9.12 by the following: *5.3.9.12 Seat Attachment Reactions* *The data of the maximum loads imposed on the tracks or fittings at all the seat attachment points must be collected and recorded (see subsection 5.3.3.2). This data can be obtained directly from the output of the load cell at each attachment location.* --- On page 50, replace subsection 5.3.10.1.1(e) and (f) by the following: *(e) A statement confirming that the data collection was performed in accordance with the requirements of this document, or a detailed description of the actual procedure used and a technical analysis showing equivalence to the requirements of this document.* *Note: Unless otherwise specified in the ETSO, you must obtain EASA approval for any deviations from the requirements of the AS8049C subsections identified as the MPS of this ETSO.* *(f) The manufacturer, governing specification, serial number, and test weights of the ATDs used in the tests, and a description of any modifications or repairs performed on the ATDs that could cause them to deviate from the specification.* *Note: Unless otherwise specified in the ETSO, you must obtain EASA approval for any deviations from the requirements of the AS8049C subsections identified as the MPS of this ETSO.* --- Add subsection 5.4.11 as follows:

When reading AS8049C	Do the following:
	5.4.11 If the ATD is exposed to impact with aircraft interior features during the test: *(a) if the test uses a Hybrid II ATD, then:* *(1) the interaction must not rotate the head about its vertical axis, relative to the torso, by more than 105 degrees in either direction from forward facing, or introduce a feature or surface that produces concentrated loading on the neck, and* *(2) the head centre of gravity must not stop sliding down the seat back for more than 10 milliseconds while the torso is still moving downward; or* *(b) if the test uses an FAA Hybrid III or equivalent, then:* *(1) the interaction must not rotate the head about its vertical axis, relative to the torso, by more than 105 degrees in either direction from forward facing, or introduce a feature or surface that produces concentrated loading on the neck, and* *(2) the Nij (calculated in accordance with 49 CFR 571.208) must be below 1.0, where Nij = (Fz/Fzc) + (Mocy/Myc), and the Nij critical values are:* i. *Fzc = 1 530 lbf for tension* *ii. Fzc = 1 385 lbf for compression* *iii. Myc = 229 lbf ft in flexion* *iv. Myc = 100 lbf ft in extension* *(3) the peak upper neck Fz is less than 937 lbf in tension and 899 lbf in compression.* *(c) If testing is first conducted with the Hybrid II ATD and the interaction could cause serious human injury as defined in paragraph (a)(2) (e.g. chin snagging on a horizontal seat back feature), then subsequent testing may be accomplished with the FAA Hybrid III or equivalent. To show acceptability using the FAA Hybrid III or equivalent:* *(1) the ATD must be positioned so that the chin will strike above the seat feature which caused the unacceptable interaction in the initial Hybrid II ATD test,* *(2) testing must demonstrate the same behaviour as shown with the Hybrid II ATD in order for the safety demonstration to be valid, and* *(3) the loads in (b)(1) and (b)(2) must be reported.* *(4) If the test demonstrates an acceptable interaction per paragraph (a)(1), and the loads in (b)(1) and (b)(2) are below the limits, no further substantiation is necessary.* *(5) Due to differing chin shapes and neck stiffnesses, the chin of the FAA Hybrid III ATD or equivalent may or may not hang up on the seat feature. If the head stops, the stop time may*

When reading AS8049C	Do the following:
	exceed 10 ms provided that the loads in (b)(1) and (b)(2) are not exceeded.
Section 6	Disregard and refer to paragraph **4** of this ETSO.
Section 7	Disregard
Appendix A	No Changes

2.0 This paragraph prescribes the MPS for SAE International ARP5526D 'Aircraft Seat Design Guidance and Clarifications', dated July 2015. When the SAE section recommends (or suggests, advises, etc.) something, and it is part of the MPS, the recommendation becomes a requirement. In addition, modify ARP5526D as follows:

Table 2 — SAE ARP5526D

When reading ARP5526D	Do the following:
Section 1	Disregard
Section 2	Disregard
Section 3	Disregard all the subsections in Section 3 not listed below. The following subsections apply as modified: On page 7, replace subsection 3.2.2. by the following: *3.2.2 Recommended Practice* *Seatbelt misalignment is a condition where the seatbelt and/or shackle is positioned to give the impression that the belt has been properly tightened, when in fact there is slack in the system or the shackle is positioned so that it will not carry the force generated in an emergency landing or turbulence condition.* *Restraint system anchorages should provide self-aligning features. If self-aligning features are not provided, the static and dynamic tests in this document should be conducted with the restraints and anchorages positioned in the most adverse configuration allowed by the design. The anchorage system must minimise the possibility of incorrect installation or inadvertent disconnection of the restraints.* *The seat belt installation should not appear to the belted occupant to be properly adjusted (snug) while there is significant (2.54 cm (1 inch) or more) slack in the system, which may pay out in an emergency landing situation. For example, the belt installation should not be able to be caught between seat features such that the occupant would not know that there was slack in the belt, which could allow the occupant to slide forward during an emergency landing or turbulence.* *When the seat system is adjusted to and from all in-flight positions, it must not allow the occupant restraint to become trapped or damaged in the seat structure or mechanisms.* *To evaluate this requirement, translate the unoccupied seat through all the adjustable positions with the restraint system unfastened and the seat cushions installed. Evaluate the size and location of any gap created for the potential of the unfastened restraint to become trapped or damaged with subsequent seat motion.* *To test the installed seat belt for misalignment, the seat should be positioned in its taxi, take-off and landing conditions. Installations on seats having bottom*

When reading ARP5526D	Do the following:
	cushions that can be removed or incorrectly repositioned without tools should be evaluated with the cushions installed, removed and incorrectly repositioned. The belt and shackle combination should be manipulated with one hand in an attempt to place the restraint in a non-design configuration where it could carry the seatbelt adjustment forces. Particular effort should be made to place the restraint in a position that the restraint forces would not be applied to the hook of the shackle in the same manner as they would be applied in a straight tension pull on the belt. Attempts should be made with the restraint in its normal shape, a single twist of the webbing and/or a single fold of the webbing. Typical areas around the restraint shackle that should be checked are the plastic shrouding around the armrest, the hydraulic seat recline device, the seat pan, anti-rotation brackets/stops, seat pan supports and exposed fasteners. If a condition of potential misalignment is identified, the seatbelt and shackle, in that condition, should be loaded by a restorative force of 22.2 N (5 pounds) applied through the belt in the direction in which it would be loaded in the emergency landing or turbulence situation. If the load is carried in the misaligned condition, the design is unacceptable. The examples in subsection 3.2.3 illustrate various misalignment conditions that have been found to be unacceptable, as indicated. These examples are not intended to be all inclusive. *To test the belt for inadvertent disengagement, where disengagement is defined as the separation of the restraint's attachment fitting from the seat structure, the belt should be tested in all orientations with the seat in the taxi, take-off and landing conditions with the seat cushions installed. Interactions with belts in adjacent seats, where the belts could be inadvertently crossed and used by occupants in those adjacent seats, must be evaluated for the possibility of disengagement.* --- On page 13, replace subsection 3.3.2 by the following: *3.3.2 Recommended Practice* *The terms 'life preserver', 'life vest' and 'life jacket' may be used interchangeably. When life preserver stowage provisions are included as part of the seat design, the stowage provisions must provide access to a life preserver for each seating position. The life preserver stowage must be designed and located such that the requirements of this section are met. The installation, operating and maintenance instructions must also reflect the requirements of this section. For example, the installation instructions must account for the allowable life preserver weight and size, and marking requirements, as well as the required unobstructed area to remove the life preserver from the container. Furthermore, the operating instructions must report the detailed content of the simulated preflight briefing and any special instructions for unique aspects of the operation of the design that should be considered for operational use and continued performance.* *a. The life preserver must be restrained under all applicable loading conditions; i.e. the retention device must not allow the preserver to come free during emergency landing static and dynamic conditions, taxi, take-off, landing, turbulence, and during stowage and removal of underseat baggage.* *b. Any life preserver locating placard installed on the seat must accurately state the location of the life preserver and be adequately marked per 3.8.2 of ARP5526D, as modified by this Appendix (e.g. 'LIFE PRESERVER*

When reading ARP5526D	Do the following:
	UNDER CENTRE ARMREST'). For life preserver locations other than under the seat or under a console between the seats, mark 'LIFE PRESERVER' or 'LIFE PRESERVER INSIDE' on the container or compartment, unless the location is identified with a pull strap. Pull straps must be red or labelled 'PULL' or 'PULL FOR LIFE PRESERVER' in a contrasting colour. *A symbolic placard may be used in lieu of text provided it has been shown to be comprehensible to the flying public. For seats intended to be installed in sequential rows, a placard may be fixed on the seat back, stating the location of the life preserver for the occupant seated behind.* *c. The retrieval path of the life preserver must be free of obstructions due to movement of the life preserver container, and/or seat or aircraft components (e.g. seat legs, cushions, baggage bars, shrouds, etc.) when the seat is in the configuration for taxi, take-off and landing.* *d. The life preserver stowage must not present any sharp edges or points that could damage the life preserver or cause injury to the occupants.* *e. For underseat pan storage on passenger seats (excluding centre console storage):* *1) a pull strap must be connected to the life preserver, or a pull strap or latch must be on the compartment opening, such that when the strap or latch is pulled, the preserver is presented on the strap or the occupant can reach into the compartment to retrieve the life preserver;* *2) the life preserver must be located no more than 3 inches (7.62 cm) aft of the front edge of the seat bottom (i.e. the seat frame or cushion), whichever is further forward;* *3) unless limited by seat cushions or structures (e.g. the seat leg, floor, etc.), designs utilising a pull strap must permit retrieval of the life preserver when pulled from any angle between:* *a) 45 degrees up and 50 degrees down from the horizontal plane,* *b) 45 degrees left and 45 degrees right from the container centre line;* *4) for designs utilising a pull strap, normal seat operation or underseat baggage storage activities must not sweep the pull strap into an unreachable location;* *5) the life preserver container, or compartment, as installed on the seat must protect the life preserver from inadvertent damage from normal passenger movements such as the stowage and removal of underseat baggage.* *f. Demonstrate that the life preserver is within easy reach of, and may be readily removed by a seated and belted occupant (shoulder strap(s) may be removed prior to demonstration), for all seat orientations and installations that are intended for use during taxi, take-off and landing. In lieu of an actual life preserver, a representative object (e.g. in size and weight) may be utilised for testing. The evaluation to quickly retrieve the preserver is to begin with the occupant in the seated position, hands in their lap. Timing begins with the movement of their hand(s) from their lap to reach for the preserver, and ends with the occupant having the*

When reading ARP5526D	Do the following:
	preserver in their hand(s) and fully removed from the stowage container. It does not include the time for the occupant to return to the upright position, to remove a pull strap from the preserver (if used) or to open the preserver package provided by the preserver manufacturer. Test the critical configuration(s) (including the minimum approved seat pitch for passenger seats, and the most confined surrounding area for the flight attendant and cockpit seats) to demonstrate retrieval in less than 10 seconds by a minimum of 5 test subjects with a success rate of no less than 75 per cent. The test must evaluate three anticipated occupant test subject size categories: the 5th, 50th and 95th percentile. At least one occupant from each size category must demonstrate successful retrieval within 10 seconds. The test subjects for either the 5th or 95th percentile occupant category must not exceed 40 % of the overall test subject population. *1) For passenger seats, the test subjects must be naïve. For the purpose of this test, naïve test subjects are defined as ones who must have had no experience within the prior 24 months in retrieving a life preserver. The subjects must receive no retrieval information other than a typical preflight briefing. The occupant size categories to be evaluated must be defined as follows:* *a. a 5th percentile occupant is no taller than 60 inches (1.5 m),* *b. a 50th percentile occupant is at least 63 inches (1.6 m) tall but no taller than 70 inches (1.8 m),* *c. a 95th percentile occupant weighs at least 244 lb (110.7 kg).* *2) For flight attendant and observer seats, the test subjects do not need to be naïve. The occupant size categories to be evaluated must be defined as follows:* *a. a 5th percentile occupant is no taller than 60 inches (1.5 m),* *b. a 50th percentile occupant is at least 63 inches (1.6 m) tall but no taller than 70 inches (1.8 m),* *c. a 95th percentile occupant weighs at least 244 lb (110.7 kg).* *3) For pilot/co-pilot seats, the test subjects do not need to be naïve. The occupant size categories to be evaluated must be defined as follows:* *a. a 5th percentile occupant is no taller than 62 inches (1.57 m),* *b. a 50th percentile occupant is at least 63 inches (1.6 m) tall but no taller than 70 inches (1.8 m),* *c. a 95th percentile occupant weighs at least 244 lb (110.7 kg).* --- On page 14, replace subsection 3.3.3 by the following:

When reading ARP5526D	Do the following:
	3.3.3 Recommended Practice for Life Vests in Leg Rests *All the requirements under 3.3.2 are applicable to life vests in leg rests, with the following additions:* *— Retrieval of life vest* *The footrest must not impact on the accessibility of the pull strap or life vest, and must be evaluated in all its positions to ensure that it can be readily moved out of the way.* *— Inadvertent opening* *The life vest container must not be susceptible to inadvertent opening by a seated occupant's foot or feet.* *— Effect of static and dynamic deformations on life vest retrievability* *The distance between the life vest container post deformation (plastic deformation only) and the aircraft floor should be such that the retrieval of the life vest will not be obstructed. Seat tracks and track covers should be considered.* --- 3.6.2 for Type A-T seats, apply as written. 3.7.2 for Type A-T seats, apply as written. --- On page 20, replace subsection 3.8.2 by the following: *3.8.2 Recommended Practice* *Safety placards on occupant seats should be permanently affixed, located such that they cannot be easily obscured, and of a type that cannot be easily erased. The height and colour contrast of the lettering should be sufficient to allow the placard to be read by the intended occupant (e.g. a placard located on the back of the seat should be designed to allow the occupant seated behind to easily read it at the anticipated installed pitch.)* --- 3.10.2: apply as written. 3.11.2: apply as written. --- On page 29, replace subsection 3.12.2 by the following: *3.12.2 Recommended Practice* *Edges that could cut skin during normal use (including edges on electrical equipment) should be eliminated, and for maintenance, should be minimised. To be considered non injurious, edges that are accessible (as defined in subsection 3.11.2.1) and could cut skin during normal use must meet either of the standards listed below:* *1. NASA Standard 3000 Volume I (NASA–STD-3000 Vol I), Man-Systems Integration Standards, Revision B, July 1995, Section 6.3.3,* *or* *2. UL 1439, Standard for Tests for Sharpness of Edges on Equipment, Edition 4, 26 February 1998, with revisions up to 6/1/2004.*

When reading ARP5526D	Do the following:

In addition, the seat should not have any features whose edges or corners are exposed when deployed and present an impediment to an occupant's egress (e.g. a cocktail table, seat back and in-arm video, flip-out PCU, ashtray, etc.).

On page 30, replace subsection 3.13.2 by the following:

3.13.2 This section recommends a test method that demonstrates that items on seats located within the striking radius of the head are not injurious to the occupant of a seat or a nearby seat. The component tests are defined in FAA Policy Memo ANM-03-115-31, and in this context, the striking radius of the head is defined in AC 25-17A, Change 1, Section 25.785.88.b(8), see Figure 88-2.

3.14.2: apply as written.
3.15.2: apply as written.
3.17.2: apply as written for Type A-T passenger seats.

On page 46, replace subsection 3.19.2 by the following:

3.19.2 Recommended Practice

Flight crew seats (cockpit) and restraints should accommodate adult occupants ranging in stature (standing height) from 5 feet 2 inches (1.57 m) to 6 feet 3 inches (1.9 m).

Flight attendant seats and restraints should accommodate adult occupants ranging in stature (standing height) from a 5th percentile female to a 95th percentile male according to Table 7. If required, additional anthropometric measurements can be obtained from the CAESAR study (reference 2.1.2).

Table 7 — CAESAR anthropometric database sitting and standing heights

	CAESAR
Sitting 5% Female	31.86 inches (80.9 cm)
Sitting 95% Male	38.78 inches (98.5 cm)
Standing 5% Female	60.08 inches (152.6 cm)
Standing 95% Male	74.83 inches (190.1 cm)

Crew restraint systems, while fastened, should neither significantly impede access to controls nor prevent the crew from performing their duties.

3.20.2: apply as written.
3.21.2: apply as written.
3.24.2: apply as written.

On page 50, replace subsection 3.25.2 by the following:

3.25.2 Recommended Practice

Where the seat being reclined could adversely affect emergency evacuation, the passenger seat recline and control mechanisms should have an override feature so that the reclined seat back may be moved to the upright position without activating the recline control button.

When reading ARP5526D	Do the following:
	3.32.2: apply as written. In addition, the selected seat reference point (SRP) method must be documented, and must be used consistently when evaluating all variations of the seat ETSOA model and subsequent changes to the seat ETSOA model design. --- Add '3.41.2 Recommended Practice' as follows: *3.41.2 Recommended Practice* *The passenger should not have ready access to the internal contents or electrical connections of any electrical components on the seat.*

3.0. Side-facing seats must meet the requirements of Table 3 of the Appendix to this ETSO. It prescribes the MPS for SAE International AS8049/1B, 'Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft', dated December 2016. When the SAE section recommends (or suggests, advises, etc.) something, and it is part of the MPS, the recommendation becomes a requirement. For the purpose of meeting the side-facing seat requirements of Table 3 of the Appendix to this ETSO, all the references to 'AS8049C' must be replaced by 'AS8049C as modified by Table 1 of the Appendix to this ETSO'. In addition, SAE AS8049/1B is modified as follows:

Table 3 — SAE AS8049/1B

When reading AS8049/1B	Do the following:
Section 1	Apply all the subsections unless disregarded or modified as shown below: --- On page 3, replace subsection 1.1 by the following: *1.1 Purpose* *This SAE Aerospace Standard (AS) defines the Minimum Performance Standards (MPSs), qualification requirements, and minimum documentation requirements for side-facing seats in civil rotorcraft, transport aircraft, and general aviation aircraft. The goal is to achieve comfort, durability, and occupant protection under normal operational loads and to define test and evaluation criteria to demonstrate occupant protection when a side-facing seat/occupant/restraint system is subjected to statically applied ultimate loads and to dynamic test conditions.* --- On page 3, replace subsection 1.3 by the following: *1.3 Seat Types* *This document covers all passenger and crew seats except pilot and co-pilot seats. Additionally, flight attendant seats are excluded for Type A-T seats.*
Section 2	Apply all the subsections unless disregarded or modified as shown below: --- On page 4, replace subsection 2.1 by the following: *2.1 Applicable Documents*

When reading AS8049/1B	Do the following:
	This document is explicitly linked with and cannot be used without AS8049C. The requirements of each section of AS8049C apply to this document unless specifically modified by this document. Sections 3 to 7 of this document note only differences between the standards of this document and the standards of AS8049C. Sections 8 and 9 are reserved for future use, and the content specific to side-facing seats is found in Section 10. Test pulse evaluations must use the method defined in AS8049C Appendix A.
Section 3	Apply as written
Section 4	Apply as written
Section 5	Apply all the subsections unless disregarded or modified as shown below: --- On page 8, subsection 5.3 is modified by adding subsection 5.3.1.5 as follows: *5.3.1.5 If smaller occupants are permitted to occupy the seat, the range of occupants must include a 2 year-old child up to a 95th percentile male (see 10.8 for further discussion on the range of occupants). This requirement applies whether the sensor-driven restraint system is designed to manage injury parameters (HIC, neck rotation, etc.) or occupant motion.* *Side-facing seating systems, including sensor-driven restraint systems, must be shown to meet the occupant injury criteria of subsection 10.7, as modified by this Appendix, throughout the entire range of yaw that encompasses installation angles ± 10 degrees relative to the aircraft longitudinal axis.* *If a shoulder belt incorporating an airbag is used, care must be taken when placing the webbing load cell to ensure that an accurate measurement is made and that the load cell does not affect the performance of the airbag.*
Section 6	Apply all the subsections unless disregarded or modified as shown below: --- On page 12, replace Section 6 by the following: *6. Markings* *The requirements prescribed in paragraph 4 of this ETSO are applicable to all side-facing seats, with the exception that side-facing seats must also be identified with the applicable occupant limitations prescribed by subsection 10.8.*
Section 7	Disregard
Section 10	Apply all the subsections unless disregarded or modified as shown below: --- On page 12, add subsection 10.1.2.1 as follows: *10.1.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.1.2, then the detailed design definition of the contactable item evaluated per subsection 10.1.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.* --- On page 13, add subsection 10.2.2.1 as follows:

When reading AS8049/1B	Do the following:
	When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.2.2, then the detailed design definition of the contactable item evaluated per subsection 10.2.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document. --- On page 13, replace subsection 10.3.1 by the following: *10.3.1 Occupant Simulation* *Injury assessments must be evaluated for all the seat places of a multiple occupant seat structure. Injury assessments must be accomplished by performing one test with ES-2re ATD (49 CFR Part 572 Subpart U) at all seat places. Alternatively, these assessments must be accomplished by multiple tests that use an ES-2re in the seat place being evaluated, and a Hybrid II ATD (49 CFR Part 572, Subpart B) or its equivalent in all the seat places forward of the one being assessed, to evaluate the occupant interactions. In this case, the seat places aft of the one being assessed may be unoccupied.* --- On page 14, add subsection 10.3.2.1 as follows: *10.3.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.3.2, then the detailed design definition of the contactable item evaluated per subsection 10.3.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.* --- On page 14, add subsection 10.3.3.1 as follows: *10.3.3.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.3.3, then the detailed design definition of the contactable item evaluated per subsection 10.3.3 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.* --- On page 17, replace subsection 10.7, Item 5, by the following: *5. Leg: Axial rotation of the upper-leg (femur) is limited to 35 degrees in either direction from the nominal (pre-test) ATD seated position. This limit only applies to femur axial rotations caused by the lateral (relative to the ATD) swinging action of the lower legs, and not to any rotations caused by other leg articulations or rebound motion. For the purposes of this criteria, the rebound begins when the forward motion of the lower leg has stopped. The rotation can be measured by using video evidence or femur axial rotation sensors on the ATD.* *For threshold tests only, if the pulse used for the threshold test has a lower energy than the research pulse used to develop the criteria (see FAA Report DOT/FAA/AM-17/2, 'Supplemental Injury Risk Considerations for Aircraft Side-Facing Seat Certification', dated January 2017), it is not necessary to meet the leg axial rotation requirement of AS8049/1B, subsection 10.7, Item 5, as modified by this Appendix.*

4.0. Oblique-facing seats must meet the requirements of Table 4 of the Appendix to this ETSO. It prescribes the MPS for SAE International SAE AS6316, 'Performance Standards for Oblique Facing Passenger Seats in Transport Aircraft', dated June 2017. When the SAE section recommends (or suggests, advises, etc.) something, and it is part of the MPS, the recommendation becomes a requirement. For the purpose of meeting the oblique-facing seat requirements of Table 4 of the Appendix to this ETSO, all the references to 'AS8049C' must be replaced by 'AS8049C as modified by Table 1 of the Appendix to this ETSO'. In addition, we have also modified AS6316 as follows:

Table 4 — SAE AS6316

When reading AS6316	Do the following:
Section 1	Apply all the subsections unless disregarded or modified as shown below: --- On page 3, replace subsection 1.1 by the following: *1.1 Purpose* *This SAE Aerospace Standard (AS) defines the Minimum Performance Standards (MPSs), qualification requirements, and minimum documentation requirements for oblique-facing seats in transport aircraft. The goal is to achieve comfort, durability, and occupant protection under normal operational loads and to define test and evaluation criteria to demonstrate occupant protection when an oblique-facing seat/occupant/restraint system is subjected to statically applied ultimate loads and to dynamic test conditions.* *These criteria are limited to seats with an occupant facing direction greater than 18° and no greater than 45° relative to the aircraft longitudinal axis. Seats installed at angles greater than 30° relative to the aircraft longitudinal axis must have an energy-absorbing rest or shoulder harness and must satisfy the criteria listed in Table 2 as modified by this Appendix.* --- On page 3, replace subsection 1.2 by the following: *1.2 Seat Types* *This document covers only Type A-T passenger seats.*
Section 2	Apply all the subsections unless disregarded or modified as shown below: --- On page 3, replace subsection 2.1 by the following: *2.1 Applicable Documents* *This document is explicitly linked with and cannot be used without AS8049C. The requirements of each section of AS8049C apply to this document unless specifically modified by this document. Sections 3 through 7 of this document note only the differences between the standards of this document and the standards of AS8049C. Sections 8 and 9 are reserved for future use, and the content specific to oblique-facing seats is found in Section 10. Test pulse evaluations must use the method defined in AS8049C Appendix A.* --- On page 3, disregard Section 2.1.1.

When reading AS6316	Do the following:
Section 3	Apply all the subsections unless disregarded or modified as shown below: --- On page 7, disregard the modification to subsection 3.4.1.
Section 4	Apply as written
Section 5	Apply all the subsections unless disregarded or modified as shown below: --- On page 7, subsection 5.3.4.1 is modified by adding the following: *g. The ATD neck forces shall be measured in accordance with the requirements of Channel Class 1000.* *h. The ATD neck forces used for calculating Nij shall be measured in accordance with the requirements of Channel Class 600.* *i. The ATD neck moments shall be measured in accordance with the requirements of Channel Class 600.* *j. The ATD spine accelerations shall be measured in accordance with the requirements of Channel Class 180.* *k. The leg axial rotation obtained from the measured leg angular velocity by integration shall require angular velocity data measured in accordance with the requirements of Channel Class 180.* --- On page 7, subsection 5.3.1.5 is modified by adding the following: *Oblique-facing seating systems including sensor-driven restraint systems must be shown to meet the occupant injury criteria of Table 2 as modified by this Appendix throughout the entire range of yaw that encompasses installations at ± 10° relative to the aircraft longitudinal axis.*
Section 6	Disregard
Section 7	Disregard
Section 10	Apply all the subsections unless disregarded or modified as shown below: --- On page 9, add subsection 10.1.2.1 as follows: *10.1.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.1.2, then the detailed design definition of the contactable item evaluated per subsection 10.1.2 and any other information required for the installation (e.g. stiffness), must be included as part of the installation instructions and limitations document.* --- On page 10, add subsection 10.2.2.1 as follows: *10.2.2.1 When a contactable item is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated per subsection 10.2.2, then the detailed design definition of the contactable item evaluated per subsection 10.2.2 and any other information required for the installation (e.g. stiffness) must be included as part of the installation instructions and limitations document.*

When reading AS6316	Do the following:
	--- On page 11, replace Table 2, 'Neck', Item (4), by the following: *The neck must not impact on any surface that would produce significant concentrated loading on the neck.* --- On page 12, in Table 2, 'Femur', add Item (1) as follows: *Note: If contact occurs with other structure that is not part of the seat design (e.g. interior furnishing, bulkhead) and is evaluated during the axial compressive load, then the detailed design definition of the item must be included as part of the installation instructions and limitations document.* --- On page 12, in Table 2, 'Femur', add Item (2) as follows: *Note: For threshold tests only, if the pulse used for the threshold test has a lower energy than the research pulse used to develop the criteria (see FAA Report DOT/FAA/AM-17/2, 'Supplemental Injury Risk Considerations for Aircraft Side-Facing Seat Certification', dated January 2017), it is not necessary to meet the leg axial rotation requirement of Table 2 as modified by this Appendix, Femur, Item (2).*

5.0. Table 5 of the Appendix to this ETSO prescribes the MPS for SAE International ARP6337, 'Design, Manufacturing, and Performance Standard for Composite Materials Used on Aircraft Seat Structures', dated November 2020. When the SAE section recommends (or suggests, advises, etc.) something, and it is part of the MPS, the recommendation becomes a requirement. For the purpose of meeting the requirements of Table 5 of the Appendix to this ETSO, all the references to 'AS8049' and 'ARP5526' must be replaced by 'AS8049C as modified by Table 1 of the Appendix to this ETSO' and 'ARP5526D as modified by Table 3 of the Appendix to this ETSO' respectively.

In addition, SAE ARP6337 is also modified as follows:

Table 5 — SAE AS63376

<table>
<tr><th>When reading AS6337</th><th>Do the following:</th></tr>
<tr><td>Section 1</td><td>Apply all the subsections unless disregarded or modified as shown below:

On page 3, replace Table 1 by the following:
<table>
<tr><th>Seat Type</th><th>Aircraft Category</th><th>Applicable CSs</th></tr>
<tr><td>A-T</td><td>Large (Transport) Aeroplane</td><td>CS-25</td></tr>
<tr><td>C</td><td>General Aviation Aircraft — All categories as specified in 1(1)(c) of this ETSO</td><td>CS-23</td></tr>
</table></td></tr>
</table>

When reading AS6337	Do the following:
Section 2	Apply all the subsections unless disregarded or modified as shown below: --- On page 6, disregard 2.1.
Section 3	Apply as written
Section 4	Apply as written
Section 5	Apply as written
Section 6	Apply all the subsections unless disregarded or modified as shown below: --- On page 18, Section 6 is modified as follows: *6. Optionally, the composite seat structure can be subjected to the following environmental conditions described in EUROCAE ED-14/RTCA DO-160, according to paragraph 2.1 of CS-ETSO Subpart A, as outlined in Table 2 below. Comparison by similarity is acceptable if the test data is directly applicable to the material system, design details, and environmental conditions characteristic of the application. Testing may be combined sequentially to reduce the number of tests and optimise the use of test resources as noted in Section 3.2 of EUROCAE ED-14/RTCA DO 160.* --- On page 18, Section 6.1 is modified as follows: *6.1 Fluid Susceptibility* *The composite seat structure should be exposed to the fluids at the temperatures listed in Table 3 using one of the methods described in EUROCAE ED-14/RTCA DO-160, according to paragraph 2.1 of CS-ETSO Subpart A, Section 11.0. Resin-dominated shear tests are best for detecting the effects of solvent exposure on resins; refer to DOT/FAA/AR-02/109 for guidance on the recommended tests. The solvent exposure and subsequent testing should be conducted at the temperatures expected during service.* --- On page 18, Section 6.2 is modified as follows: *6.2 Waterproofness* *The composite seat structure shall withstand the effects of liquid water falling onto the seat, or the effects of condensation. The seat system shall be tested per Section 10.3.2 (drip test only) of EUROCAE ED-14/RTCA DO-160, according to paragraph 2.1 of CS-ETSO Subpart A. The seat manufacturer shall be able to demonstrate that the seat and the associated components are not adversely affected by the parameters considered.*
Section 7	Apply as written
Section 8	Disregard
Appendix A	Disregard

[Amdt ETSO/11]
[Amdt ETSO/17]

APPENDIX 2 TO ETSO-C127c – ELECTIVE MPS FOR ROTORCRAFT, TRANSPORT AEROPLANE, AND SMALL AEROPLANE SEATING SYSTEMS

ED Decision 2022/018/R

Compliance with the MPS described in these paragraphs is elective; however, the MPS must be followed for the MPS with which the applicant has elected to comply. Deviations from an elective MPS must be approved by EASA. Applicants should document and report which elective MPS subparagraphs they complied with so they can receive credit under this ETSO. In addition, see ETSO paragraph 4(a)(1) for the marking requirements.

a. Step Load on Baggage Bars: For seats where the baggage restraint allows application of a foot step load, apply the test criteria of ARP5526D, subsection 3.7.2. The testing must not degrade either the basic forward nor the side load carrying capabilities noted in AS8049C Table 4A, nor result in deformation, thus posing a tripping hazard.

b. Electrically Actuated Features: For seats with electrically actuated moving parts, which could potentially entrap and cause injury to passengers, apply ARP5526D, subsection 3.18.2.

c. Secondary Structure Abuse Loads: For seats that include the features listed in ARP5526D, Section 3.26.2, Table 9, apply the loads within the table to qualify the design.

d. Testing to Higher Static Loads: To substantiate seats to load factors higher than those specified in Table 4A of AS8049C, or to combine load factors, the higher load factors must be reported. The higher load factors must be marked on the ETSO placard.

e. Hand Holds: For seats designed to provide a handhold for passengers moving about the aeroplane, apply ARP5526D, Section 3.1.2.

f. Batteries Containing Lithium: For seats with batteries containing lithium in their design, test and meet the requirements defined in ETSO-C142b (or later EASA-approved ETSO for non-rechargeable lithium batteries) or ETSO-C179b (or later EASA-approved ETSO for rechargeable lithium batteries). An ETSO approval does not include installation approval in an aircraft, and special conditions may be required to gain installation approval if the design includes lithium batteries

g. Flammability — Large Exposed Non-metallic Parts: For Type A seats incorporating non-traditional, large non-metallic panels in their design, test and meet the fire protection provisions of Appendix F, Parts IV and V (heat release and smoke emission) of CS-25. Demonstrate the fire protection properties of the materials by using the methods provided in FAA policy statement PS ANM-25.853-01-R2, 'Flammability Testing of Interior Materials', which may permit substantiation based on previously tested materials, and SAE ARP6199A, 'Method to Evaluate Aircraft Passenger Seats for the Test Requirements of 14 CFR Part 25 Appendix F, Parts IV and V'. Although ARP6199A provides an acceptable compliance method for determining which panels on the seat must be evaluated and substantiated to comply with certain special conditions, the intent is to limit the quantities of materials that do not comply with the smoke emission and heat release test requirements.

   In addition, report which parts meet the requirements of Appendix F, Parts IV and V, as part of your ETSO-furnished data.

[Amdt ETSO/11]
[Amdt ETSO/17]