BS EN 4697:2016

BSI Standards Publication

Aerospace series — General and installation requirements for passenger seat fittings

bsi.

National foreword

This British Standard is the UK implementation of EN 4697:2016. It supersedes BS EN 4697:2012 which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Luft- und Raumfahrt - Allgemeine und Einbau Anforderungen an die Sitzanbindung von Passagiersitzen

This European Standard was approved by CEN on 27 September 2015.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 4697:2016) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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1 Scope

This European Standard specifies the installation and removal requirements and the space envelopes for passenger seat fittings on aircraft. The purpose is to reduce the installation time and the tooling required for seat installation by standardizing the seat attachment fasteners (fittings).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 9100, *Quality Management Systems — Requirements for Aviation, Space and Defence Organizations*

EN 9133, *Aerospace series — Quality management systems — Qualification procedure for aerospace standard parts*

AMS 1424J, *Deicing/Anti-Icing Fluid, Aircraft*[1)]

AMS 1428F, *Fluid, Aircraft De-icing/Anti-Icing, Non-Newtonian, (Pseudoplastic)*[1)]

AMS 1550B, *Cleaner, Water Base, Aircraft Interior Hard Surface Materials*[1)]

AMS 1630C, *Cleaner, Carpet Shampoo Type*[1)]

AMS 1631C, *Cleaner, Carpet Water Extraction Type*[1)]

AS8049B, *Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft and General Aviation Aircraft*[1)]

CS-25 Amendment 5, 5th September 2008, *Certification Specification for Large Aeroplanes*[2)]

FAR 25 Amendment 127, 28th October 2008, *Airworthiness Standards: Transportation Category Airplanes*[3)]

RTCA DO-160F ,6th December 2007, *Environmental Conditions and Test Procedures for Airborne Equipment*[4)]

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1) Published by: SAE National (US) Society of Automotive Engineers (http://www.sae.org/).

2) Published by: European Aviation Safety Agency (EASA), Postfach 101253, D-50452 Koeln, Germany.

3) Published by: FAA National (US) Federal Aviation Administration **(**http://www.faa.gov/).

4) Published by: Radio Technical Commission for Aeronautics (RTCA), 1828 L Street, NW, Suite 805 Washington, DC 20036, USA.

3 Abbreviations

For the purposes of this standard, the following abbreviations apply.

A/C Aircraft.

Acc. According.

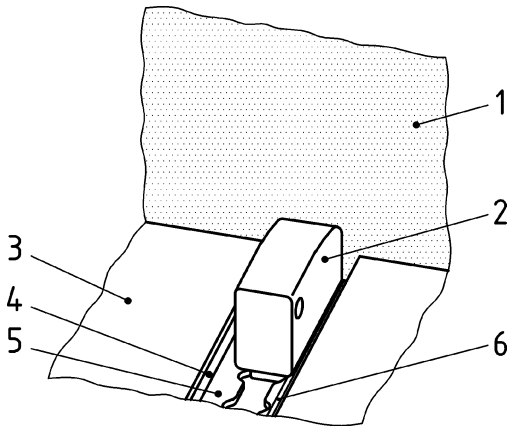
Fwd Forward.

SLD Shear Locking Device.

4 Requirements

4.1 General

The fitting design shall fit within the given space envelope, according to Figure 1 and Figure 6.



Key

1 Monument
2 Fitting body
3 Carpet
4 Floor panel
5 Seat rail
6 Raceway

Figure 1 — Fitting environment 1

All fittings attached to seat legs shall be pre-set to the correct seat track dimensions with fine adjustment of the fitting during installation not being necessary.

Minimum front to rear fitting distance shall be 482,6 mm (19”) between the extreme studs of each fitting.

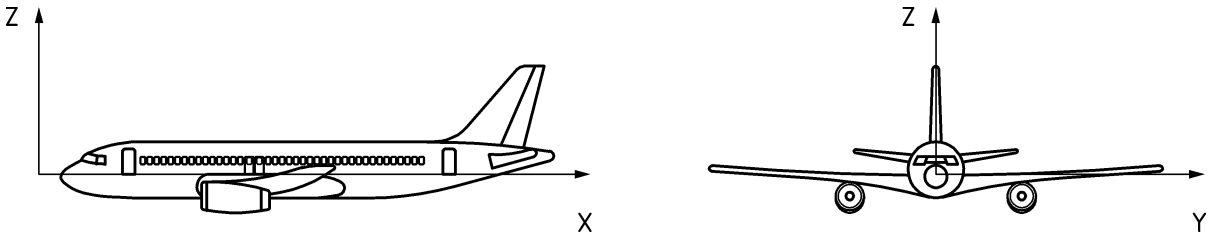


Figure 2 — Aircraft Coordinate System

The front attachment fasteners shall cover the tolerances in X-direction (see Figure 2) that might occur due to installation tolerances (of the seat leg and of the A/C structure).

The fitting weight shall be according to Table 1.

Table 1 — Fitting classes

Fitting class	Fitting	Weight g
A	Rear triple stud fitting	≤ 150
B		≤ 250
C	Rear quadruple stud fitting	≤ 200
D		≤ 290
E	Forward single stud fitting	≤ 50
F		≤ 90

Maintenance or repair work on the seat track shall be taken into account during fitting design. Details see Figure 3.

Dimensions in millimetres

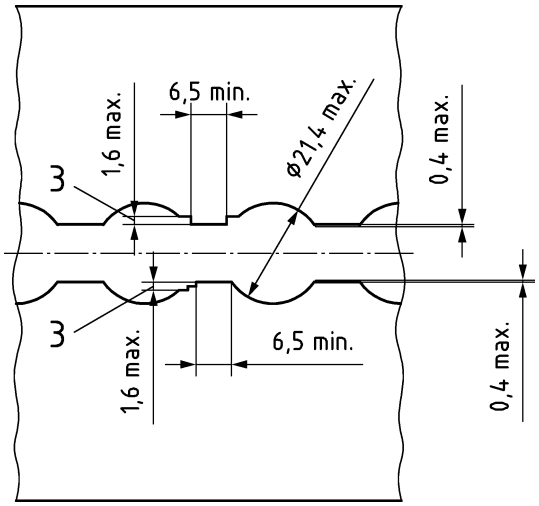


Figure 3a — Seat track top view

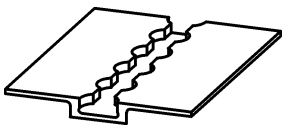


Figure 3b — Seat track 3 D view

Continued

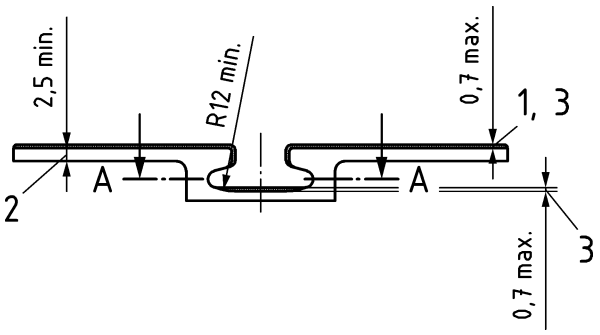


Figure 3c — Damage repair cross section 1

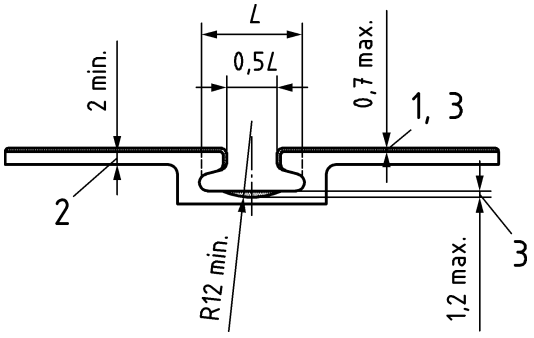


Figure 3d — Damage repair cross section 2

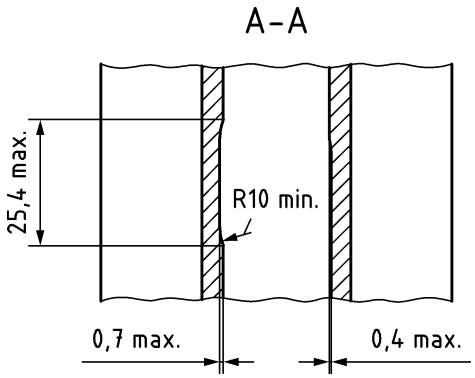


Figure 3e — Damage repair top view

Key

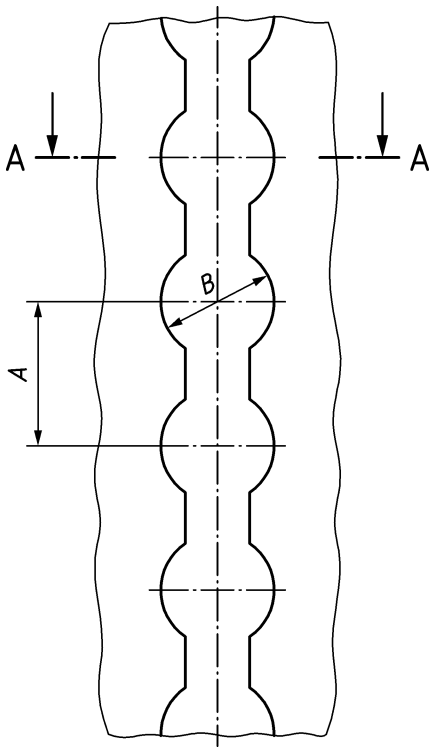
1 If the amount of material removed on one side of a seat track exceeds 0,3 mm (0,012 inch) maximum in depth, it is necessary to remove the same amount from the other side, so that a level surface is achieved
2 Minimum remaining thickness after rework
3 Maximum rework depth as reference to nominal thickness

Figure 3 — Seat track allowable damage limits and repair solutions

The fitting design shall show no evidence of any movement/rattling of the fitting-track combination. A continuous load path shall be ensured at all times. A shear-locking device should only be incorporated in the rear fitting. Fitting design and performance shall be validated incorporating the fitting-seat combination.

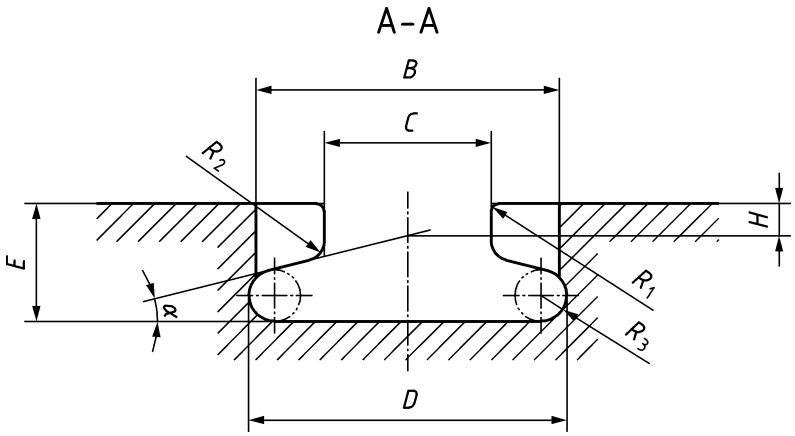
4.2 Interface

The fitting shall be compatible with the standard seat track concept, see Figure 4 and Figure 5 including the tolerances of the installed seat tracks see Figure 6 and Figure 7.



Dimension *A*
Tolerance of ± 0,1 mm (0,004 inch) on 1 pitch
Tolerance of ± 0,5 mm (0,020 inch) on 100 pitches

Figure 4 — Seat rail top view



Detailed seat rail dimensions, see Table 2.

Figure 5 — Seat rail cross section

Table 2 — Seat rail dimensions

Dimensions in millimetres (in inches)

A min. max.	*B* min. max.	*C* min. max.	*D* min. max.	*E* min. max.	*H* min. max.	α° min. max.	R_1 min. max.	R_2 min. max.	R_3
25,3 25,5 (0,996 1,004)	19,7 20,0 (0,776 0,787)	10,7 11,0 (0,421 0,433)	20,5 21,0 (0,807 0,827)	7,8 8,0 (0,307 0,315)	2,3 2,7 (0,091 0,106)	13,75 14,25	0 1,0 (0 0,039)	0,8 1,8 (0,031 0,071)	Full Full
NOTE 1 Diameter *B* and slot centerline *D* shall be coincident with slot centerline *C* to within 0,13 mm (0,005 inch). NOTE 2 All faces shall be within 0,5° of the specified position relative to the upper surface of the rail.									

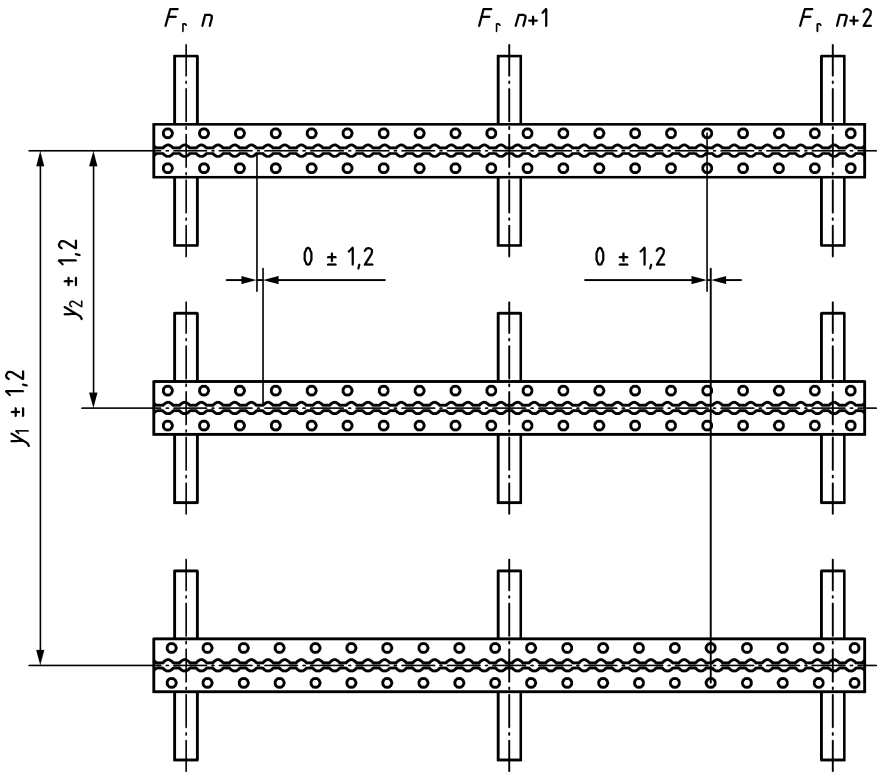
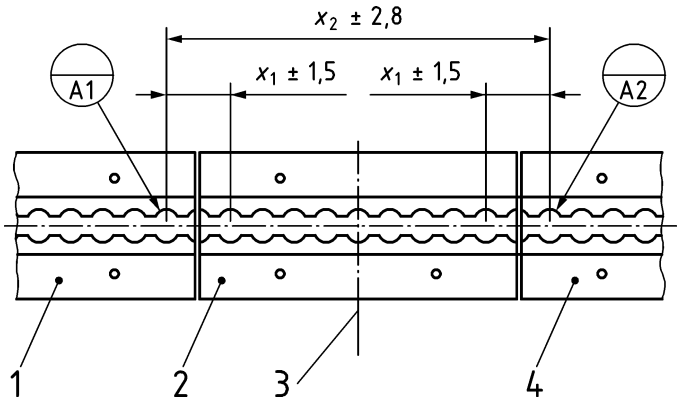


Figure 6 — Location tolerances of separate tracks



Key

1 Seat track on section 1
2 Junction seat rail
3 Centerline of A1 – A2
4 Seat track on section 2

A1 Last hole of seat track section 1
A2 Last hole of seat track section 2

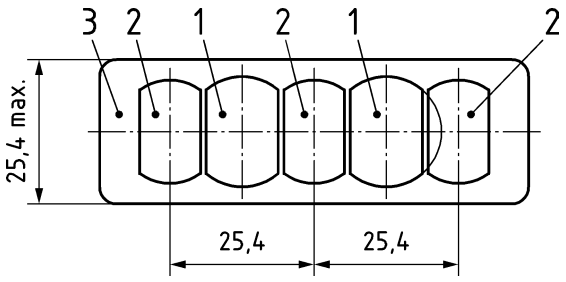
Figure 7 — Track splice tolerance in x

The fitting shall be compatible with the currently marketed seat concepts. Therefore several clevis positions of the fitting should be available.

The rear fitting shall have dimensions according to Figure 8 and Figure 9 and a compact design without any sharp edges or corners.

The front fitting shall have dimensions according to Figure 10 and a compact design without any sharp edges or corners.

Dimensions in millimetres

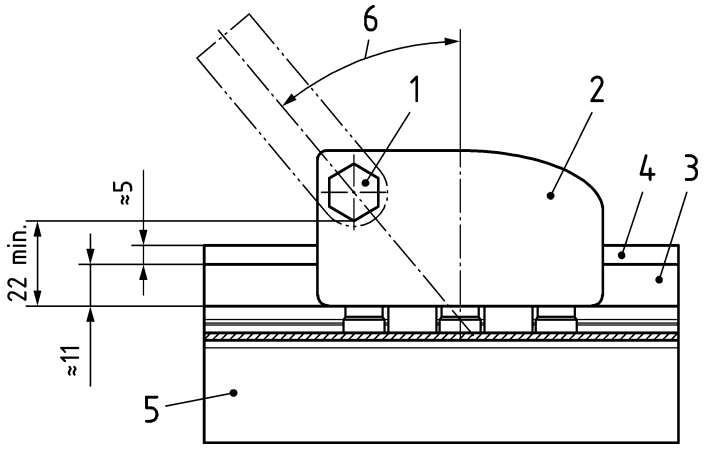


Key

1 Shear pin
2 Stud
3 Fitting body

Figure 8 — Design example rear fitting bottom side

Dimensions in millimetres



Key

1 Bolt
2 Fitting body
3 Floor panel
4 Carpet
5 Seat rail
6 Reference only, 35° to 45° is the best angle for the load introduction

Figure 9 — Dimensions 2 rear fitting side view

It shall be possible to route seat-to-seat cables by/alongside/near the fitting, which in turn shall not damage or squeeze the cables when the seats are shifted inside the rail. Therefore the width shall not exceed max. 25,4 mm (max. 1 inch), according to Figure 8 and Figure 10.

Particular attention shall be paid to galvanic corrosion between seat tracks and fitting materials. The seat track fitting material shall be corrosion resistant, considering not only the potential action of water/humidity, but also fluids and materials present in the normal seat environment, as well as passenger activity.

4.3 Installation Requirements

The fitting shall be quickly lockable by one person without the need for any tools. A single tool – Allen Key 3/16, ¼ or 5/16 shall be used for unlocking of the attachments fasteners.

The maximum force for the locking operation shall not exceed (5 ± 1) daN, respecting ergonomic aspects.

The (pure) seat installation time, comprising two (2) Fwd and two (2) aft fittings, shall not exceed one (1) minute. The last seat row may have a longer installation time due to restricted accessibility of a monument installation (e.g. Doghouses, partitions, etc.).

The SLD shall not include parts that have to be disassembled or removed from the device for seat position shifting, removal and installation.

The locking motions of the fitting shall not damage the seat track, floor panels or any other component and their surfaces.

A clear and reliable visible indication for the SLD in locked position shall be incorporated in order to guarantee correct installation and engagement of the fitting.

The SLD engagement/disengagement to the track shall be directly visible to personnel (e.g. quality inspector) standing in the longitudinal passenger aisle.

Unhindered access to the attachment fitting shall be considered, e.g. without the need to disassemble any parts of the seat or any adjacent components as stowages, doghouses, etc.

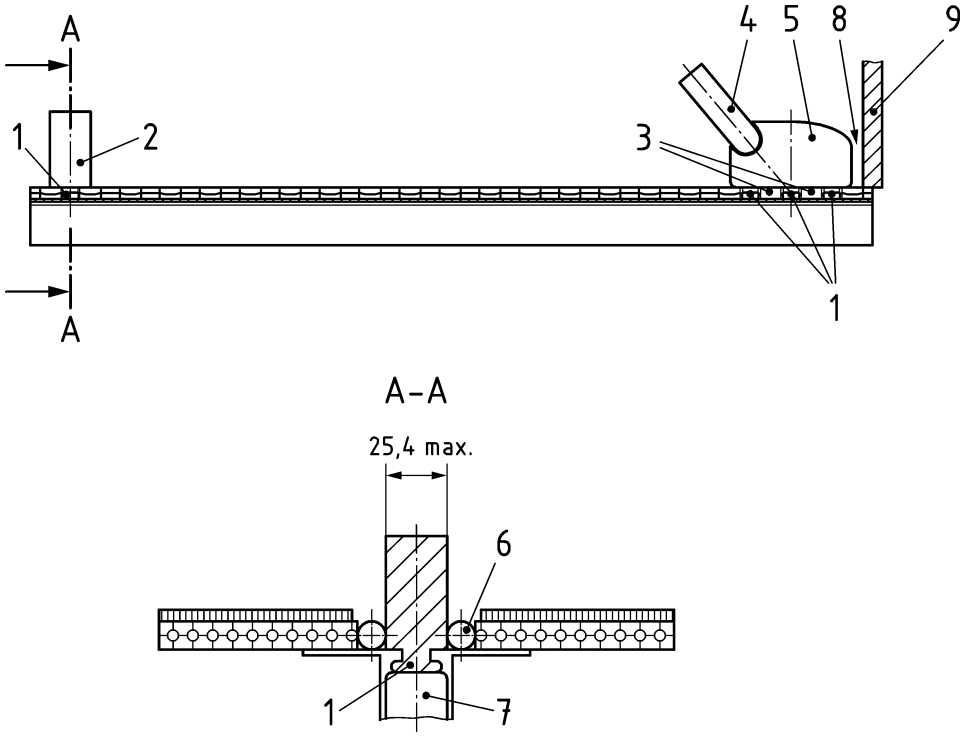
The shifting of seats (movement of the seat in x-direction) fwd and aft shall be possible without having to remove them from the seat rail.

The fitting design shall prevent jamming in the seat rail, neither during changing the seat position nor during seat installation/removal.

The fitting design shall allow seat reconfiguration within five (5) min (e.g. unlock, shift, re-lock of a seat group).

For unfastening operations of the fitting the environment shall be considered (e.g. floor panels, carpet, raceways, monuments), as per Figure 10.

Dimensions in millimetres



Key

1 Stud
2 Front seat leg
3 Shear pins
4 Rear seat leg
5 Fitting
6 Seat to seat cables
7 Seat track
8 Clearance fitting – monument no tool access feasible
9 Monument

Figure 10 — Fitting Environment 2

4.4 Performance and Safety

In order to avoid unfastening by unauthorized persons, unlocking shall only be possible by use of a tool, see 4.3. SLD Locking function/ device shall not require the use of safety wire. The front and rear fitting shall be protected against abuse loading from passenger feet and luggage.

The fitting design shall avoid passenger injuries.

The SLD shall be designed for positive engagement in the seat track.

This positive engagement can be gravity, spring loading or self-locking under forward or downward inertia load factors or a combination of these.

The SLD shall lock itself in the engaged position by an approved means to sustain flight, landing, abuse and ground test loads.

Three (3) life cycle/performance tests shall be performed according to the following procedure:

a) Operation of the locking device:

The design shall consider a minimum use of 1 000 cycles operating of the locking device.

1) Fit into the seat track.
2) Lock.
3) Unlock.
4) Lift out of the seat rail.

Pass/Fail criteria:

- Rattling.
- Friction.
- Play.
- Force for locking operation is still ± 1 daN of initial force.

b) Movement along the seat track:

The design shall consider a minimum of 100 cycles movement along the seat track. Test rig with two (2) seat legs, distance 527 mm (two (2) front fittings, two (2) rear fittings) loaded weight 180 kg.

1) Movement along the seat track by 8”.
2) Lock.
3) Unlock.

Pass/Fail criteria:

- Surface treatment not damaged so that the track material becomes visible

c) Movement along the seat track, environmental conditions considered:

The design shall consider a minimum of 100 cycles movement along the seat track. Test rig with two (2) seat legs, distance 527 mm (two (2) front fittings, two (2) rear fittings) loaded weight 180 kg.

Environmental conditions: Sand, dust, fluids (anti- and de-icing agents according to AMS 1424J);

AMS 1428F, coke, alcohol, distilled vinegar (10 % concentrated), cleaning agents according;

AMS 1550B (normal), AMS 1630C and AMS 1631C (carpet).

1) Movement along the seat track by 8”.
2) Lock.
3) Unlock.

Pass/Fail Criteria:

— Fitting still operable.
— Test rig still movable.
— Test cycle duration shall not exceed five (5) minutes.

Refer to the following chapters from: CS-25:2008, Amendment 5/FAR 25:2008, Amendment 127: 25.603 Materials; 25.605 Fabrication methods; 25.607 Fasteners; 25.609 Protection of structure; 25.613 Material strength properties and Material Design Values; 25.621 Casting factors; 25.785 Seats, berths, safety belts and harnesses.

4.5 Stress requirements

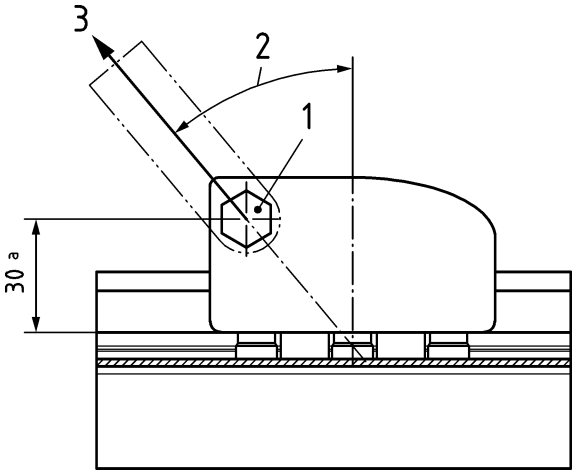
4.5.1 Static requirements

The seat rail attachment fitting shall be designed for the values stated in the Table 3 and Figure 11.

Table 3 — Interface Loads

Stud	Direction	With fitting factor 1,33 incl.	With fitting factor 1,33 incl.		
		daN	F_x daN	F_y daN	F_z daN
Rear double, triple, quadruple	F_x	± 2 700	–	–	–
	F_y	± 1 600	–	–	–
	F_z	± 3 500	–	–	–
	R_{xz}	4 400	2 700	0	3 500
	R_{yz}	3 800	0	1 600	3 500
	R_{xyz}	4 423	2 700	1 600	3 500
Front single	F_x	± 2 700	–	–	–
	F_y	± 1 600	–	–	–
	$F_{z\,up}$	1 828	–	–	–
	$F_{z\,down}$	− 3 500	–	–	–
	R_{yz}	2 430	0	1 600	1 828

Dimensions in millimetres



Key

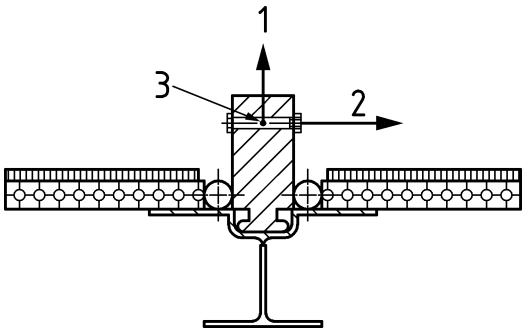
1 Load application point
2 35° to 45°
3 Resultant load

a NOTE 30 mm recommended

Figure 11 — Load application rear fitting

Interface loads not exceeding $F_x = \pm$ 3 000 daN (incl. fitting factor) shall be supported without further investigation.

For the fitting, it shall be ensured, that a combination of the stated loads can act simultaneously on the fitting at one point. Load application point, see Figure 12.



Key

1 Load F_z
2 Load F_y
3 Load application point at fitting connection to seat leg

Figure 12 — Load application front fitting

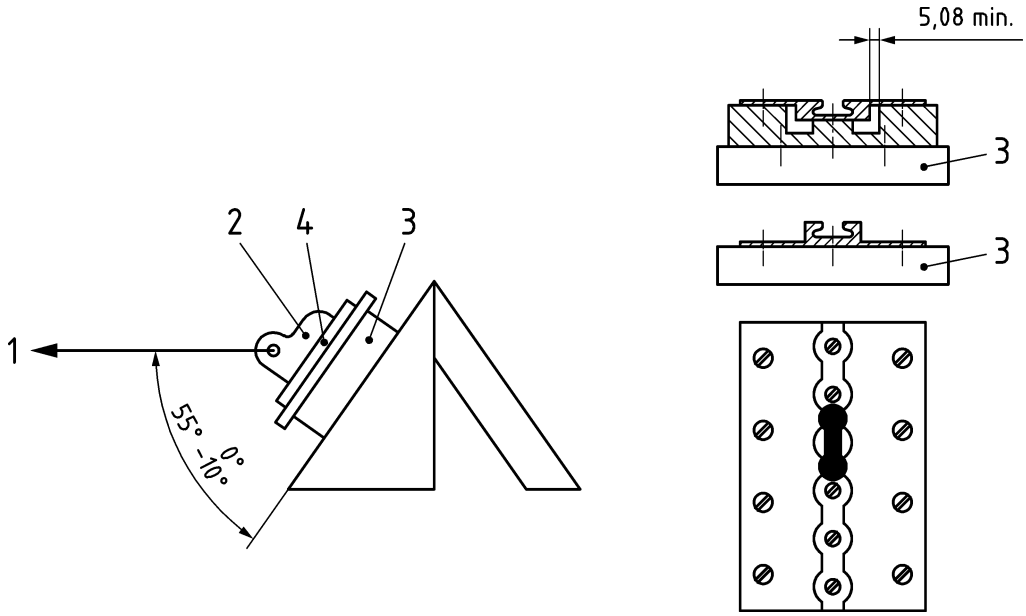
4.5.2 Dynamic requirements (rear fitting only)

Dynamic loads from seats according CS-25:2008, Amendment 5, Chapter 25.562 Emergency landing dynamic conditions shall be supported. Additionally pre-stress is created due to induced pitch and roll of the track according to the requirements stated in CS-25:2008 Amendment 5, Chapter 25.562 Emergency landing dynamic conditions. One or more different approaches may be chosen to validate the combination of fitting and track crown:

1) Dynamic test that will prove the fitting
2) Generic sled test with tripods or similar rigid structure and weights to evaluate dynamic fitting capability under generic loads.
3) Static coupon test with crown and stud, which may indicate the dynamic capability.

Test Setups. Setup A – C preferred, Setup D optional.

Dimensions in millimetres

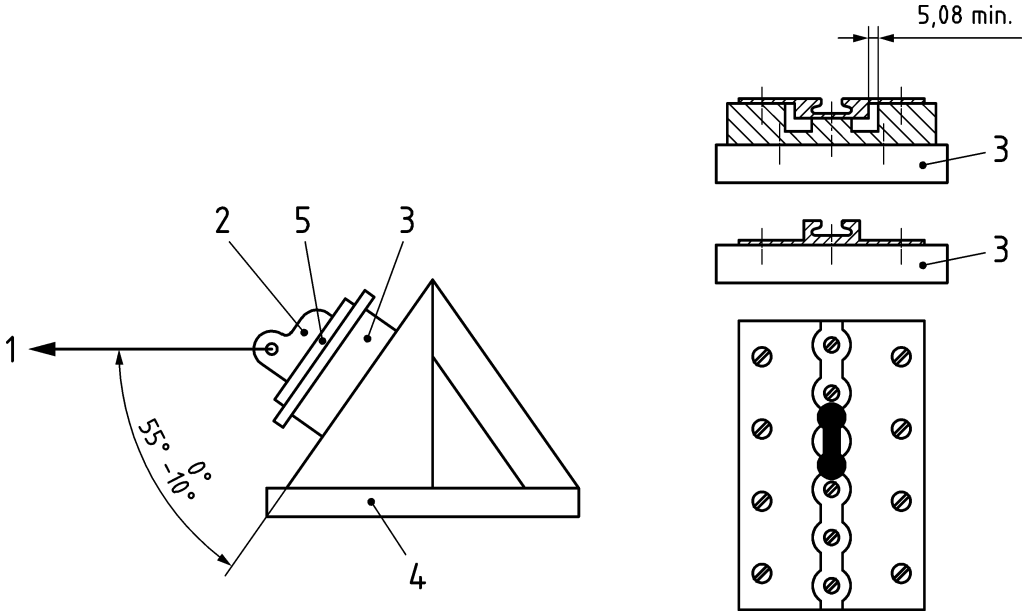


Key

1 Bumper tester
2 Fitting
3 Load cell
4 6” seat track

Figure 13 — Setup A with bumper tester

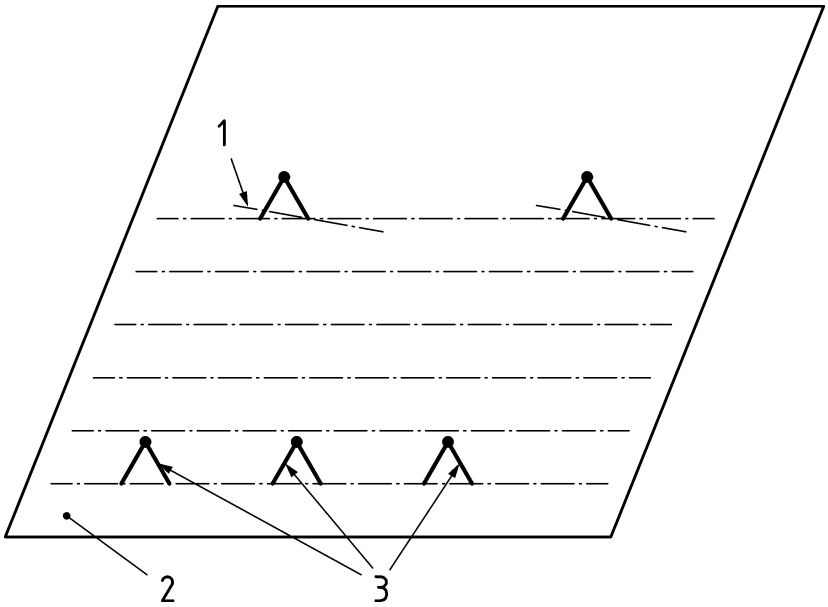
Dimensions in millimetres



Key

1 Weight
2 Fitting
3 Load cell
4 Sled according AS8049B
5 6” seat track

Figure 14 — Setup B with sled test and weight directly attached to fitting

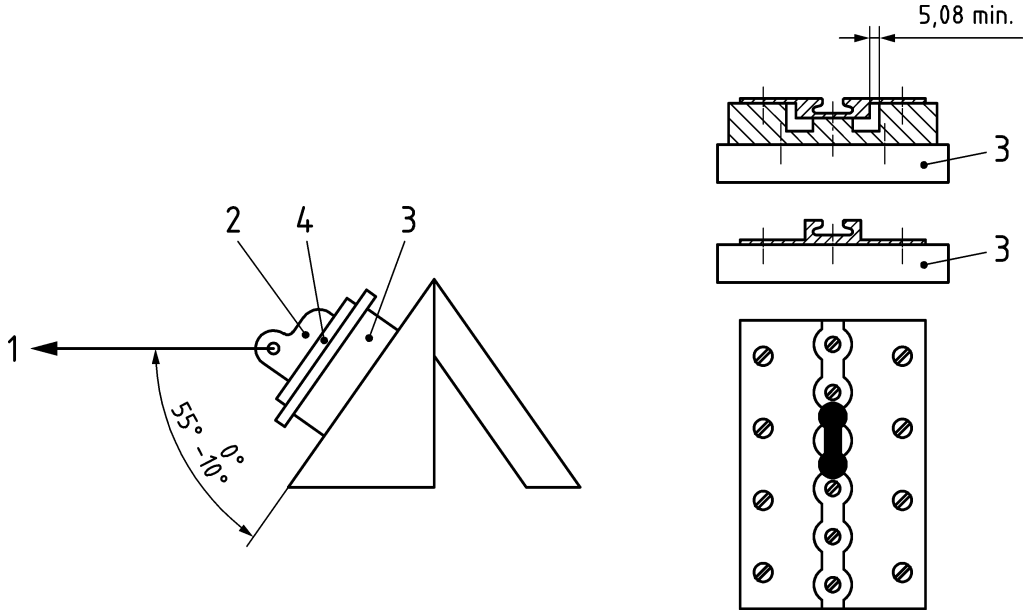


Key

1 Tripods 10° pitch
2 Sled according AS8049B
3 Steel tripods with different weights

Figure 15 — Setup C with sled test and weight on tripods

Dimensions in millimetres

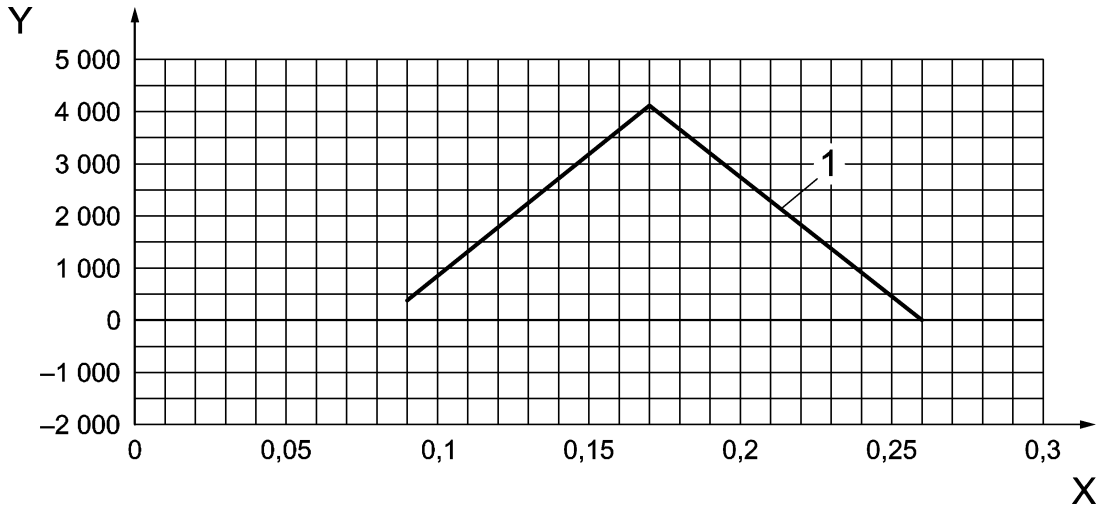


Key

1 Static load 55 kN, hold 3 sec.
2 Fitting
3 Load cell
4 Seat track

Figure 16 — Setup D alternative static test

The dynamic load envelopes according to Figure 17 to Figure 20 shall be covered. Test set up see Figure 13, Figure 14, and Figure 15:



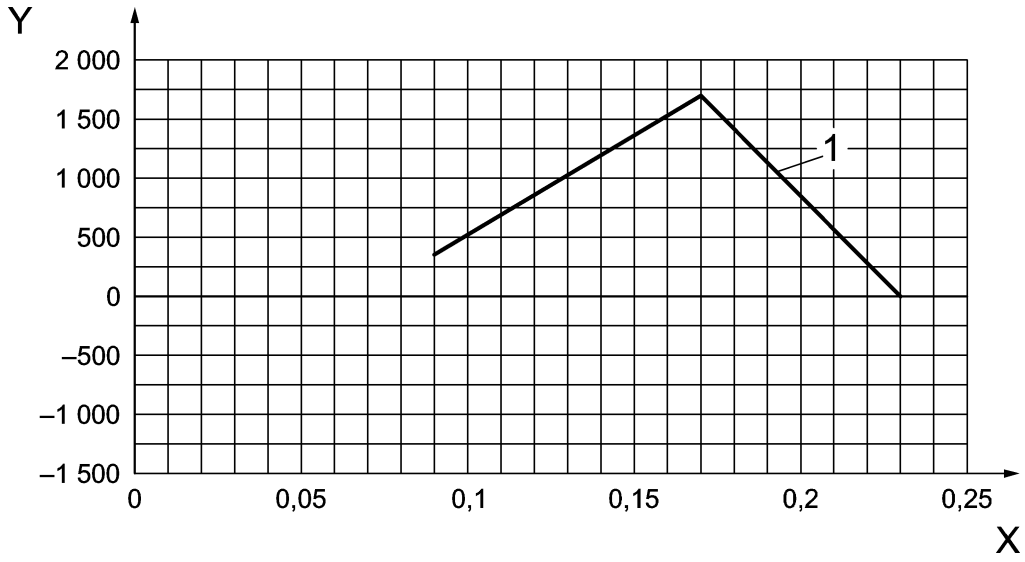
Key

1 X load envelope

X Time (sec)

Y Load (daN)

Figure 17 — Dynamic X load envelope



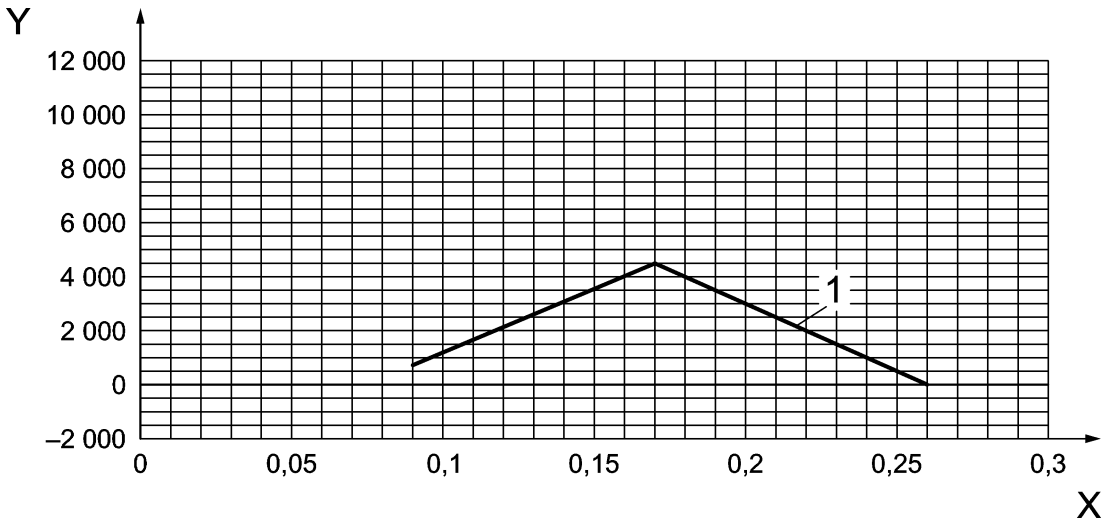
Key

1 Y load envelope

X Time (sec)

Y Load (daN)

Figure 18 — Dynamic Y load envelope

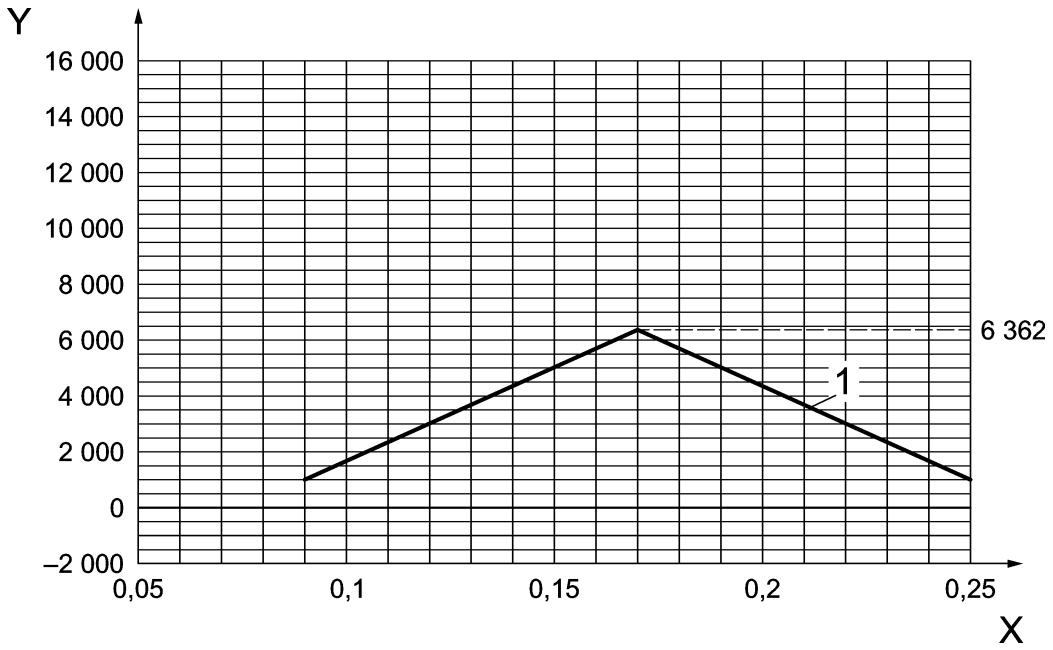


Key

1 Z load envelope

X Time (sec)
Y Load (daN)

Figure 19 — Dynamic Z load envelope



Key

1 Resultant load envelope 1

X Time (sec)
Y Load (daN)

Figure 20 — Dynamic resultant envelope 1

4.6 Environmental requirements

The fitting shall comply with the following environmental conditions requirements:

- Temperature and Temperature Variation according to RTCA DO 160F: 2007, Section 4, Category A1 and Section 5 Category C;
- Mechanical Vibrations according to RTCA DO-160F: 2007, Section 8.5.2, Category S, Curve C;
- Humidity according to RTCA DO-160F: 2007, Section 6 Category A;
- Fluids Susceptibility according to RTCA DO-160F: 2007, Section 11, Category F.
- Fluids, which shall be tested, are defined in 4.4 (3rd test set up).

4.7 Additional requirements

Vibration test requirements derived from sustained engine imbalance (windmilling) and nose wheel imbalance shall be considered and verified by the seat supplier in conjunction with the seat.

5 Qualification

All seat track fitting design solutions shall be approved by the aircraft manufacturer/installer for installation, by review of detailed drawings, stress analysis reports and test results.

Approval of manufacturers: see EN 9100.

Qualification of fitting: see EN 9133.

Annex A
(informative)
Standard evolution form

The main changes with respect to the previous edition EN 4697:2012 P1 are listed in Table A.1.

Table A.1 — Main changes to previous edition

MODIFICATION	REASON AND VALIDATION
Additional new Figure 6: Location tolerances of separate tracks.	Lessons Learned has shown that the tolerances of the seat track installation in y-direction are important for the seat installation and fitting design.
Additional new Figure 7: Track splice tolerance in x.	In some areas the seats are also installed over a seat track junction. In this area the tolerances needs to be taken into consideration for the fitting design.
In Table 3: Interface Loads: Additional new direction F_x with fitting factor ± 2 700 daN for front single stud.	F_x load was missing in previous issue. Correction of a mistake.
Change in Table 3: Interface Loads: Before: F_z with fitting factor ± 1 828 daN for front single stud. After: $F_{z\ up}$ with fitting factor 1 828 daN for front single stud. and $F_{z\ down}$ with fitting factor – 3 500 daN for front single stud.	Vertical load is different in up and down direction. Correction of a mistake.
Additional information in new Figure 11 (former Figure 9): Load application rear fitting: New Dimensions: 30 mm recommended for centerline of attachment bolt. 11 mm for floor panel. 5 mm for carpet.	30 mm can be only a recommendation, otherwise in contradiction to Figure 9.
Remove of old Figure 19: Dynamic resultant envelope 2 including the sentence: "Set preload at the indicated value from 0 kg to 1 500 kg. The curve shows the resultant dynamic load that the crow needs to withstand during dynamic test".	Load case is from automotive and not applicable for aircraft seats.

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