BS EN 4723:2015

BSI Standards Publication

Aerospace series — Standardized measurement methods for comfort and living space criteria for aircraft passenger seats

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 4723:2015.

The UK participation in its preparation was entrusted to Technical Committee ACE/1, International and European Aerospace Policy and Processes.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2015

ISBN 978 0 580 81334 4

ICS 49.095

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2015.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 4723

September 2015

ICS 49.095

English Version

Aerospace series - Standardized measurement methods for comfort and living space criteria for aircraft passenger seats

Série aérospatiale - Mesure standardisée du confort et de l'espace de vie des sièges passagers d'avion

Luft- und Raumfahrt - Sandardisierte Meßmethoden für Komfort und Living Space Kriterien bei Passagiersitzen im Flugzeug

This European Standard was approved by CEN on 19 March 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

European foreword

This document (EN 4723:2015) 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 European 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 March 2016, and conflicting national standards shall be withdrawn at the latest by March 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.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies requirements and measurement methods for the assessment of passenger living space and comfort. Its aim is to improve the passenger comfort quality of aircraft cabins and provide measurement methods to compare cabin seat layouts and seats.

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 ISO 1856, *Flexible cellular polymeric materials — Determination of compression set (ISO 1856)*

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

SAE J826, *Devices for Use in Defining and Measuring Vehicle Seating Accommodations* [1)]

ASTM D3574, *Standard Test Methods for Flexible Cellular Materials — Slab, Bonded, and Molded Urethane Foams* [2)]

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

2) Published by: ASTM National (US) American Society for Testing and Materials (http://www.astm.org/).

3 Abbreviations and definitions

For the purposes of this document, the following abbreviations and definitions apply.

A/C	Aircraft
ACH	Armrest height over compressed cushion height
ARL	Armrest length
ARW	Armrest width
ATD	Anthropomorphic test dummy
BPD	Seat bottom pressure distribution / mapping
CAD	Computer-aided design
CCD	Compressed cushion datum
CHoF	Cushion height over floor level
CRP	Cushion reference point
E/C	Economy Class
e.g.	exempli gratia (for example)
FS	Foot space
H-point	Hip-point
HR	Headrest
HT	Headrest thickness
KS	Knee space
LR	Long range
P/C	Premium Class
PAX	Passenger
SAE	Society of automotive engineers
SCRP	Seat comfort reference point
SHC	Shine clearance
SOH	Shoulder obstruction height
SMRP	Seat measurement reference point
SRP	Seat reference point
SWAR	Seat width between armrests
TACH	Armrest top height over seat bottom cushion
TH	Table height over bottom cushion
TTL	Taxi-take off-landing
VS	Visual space
w/o	Without

4 Requirements

4.1 General

For the aim of this document, the aircraft coordinate system is shown in Figure 1.

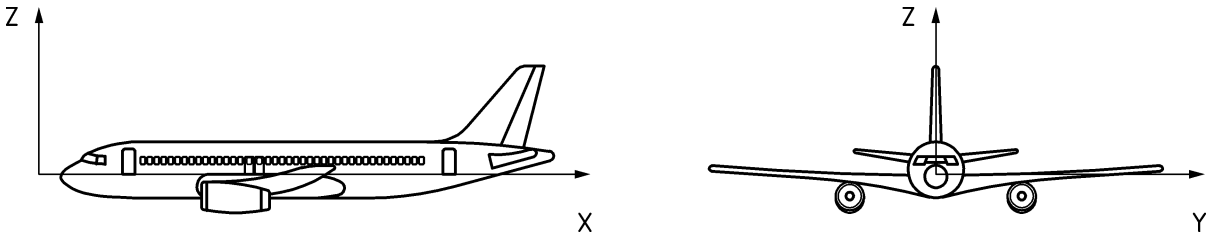


Figure 1 — Aircraft coordinate system

4.2 Comfort and living space metrics

Compliance with airworthiness requirements, e.g. passageways, minimum aisle widths between armrests etc. are mandatory.

Comfort and living space criteria are often mixed up. Table 1, Table 2 and Table 3 indicate the category each criterion belongs to.

Table 1 — Economy class passenger seats

Living space	Comfort
Economy class seat metrics	
Pitch	Armrest height relative to cushion height
3-D living space	Seat surface climate
Shin clearance at 60°, 45°	Cushion height above cabin floor level
Shin clearance at 35° for LR A/C only	Seat depth
Shoulder obstruction height	Backrest angle to seat bottom cushion (with and w/o recline)
Table height over bottom cushion edge	Headrest thickness
Visual space	Traverse path of headrest including extreme positions
Knee space	For seats with kinematics and hinge point in the backrest traverse path of headrest including extreme positions for basic and hinged position
Clearance height below seat in front	Seat pan pressure mapping
Length of armrest	Headrest type (hammock, movable x-ways, integrated in backrest foam)
Width of armrest	Foam hardness
Seat width between armrests	
Usable seat bottom cushion width between armrests	
Ingress/egress at 28 in (711,2 mm), 30 in (762 mm), 32 in (812,8 mm) pitch, each with backrest table deployed/undeployed at no and full recline	

Table 2 — Premium class passenger seats lie flat

Living space	Comfort
Lie flat business class metrics	
Shoulder obstruction height	Armrest height relative to cushion height
Pitch	Seat height
Table height over bottom cushion edge	Cushion height above cabin floor level in upright (TTL) mode
3-D living space	Seat surface climate
Visual space	Total seat depth in full recline position
Knee space	Average bed angle in full recline position
Bed length in full recline position	Headrest thickness
Seat bottom width in upright (TTL) position	Traverse path of headrest including extreme positions
Bed width at elbow level 43 in (1 092,2 mm) from end of bed in full recline position	Backrest angle to seat bottom cushion (with and w/o recline)
Bed with at shoulder level 60 in (1 524 mm) from end of bed in full recline position	Seat pan pressure mapping
Length of armrest	Headrest type (hammock, movable x-ways, integrated in backrest foam)
Width of armrest	Foam hardness
Seat width between armrests	
Usable seat bottom cushion width between armrests	

Table 3 — Premium class passenger seats full flat

Living space	Comfort
Full flat/full horizontal business class metrics	
Shoulder obstruction height	Armrest height relative to cushion height
Pitch	Seat height
3-D living space	Seat surface climate
Table height over bottom cushion edge	Cushion height above cabin floor level in upright (TTL) mode
Visual space	Total seat depth in full recline position
Knee space	Headrest thickness
Bed length in full recline position	Traverse path of headrest including extreme positions
Seat bottom width in upright (TTL) position	Backrest angle to seat bottom cushion (with and w/o recline)
Bed width at elbow level 43 in (1 092,2 mm) from end of bed in full recline position	Seat pan pressure mapping
Living space at elbow level in full recline position	Headrest type (hammock, movable x-ways, integrated in backrest foam)
Bed width at shoulder level 60 in (1 524 mm) from end of bed in full recline position	Foam hardness
Length of armrest	
Width of armrest	
Seat width between armrests	
Usable seat bottom cushion width between armrests	

5 Technical/geometric definitions and measurement methods

5.1 General

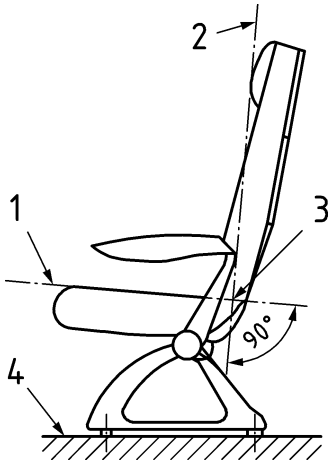
This clause specifies the different geometrical points from which measures are taken. Measuring methods are indicated below each of the measure explanations and figures. They shall be used to provide an objective and reproducible result for each seat measured. Measurements shall be carried out as indicated using anthropomorphic dummies (95%ile, 50%ile male and 5%ile Japanese female) according to SAE AS8049B if not stated differently. In case of non-availability, humans matching the anthropomorphic data may be used. Measures shall be taken in an upright and fully reclined position.

5.2 Cushion reference point (CRP)

5.2.1 CRP definition

The cushion reference point (CRP), see Figure 2, is defined as the intersection of the plane of the uncompressed top of the seat cushion with the plane perpendicular to the seat cushion, which touches the most forward surface of the uncompressed centre of the seat back.

If a lumbar device is provided, and if it alters the position of the CRP, then the most extended position (most forward position of the CRP) must be considered.



Key

1 Uncompressed cushions centre line
2 Plane perpendicular to seat cushion touching most forward surface of uncompressed centre of seat back
3 Cushion reference point (CRP)
4 Top of track

Figure 2 — Cushion reference point (CRP)

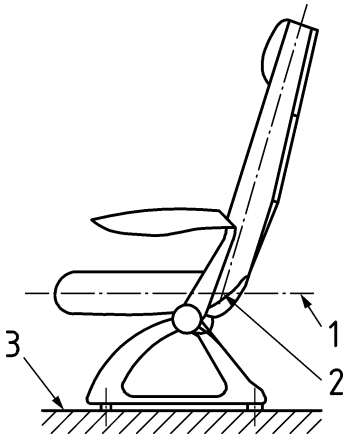
5.2.2 CRP measurement method

Place a thin, but rigid sheet of metal or plastic on top of the uncompressed seat bottom cushion and place a back square /tri-square with a long upper leg on top. Move the back square /tri-square towards the uncompressed centre of the backrest cushion until it touches the most forward position of the backrest cushion, be it a fully extended lumbar support or in the case of no lumbar support, the backrest cushion itself. The point of intersection between the prolonged line of the contact to the backrest cushion and the plane of the uncompressed seat bottom cushion perpendicular to it marks the cushion reference point.

5.3 Seat reference point (SRP)

5.3.1 SRP definition

The seat reference point (SRP), see Figure 3, is the intersection of the compressed cushion datum (CCD) and the back tangent line of a seat occupied by a 75 kg to 80 kg (160 lb to 180 lb) subject or 50%ile male anthropomorphic test dummy (ATD). The methods achieving SRP data are derived from SAE AS8049B.



Key

1 Compressed seat cushion lowest point (for H-point method plane 97 mm below H-point)
2 Seat reference point (SRP)
3 Top of track

Figure 3 — Seat reference point (SRP)

5.3.2 SRP measurement method

The SRP shall be measured in accordance with SAE AS8049B. The preferred measurement method is: measure SRP with H-Point machine according to SAE J826.

H-point method using H-point machine - procedure for establishing SRP:

1) Place an H-point machine in the seat in accordance with SAE J826 and measure the horizontal and vertical coordinate of a seat datum point (typically the front stud), the H-point, and note the indicated seat back angle.

2) Establish the back tangent line. The back tangent line is the line parallel to the seat back angle passing through a point 127 mm (5,0 in) directly behind the H-point.

3) Establish the compressed cushion datum (CCD). The CCD is a line parallel to the floor water line 97 mm (3,8 in) below the H-point.

4) The SRP is located at the intersection of the CCD and the back tangent line.

CAUTION — Measurement tolerances of up to ± 4 mm (0,157 in) in x-direction and ± 4 mm (0,157 in) in z-direction need to be taken into account during measurement procedure with the H-point machine. Measurement tolerances of up to ± 15 mm (0,591 in) in x-direction and ± 2 mm (0,079 in) in z-direction need to be taken into account for repeated setting of the dummy in the seat.

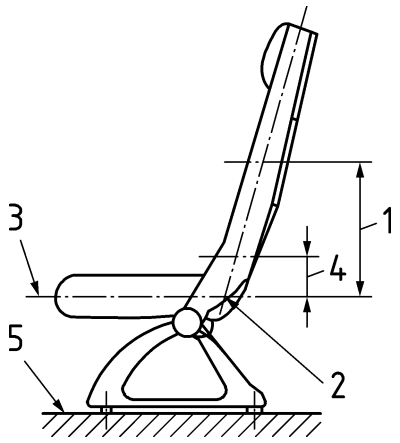
5.4 Seat measurement reference point (SMRP) / Seat comfort reference point (SCRP)

5.4.1 SMRP/SCRP definition

The seat measurement reference point (SMRP) or seat comfort reference point (SCRP), see Figure 4, is defined per common known criteria as the intersection of two extended planes:

The “compressed seat cushion height” plane runs parallel to the airplane floor at the point of maximum compression of the seat bottom cushion by a 77 kg (170 lb) passenger.

The “seatback plane”: A six-inch wide plane parallel to the vertical centre axis of the seatback; running through the front surface of the compressed seatback at points 3 in (76,2 mm) and 23 in (584,2 mm) above the “compressed seat cushion height”.



Key

1 Compressed seatback at 23 in (584,2 mm)
2 SMRP/SCRP
3 Compressed seat cushion lowest point
4 Compressed seatback at 3 in (76,2 mm)
5 Top of track

Figure 4 — Seat comfort reference point (SCRP/SMRP)

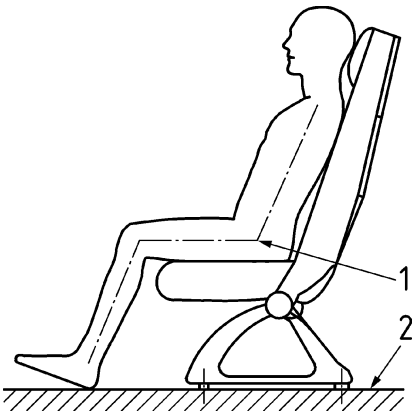
5.4.2 SMRP / SCRP measurement method

The SMRP/SCRP is to be measured with a 3-D CAD system. The seat including the full geometry of the seat cushions need to be reflected in the 3-D CAD system. The compressed seat bottom cushion plane shall be drawn parallel to the top of track plane at a height to which a 77 kg (170 lb) weight passenger equivalent to a 50%ile SAE anthropomorphic dummy has compressed the cushion. The seatback plane is designed by drawing a six-inch wide plane parallel to the vertical centre axis of the seatback and running through the front surface of the compressed seatback at points 3 in (76,2 mm) and 23 in (584,2 mm) above the previously measured compressed seat cushion height.

5.5 H-point

5.5.1 H-point definition

The H-point is defined as the point where centre-lines of upper torso and femoral of the dummy (50%ile male) seated in upright position meet, see Figure 5.



Key

1 H-point

2 Top of track

Figure 5 — H-point

5.5.2 H-point measurement method

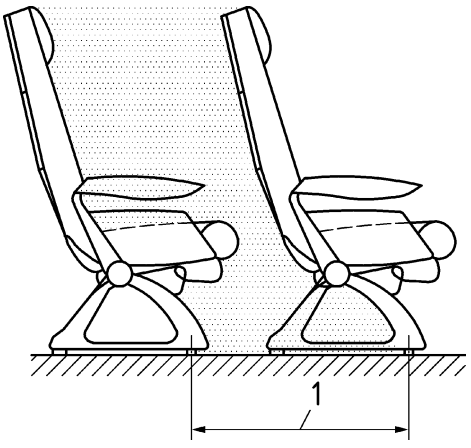
The H-point shall be measured according to SAE AS8049B linked to SAE J826.

6 Living space

6.1 Pitch and 3-D living space

6.1.1 Pitch and 3-D living space definition

The pitch indicates the possible and certified distances between two seats and shall be measured either from front stud to front stud or from rear stud to rear stud on two seats placed behind each other over the seat place width of one PAX seating place, see Figure 6. 3-D living space volume shall be measured in a 3-D CAD programme in cubic inches and cubic meters. At least the following pitches shall be taken into account: 28 in (711,2 mm), 30 in (762 mm), 32 in (812,8 mm) and 36 in (914,4 mm) for E/C, 45 in (1 143 mm), 58 in (1 473,2 mm), 60 in (1 524 mm), 70 in (1 778 mm) and 80 in (2 032 mm) for P/C where applicable.



Key

1 Seat pitch distance

Figure 6 — Pitch example

6.1.2 Pitch and 3-D living space measurement method

The seat pitch shall be measured from front stud to front stud in the seat centre plane.

3-D living space shall be measured in a CAD-drawing programme by computing the space volume from the seat back surface to the seat front surface of a pair of seat pax places at pre-defined pitches.

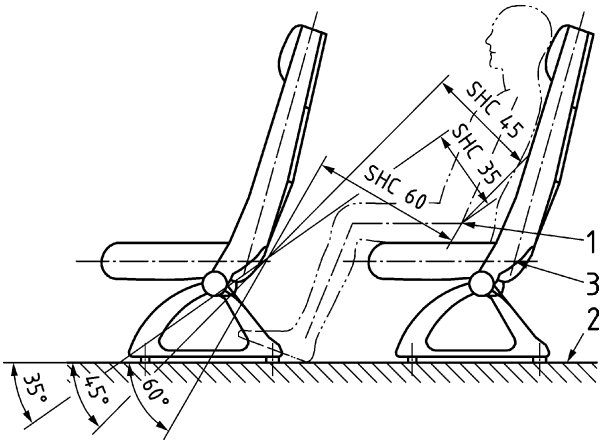
Pitches: 28 in (711,2 mm), 29 in (736,6 mm), 30 in (762 mm), 31 in (787,4 mm), 32 in (812,8 mm), 33 in (838,2 mm), 34 in (863,6 mm), 35 in (889 mm) and 36 in (914,4 mm) for E/C, 45 in (1 143 mm), 58 in (1 473,2 mm), 60 in (1 524 mm), 70 in (1 778 mm) and 80 in (2 032 mm) for P/C where applicable.

For the sake of comparison, this measurement shall be performed at a seat spreader distance of 500 mm (19,685 in) in y-direction.

6.2 Shin clearance (SHC)

6.2.1 SHC definition

The shin clearance (SHC) is defined as the shortest distance from the "H-point" to a 60 in (1 524 mm), 45 in (1 143 mm) or 35 in (889 mm) (for long range A/C only) degree plane touching the aft lower portion of the seat back, frame or shrouding, see Figure 7.



Key

1 H-Point
2 Top of track
3 SRP

Figure 7 — Shin clearance (SHC)

6.2.2 SHC measurement method

6.2.2.1 General

Shin clearance shall be measured for following distances:

Pitches shall be measured in full inch increments for the requested range as far as the seat is qualified for these. For economy class seats pitches from 28 in (711,2 mm) to 36 in (914,4 mm), for premium class seats pitches of 34 in (863,6 mm) up to 40 in (1 016 mm) and, for business class seats pitches from 45 in (1 143 mm) up to 60 in (1 524 mm) shall be measured.

This measurement can be performed either in a CAD-programme or directly on the hardware. The shin clearance shall be measured along the x-axis according to the H-point.

6.2.2.2 Hardware

A pair of seats shall be placed at pre-defined pitches. A rigid measuring device shall be adjusted to angles 35°, 45° and 60°, one angle per measurement. The previously measured H-point shall be indicated on the rear pax place by a rigid and securely attached device. The shortest distance from the H-point to each SHC-line (SHC 60, SHC 45 and SHC 35) shall be measured. The shortest distance is defined as that line from H-point meeting the SHC-line under 90°.

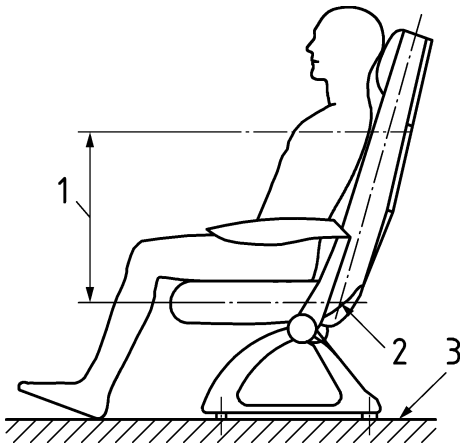
6.2.2.3 CAD-Programme

A virtual pair of seats shall be placed at pre-defined pitches. Fixed lines shall be added under angles of 35°, 45° and 60°, one angle per measurement. The previously measured H-point shall be indicated on the rear pax place by a fixed point in the drawing. The shortest distance from the H-point to each SHC-line (SHC 60, SHC 45 and SHC 35) shall be measured. The shortest distance is defined as the line from where the H-point meets the SHC-line under 90°.

6.3 Shoulder obstruction height (SOH)

6.3.1 SOH definition

The shoulder obstruction height (SOH) is defined as the distance from the "Compressed seat cushion height" to the bottom of anything (generally a headrest) that projects forward from the upper seat back, see Figure 8.



Key

1 SOH

1 SCRP

3 Top of track

Figure 8 — Shoulder obstruction height (SOH)

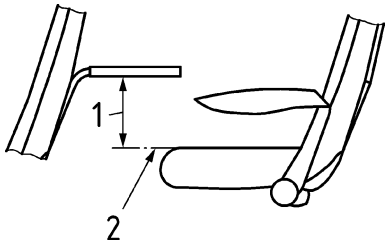
6.3.2 SOH measurement method

The shoulder obstruction height shall be measured in a CAD-programme in 2-D. The seat model needs to be entered into the CAD-programme with full cushion and headrest lines and contours. The compressed seat cushion lines shall be placed correctly according to the method described in 5.3.2, 3), in the 2-D seat model. A line parallel to the compressed seat cushion line shall be drawn to the forward in 2 in distance. The SOH shall be measured parallel to the compressed seat cushion line as the distance from the point where the 2 in-parallel line intersects the contour of the seat cushion (most probably headrest cushion) down to the SCRP (seat reference point) defined in 5.3.

6.4 Table height over bottom cushion edge (TH)

6.4.1 TH definition

The table height over the bottom cushion (TH) is measured between the two parallel planes set up by the front lower edge of the meal tray table spread horizontally to the rear and a horizontal plane touching the highest edge of the seat bottom cushion, see Figure 9.



Key

1 TH

2 Uncompressed cushion line

Figure 9 — Table height over bottom cushion (TH)

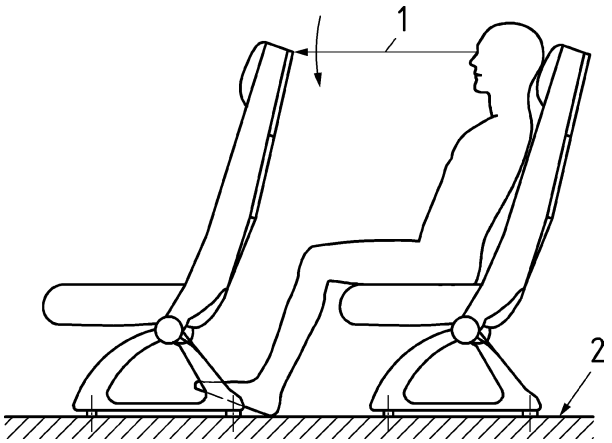
6.4.2 TH measurement method

Place a rigid sheet of metal or plastic in the size of the seat bottom cushion on the uncompressed seat bottom cushion to create the plane of the uncompressed top of the seat cushion with the plane perpendicular to the cushion. Measure from the front lower edge of the tray table perpendicular to the front lower edge of the rigid sheet to produce the table height over bottom cushion measure.

6.5 Visual space (VS)

6.5.1 VS definition

The visual space (VS) is defined as the distance from the eye of an anthropomorphic test dummy female 5%ile, male 50%ile and 95%ile male to the most rearward point of the seat or other next obstacle in front in TTL position described by a radius for dedicated pitches, see Figure 10.



Key

1 VS

2 Top of track

Figure 10 — Visual space (VS)

6.5.2 VS measurement method

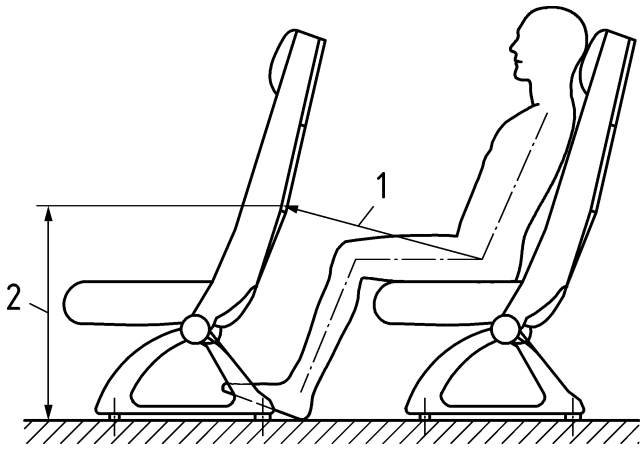
Set up two seats or seat rows at requested pitch in TTL-position. It is recommended to measure with an anthropomorphic test dummy or equivalent person female 5%ile, male 50%ile and 95%ile male. At least place a SAE 95%ile male dummy or equivalent person firmly in the seat with back and thighs in realistic contact pressure to the seat cushions. Measure the possible radius from the eyes towards the most rearward point of the seat or other next obstacle in front.

Pitches shall be measured in full inch increments for the requested range as far as the seat is qualified for these. For economy class seats pitches from 28 in to 36 in, for premium class seats pitches of 34 in (863,6 mm) up to 40 in (1 016 mm) and, for business class seats pitches from 45 in (1 143 mm) up to 60 in (1 524 mm) shall be measured.

6.6 Knee space (KS)

6.6.1 KS definition

The knee space (KS) is defined by the distance from H-point to backrest at a height of 25,6 in (650,2 mm) from floor level of seat in front, see Figure 11.



Key

1 KS

2 25,6 in (650,2 mm)

Figure 11 — Knee space (KS)

6.6.2 KS measurement method

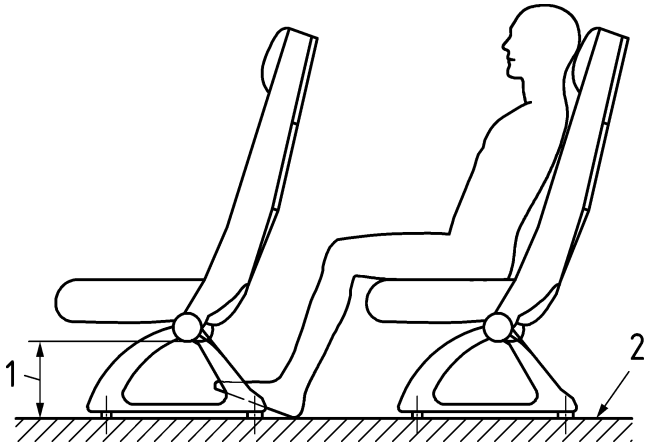
Set up two seats or seat rows at requested pitch in TTL-position. Place a SAE 50%ile male dummy firmly in the seat with back and thighs in realistic contact pressure to the seat cushions. Measure the possible distance from the H-point towards the most rearward point of the seat in front or other next obstacle in front at a height of 25,6 in (650,2 mm).

Pitches shall be measured in full inch increments for the following range as far as the seat is qualified for these. For economy class seats pitches from 28 in (711,2 mm) to 36 in (914,4 mm), for premium class seats pitches of 34 in (863,6 mm) up to 40 in (1 016 mm) and, for business class seats pitches from 45 in (1 143 mm) up to 60 in (1 524 mm) shall be measured.

6.7 Foot Space (FS)

6.7.1 FS definition

The foot space (FS) is defined as the unobstructed height below the seat in front. It is measured from the airplane floor to the nearest obstruction vertically above on the airplane floor plane below the seat in front, see Figure 12.



Key

1 FS

2 Top of track

Figure 12 — Foot space (FS)

6.7.2 FS measurement method

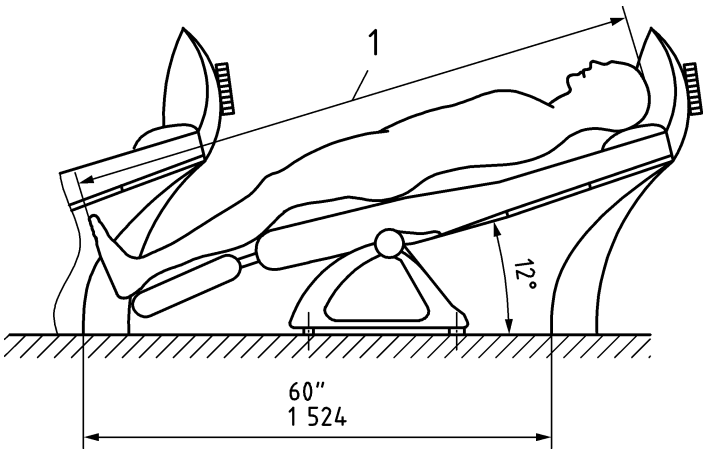
Place a seat on a plane floor. Measure the unobstructed height perpendicular from the top of track beneath the seat to the nearest obstacle above the bottom line under the seat. Soft obstacles, such as life vest pouches are to be measured with life vest and without pressure on the obstacle itself.

6.8 Bed length in full recline position

6.8.1 Bed length in full recline position definition

The bed length of a seat is measured between the low bed end and the high bed end. The low bed end is defined by a plane perpendicular to the low end bed surface and a plane perpendicular to the bed surface at the upper end, see Figure 13.

It shall be measured from the internal side of the extended footrest to the internal side of the shell, at 60 in (1 524 mm) pitch.



Key

1 Bed length

Figure 13 — Bed length

6.8.2 Bed length in full recline measurement method

The seat is to be placed in full possible qualified recline. A tape measure shall be used to measure form the upper usable edge of the bed surface of the lowest usable end of the bed surface.

6.9 Armrest length (ARL)

6.9.1 ARL definition

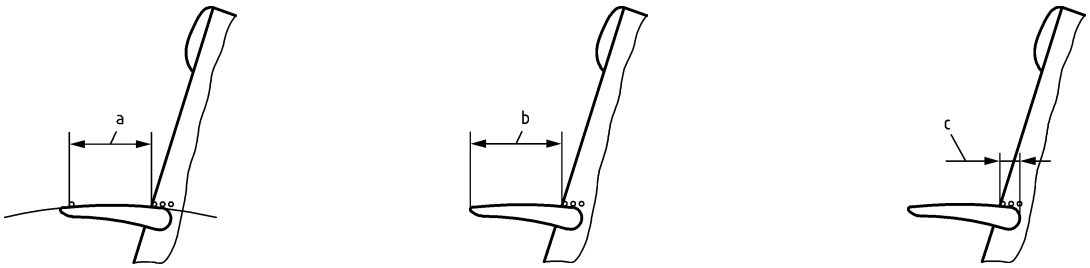
The armrest length (ARL) is measured for three positions: Forward length on the “straight” part (ARL for), complete forward length meaning “straight” and most forward bent tip (ARL for all) and the rear length behind the “straight” part (ARL rea), see Figure 14. Modern armrests usually show an ergonomic radius.

6.9.2 ARL measurement method

ARL for: usable length of armrest in flight direction: For comparable measurements radii of $R \geq$ 1 500 mm ($R \geq$ 59,055 in) shall be assumed. The intersection from the radius bend with the armrest shall be positioned such that the rear intersection lies on the intersection of the uncompressed backrest foam with the top of the armrest. The measurement from the rear intersection to the front intersection indicates the ARL for.

ARL for all: The complete forward length shall be measured from the rear foam/top of armrest intersection to the tip of the armrest.

ARL rea: The usable length of the armrest against flight direction uses radii of $R \leq$ 1 000 mm ($R \leq$ 39,370 in) and shall be measured rearwards from the intersection of top of armrest with uncompressed backrest foam to the intersection with the radius bend.



a) ARL for **b) ARL for all** **c) ARL rea**

Key

[a] ARL for

[b] ARL for all

[c] ARL rea

Figure 14 — Armrest length (ARL)

6.10 Armrest width in total (ARW)

6.10.1 ARW definition

The armrest width in total (ARW) is defined as the overall width of the armrest measured from one side to the other on the shortest diameter, see Figure 15.

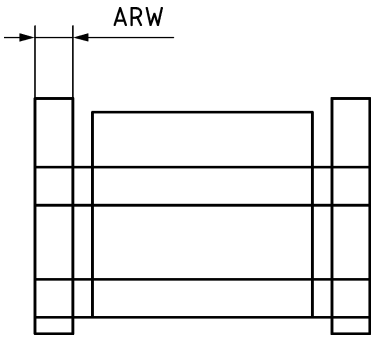


Figure 15 — Armrest width in total (ARW)

6.10.2 ARW measurement method

Use a slide gauge / calliper gauge and place the two cheeks either side of the armrest. Make the fixed cheek touch the one side of the outer surface of the armrest side and gently move the sliding cheek towards the opposite side of the armrest until it touches the surface. The measure indicated by the slide gauge is the total armrest width.

6.11 Seat width between armrests (SWAR)

6.11.1 SWAR definition

The seat width between armrests (SWAR) defines the shortest distance between two armrests flanking a seat place, see Figure 16.

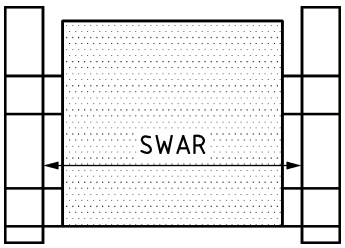


Figure 16 — Seat width between armrests (SWAR)

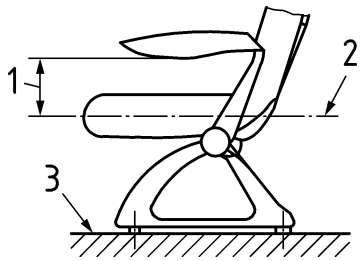
6.11.2 SWAR measurement methods

The seat width between armrests shall be measured at the narrowest point between the two inner sides of armrests flanking a seat place. The measure shall be taken by using a calliper gauge / slide gauge with flanks for outer measures.

6.12 Armrest height over compressed cushion height (ACH)

6.12.1 ACH definition

The armrest height over compressed cushion height (ACH) is defined as shortest distance between the front edge lowest point and the compressed seat bottom cushion below, see Figure 17.



Key

1 Armrest height over compressed cushion height (ACH)
2 Compressed seat cushion lowest point
3 Top of track

Figure 17 — Armrest height over compressed cushion height (ACH)

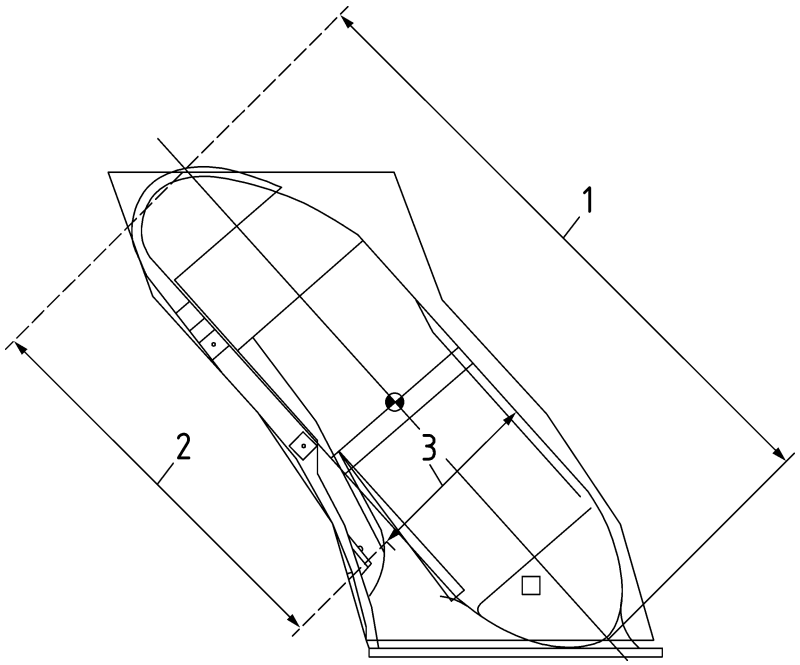
6.12.2 ACH measurement method

First define the front edge lowest point of the armrest and set up a line tangent to this point and parallel to the compressed seat cushion line. The distance between the parallel lines provides the ACH measure.

6.13 Bed width at elbow level (43 in / 1 092,2 mm from end of bed) in full recline position

6.13.1 Bed width at elbow level in full recline position definition

The bed width at elbow level is defined as measure measured 43 in (1 092,2 mm) from the end of the bed in a fully reclined position over the width of bed with armrests collapsed (if applicable) at 43 in (1 092,2 mm) from internal side of the footrest, see Figure 18.



Key

1 Bed length

2 Elbow level (43 in (1 092,2 mm) from end of bed)

3 Bed width at elbow level

Figure 18 — Bed width at elbow level

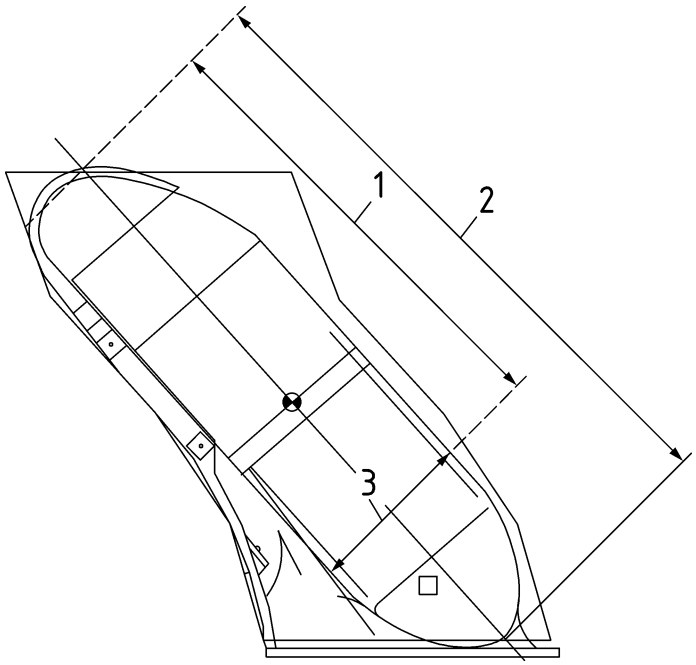
6.13.2 Bed width at elbow level in full recline position measurement method

The bed width at elbow level shall be measured 43 in (1 092,2 mm) from the end of the bed in a fully reclined position. It is defined as the width of the bed with armrests collapsed (if applicable) at 43 in (1 092,2 mm) from the internal side of the footrest.

6.14 Bed width at shoulder level

6.14.1 Bed width at shoulder level definition

The bed width at shoulder level is defined as the width of the bed with armrests collapsed (if applicable) at 60 in (1 524 mm) from the internal side of the footrest and measured in fully reclined position, see Figure 19.



Key

1 Shoulder level (60 in (1 524 mm) from end of bed)

2 Bed length

3 Bed width at shoulder level

Figure 19 — Bed width at shoulder level

6.14.2 Bed width at shoulder level measurement method

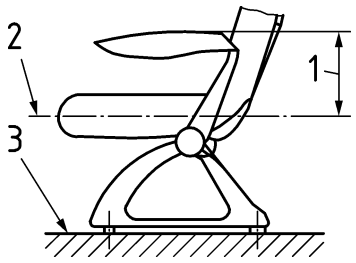
The seat is to be brought into a fully reclined position with armrest collapsed (if applicable). At 60 in (1 524 mm) from the internal side of the footrest, the bed width shall be measured as the shortest distance across the flat surface only, meaning that the fully collapsed armrest adds to the flat surface (i.e. measure over the armrests). If the armrests cannot be fully collapsed and do not add to the flat surface, than the measure shall be taken in between the most inner points of the armrests.

7 Comfort

7.1 Armrest top height over seat bottom cushion (TACH)

7.1.1 TACH definition

The armrest top height over seat cushion (TACH) is defined as the distance between the compressed seat bottom and the highest point of the upper armrest contour, see Figure 20.



Key

1 Armrest height over cushion (TACH)
2 Compressed seat cushion lowest point
3 Top of track

Figure 20 — Armrest top height over seat bottom cushion (TACH)

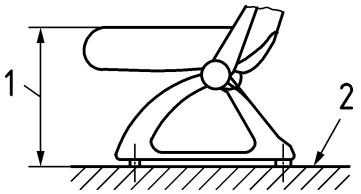
7.1.2 TACH measurement method

First define the highest point of the armrest upper surface and set up a line at a tangent to this point and parallel to the compressed seat cushion line. The shortest distance between the parallel lines provides the TACH measure.

7.2 Cushion height above cabin floor level (CHoF)

7.2.1 Cushion height above cabin floor level definition

The cushion height above cabin floor level is defined as the perpendicular distance from highest point at the front edge of the uncompressed cushion to the airplane floor plane, see Figure 21. The cushion height above floor level shall be measured in an upright TTL position. This measure is mandatory for long range seats only but can be provided for any seats.



Key

1 Cushion height over floor level (CHoF)
2 Top of Track

Figure 21 — Cushion height over floor level (CHoF)

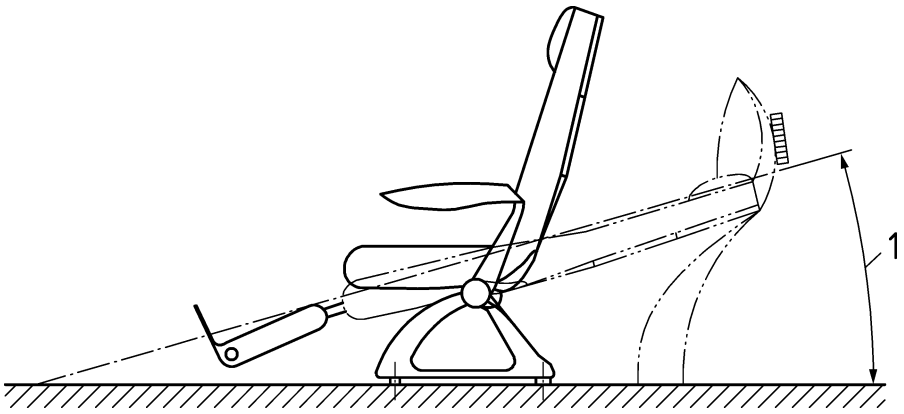
7.2.2 Cushion height above cabin floor level measurement method

Place the seat in an upright TTL position. Place a marking gauge on top of the track level and measure the highest point at the front edge of the uncompressed seat bottom cushion.

7.3 Average bed angle in full recline position

7.3.1 Average bed angle in full recline position definition

The bed angle is defined as the angle between the plane of the aircraft floor and the plane of the bed surface defined as the plane running over the fully reclined seat pan and backrest (in degrees), see Figure 22. It is measured in a fixed pitch.



Key

1 Bed angle

Figure 22 — Bed angle

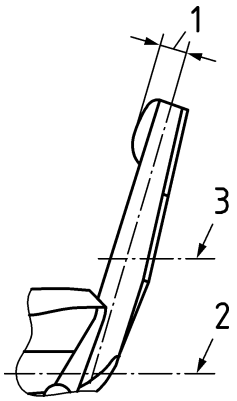
7.3.2 Average bed angle in full recline position measurement method

Measure to be taken in the CAD system. Place the fully reclined seat properly in the seat tracks. Measure the angle between the plane of the aircraft floor and the plane of the bed surface running over the fully reclined seat pan and backrest in degrees. Indicate the pitch it is measured in. If there are differences over different qualified seat pitches, indicate the measure for all different pitches by full inch increments.

7.4 Headrest thickness (HT)

7.4.1 Headrest thickness definition

The headrest thickness is the distance between the plane of the compressed seat cushion in the vicinity of the headrest and the lowest compressed point of the headrest, measured at the centre of the headrest in TTL position, see Figure 23.



Key

1 Headrest thickness (HT)

2 Compressed bottom cushion line

3 Compressed backrest cushion line

Figure 23 — Headrest thickness (HT)

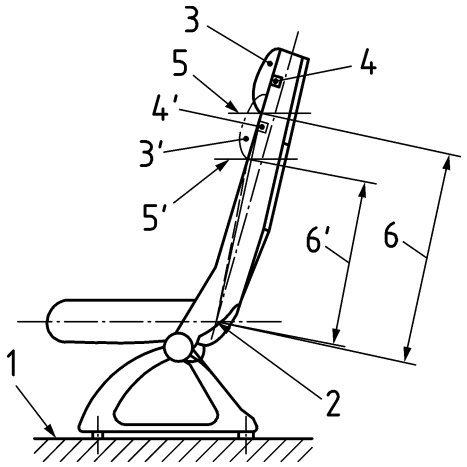
7.4.2 Headrest thickness measurement method

The headrest thickness is measured in the CAD system. Use a seat in TTL-position. Draw a line parallel to the compressed seat cushion line in the vicinity of the headrest and place it on the lowest compressed point of the headrest, measured at the centre of the headrest and caused by a 50%ile male anthropomorphic dummy, when seated in the seat in upright position.

7.5 Traverse path of headrest including extreme positions

7.5.1 Traverse path of headrest including extreme positions definitions

This is applicable only for movable headrests (HR) moving up and down in relation to the seat bottom. The traverse path of the headrest is defined as the distance between its lowest and highest position. For seats with kinematics and a hinge point in the backrest, the traverse path of the headrest including extreme positions shall be measured both for basic and hinged position, see Figure 24.



Key

1 Top of track
2 SMRP
3 HR in highest position
4 HR sliding device in highest position
5 Line of lowest point in centre position of HR in highest position
6 Distance from 5 to SMRP

3' HR in lowest position
4' HR sliding device in lowest position
5' Line of lowest point in centre position of HR in lowest position
6' Distance from 5' to SMRP

Figure 24 — Traverse path of headrest

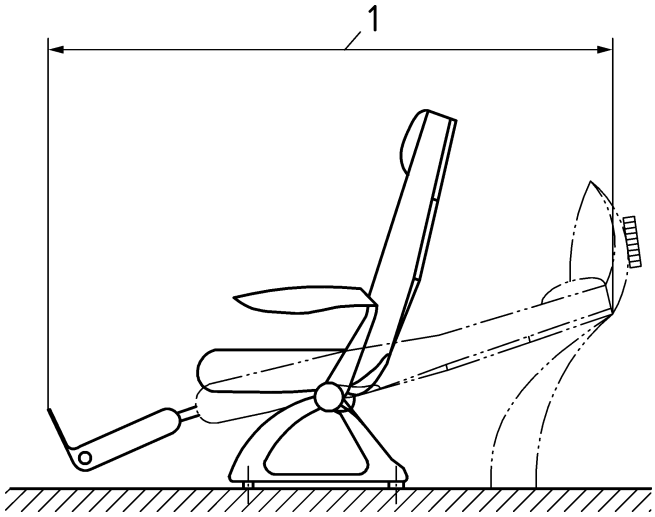
7.5.2 Traverse path of headrest including extreme positions measurement method

The traverse path of the headrest shall be measured from the low edge in the centre of the headrest against the SMRP. Two measures shall be taken, one for each extreme position. Subtracting the lowest from the highest position equals the distance.

7.6 Seat depth

7.6.1 Seat depth definition

The seat depth is measured from tip of extended footrest to back of inner shell. It shall be measured in full recline and maximum extension of the bed, see Figure 25.



Key
1 Total seat depth

Figure 25 — Total seat depth

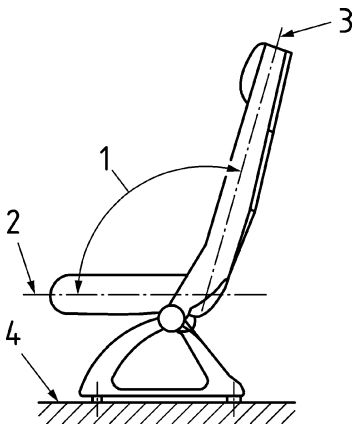
7.6.2 Seat depth measurement method

Measure from the tip of the extended footrest to back of the inner shell. It shall be measured in full recline and maximum extension of the bed.

7.7 Backrest angle to seat bottom cushion (with and w/o recline)

7.7.1 Backrest angle to seat bottom cushion (with and w/o recline) definition

The backrest angle is defined as the angle between the compressed bottom cushion line and compressed backrest cushion line in an upright TTL position and in full recline, see Figure 26.



Key

1 Backrest angle
2 Compressed bottom cushion line
3 Compressed backrest cushion line
4 Top of track

Figure 26 — Backrest angle to seat bottom cushion

7.7.2 Backrest angle to seat bottom cushion (with and w/o recline) measurement method

The backrest angle shall be measured between the compressed bottom cushion line and the compressed backrest cushion line. The angle shall be measured for both upright TTL position and full recline.

7.8 Seat bottom pressure mapping / distribution (BPD)

7.8.1 Seat bottom pressure mapping definition

It shall be measured on the seat pan only. Results are simply a quantitative indication and shall help to detect points of high pressure in order to lower the pressure at these points.

50%ile Male SAE dummy, upright TTL position, femoral horizontal.

50%ile Male SAE Dummy, upright TTL position, femoral 35°.

The values for maximum pressure peaks, the average and standard deviation shall be measured, see Figure 27.

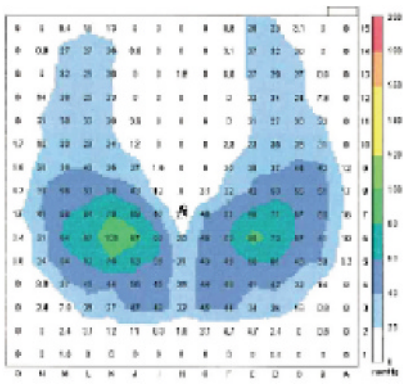


Figure 27 — Seat bottom pressure distribution (BPD)

7.8.2 Seat bottom pressure mapping measurement method

Place the seat in an upright TTL position and fix the pressure mapping mat correctly on the seat bottom cushion. Place a 50%ile Male SAE dummy, in an upright TTL position, femoral horizontal firmly in the seat and measure the seat pressure in mm Hg. The scale is ideally set from 0 mm to 200 mm Hg. The pressure map should have at least $15 \times 15 = 225$ measurement points.

7.9 Foam hardness

7.9.1 Foam hardness definition

EN ISO 1856 (40 % deflection) and ASTM D3574 D_1 (25 % deflection).

7.9.2 Foam hardness measurement method

The foam hardness shall be measured in Newtons according to EN ISO 1856 (40 % deflection) and ASTM D3574 D_1 (25 % deflection). It shall be measured on new foams, as long as no procedure is defined for pre-aged foams.

7.10 Integrated seat climate definition

7.10.1 Integrated seat climate definition

The integrated seat climate is defined by the seats ability to circulate air through the foam and fabric in an airworthy certified condition with humidity being absorbed.

7.10.2 Integrated seat climate measurement method

The seat cushion shall be mechanically loaded and the seat surface is to be subjected to a flow of moisture from a climate mat. Any moisture stagnation at the seat surface shall be measured.

Cover the seat cushion with a multilayer climate mat consisting of a plurality of flat layer moisture sensors, a trouser-material layer with low moisture uptake, a seat cushion dress cover material layer as used in the aircraft, a layer of fire blocking material if necessary, a distribution layer that is readily permeable to air and has a non-compressible structure, a fleece layer that can be moistened and replaced as the moisture storage medium, an electrically insulating vapour barrier and an electrically heatable heating mat that can be set to a specific temperature. Load it with a realistically anthropometrically shaped seat testing punch.

Measure the humidity being absorbed in millilitres (ml).

Temperature pre-set: 35 °C.

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™