
Aeronavtika - Zglobna ročica z vgrajenim sornikom - 1. del: Tehnična specifikacija

Aerospace series - Tie rod with integrated bolts - Part 1: Technical specification

Luft- und Raumfahrt - Zug-Druck-Stange mit integrierten Bolzen - Teil 1: Technische Lieferbedingung

Série aérospatiale - Bielle avec axes intégrés - Partie 1 : Spécification technique

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ICS:

49.035	Sestavni deli za letalsko in vesoljsko gradnjo	Components for aerospace construction
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Lieferbedingungen

This European Standard was approved by CEN on 25 June 2016.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 4691-1:2017) 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of an identical text or by endorsement, at the latest by April 2018, and conflicting national standards shall be withdrawn at the latest by April 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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Introduction

Aerospace and Defence Standardization (ASD-STAN) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent.

USA: US 8371767

China: CN 10104431

Japan: JP 4885140

Russia: RU 2389914

South Africa: ZA 2007/03913

Canada: 2584387

South Korea: 7011559

ASD-STAN takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured ASD-STAN that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ASD-STAN. Information may be obtained from:

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TRIGUM Engineering GmbH

Brunskamp 4

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1 Scope

This standard specifies the required characteristics, inspection and test methods, qualification and acceptance conditions for rod assemblies with two adjustable ends with integrated bolts, designed to withstand static and dynamic loads possible for interior and substructure in the temperature range from – 55 °C to 85 °C. It is applicable whenever referenced.

For a complete overview see EN 4691-2.

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.

DIN 53504, *Testing of rubber — Determination of tensile strength at break, tensile stress at yield, elongation at break and stress values in a tensile test*

DIN 65271, *Aerospace series — Elastomeric semi-finished products and parts — Technical specification*

EN 571-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

EN 2004-1, *Aerospace series — Test methods for aluminium and aluminium alloy products — Part 1: Determination of electrical conductivity of wrought aluminium alloys*

EN 2424, *Aerospace series — Marking of aerospace products*

EN 2825, *Aerospace series — Burning behaviour of non metallic materials under the influence of radiating heat and flames — Determination of smoke density*

EN 2826, *Aerospace series — Burning behaviour of non metallic materials under the influence of radiating heat and flames — Determination of gas components in the smoke*

EN 3844 (all parts), *Aerospace series — Flammability of non metallic materials*

EN 4691-2, *Aerospace series — Tie rod with integrated bolts — Part 2: Overview construction kit*

EN 4692, *Aerospace series — Tie rod with integrated bolts — Locking clip*

EN 4693, *Aerospace series — Tie rod with integrated bolts — Assembly Code A, B and C*

EN 4694, *Aerospace series — Tie rod with integrated bolts — Assembly Code D, E and F*

EN 4695, *Aerospace series — Tie rod with integrated bolts — Assembly Code G, H and K*

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

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

EN 10204, *Metallic products — Types of inspection documents*

EN ISO 75-2, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite (ISO 75-2)*

EN ISO 175, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals (ISO 175)*

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EN ISO 178, *Plastics — Determination of flexural properties (ISO 178)*

EN ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test (ISO 179-1)*

EN ISO 291, *Plastics — Standard atmospheres for conditioning and testing (ISO 291)*

EN ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2)*

EN ISO 1172, *Textile-glass-reinforced plastics — Prepregs, moulding compounds and laminates — Determination of the textile-glass and mineral-filler content — Calcination methods (ISO 1172)*

EN ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1)*

EN ISO 9001, *Quality management systems — Requirements (ISO 9001)*

EN ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227)*

ISO 34-1, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 2781, *Rubber, vulcanized or thermoplastic — Determination of density*

ISO 5855-1, *Aerospace — MJ threads — Part 1: General requirements*

ISO 5855-2, *Aerospace — MJ threads — Part 2: Limit dimensions for bolts and nuts*

ISO 10123, *Adhesives — Determination of shear strength of anaerobic adhesives using pin-and-collar specimens*

ISO 10964, *Adhesives — Determination of torque strength of anaerobic adhesives on threaded fasteners*

ASTM E112, *Standard Test Methods for Determining Average Grain Size¹⁾*

ASTM C177, *Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus²⁾*

ASTM D696, *Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30 °C and 30 °C with a Vitreous Silica Dilatometer²⁾*

FAR/JAR/CS 25.853, *Compartment Interiors²⁾*

¹⁾ Published by: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA. <http://www.astm.org/>

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

RTCA-DO 160E, *Environmental Conditions and Test Procedures for Airborne Equipment*³⁾

UL 746B version 1.3 date 29.11.2000, *Plastics — Polymeric Materials — Long Term Property Evaluations*⁴⁾

3 Terms and definitions

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

3.1

standard part

completed rod assembly, which consists of a rod body, two end fittings (adjustable) and their associated locking or blocking system

3.2

assembly

- See EN 4693;
- See EN 4694;
- See EN 4695.

3.3

traceability

ability to trace the history, application or location of an entity by means of recorded identifications

Note 1 to entry: Traceability of raw materials and manufacturing processes of each individual component of every tie rod refers to EN 9100. Every tie rod is marked for traceability with a serial number.

3.4

Batch definition

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3.4.1

manufacturing batch

composed of rod bodies made of same material (same material batch), with same diameter and same thickness and belonging to the same manufacturing campaign and equipped with rod body ends and rods ends of same design

3.4.2

artificial batch

consists of different manufacturing batches and are limited to a maximum of 100 rods

3.5

qualification test

is a test or series of tests to demonstrate that the products comply with the requirements stipulated in this specification and/or in a product standard and are accomplished according to documented parameters and under reproducible conditions

3.6

acceptance test

demonstrates that the characteristics of manufactured products comply with the requirements

³⁾ Published by: Radio Technical Commission for Aeronautics (RTCA), 1140 Connecticut Ave., N.W. Suite 1020, Washington, D.C. 20036, USA.

⁴⁾ Published as UL Standard, <http://ulstandardsinfonet.ul.com>.

4 Symbols and abbreviations

L_1 = tie rod length Pin to Pin [mm]

a = amplitude

D = outer diameter rod body

d = transformed diameter rod body

D_a = total damage

D_{ai} = partial damage

R = border stress rate

n = lifetime

R_a = roughness

s_1 = factor ultimate, limit load

s_2 = fitting factor

QTP = Qualification Test Plan

QTR = Qualification Test Report

F_c = compression Load [N]

F_a = load amplitude [N]

L_c = load cycle

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5 Required characteristics, inspections and test methods

See Table 1.

Table 1 — Inspections and test methods

Clause	Characteristic	Requirement	Inspection and test method	Q ^a	A ^b
7	Allowable dynamic loads	In accordance with Clause 7 in this specification or design documentation at 85 °C temperature	See 7.2. Wöhler curve and Miner's rule	X	-
8	Assembly load locking clip	In accordance with Table 3 in this specification or design documentation	See Clause 8. Assembly load locking clip EN 4692	X	X
9	Adjustment-torque	In accordance with Table 4 in this specification or design documentation	See Clause 9. Adjustment-torque	X	X
/	Check of heat treatment condition for Aluminium alloy	According to EN 2004-1	See EN 2004-1.	X	X
10.2	Check of external surfaces	In accordance with 10.2 in this specification or design documentation	See 10.2.1, 10.2.2 and 10.2.3.	X	X
10.3	Cross sectional check	In accordance with 10.3 in this specification or design documentation	See 10.3.2 and 10.3.3.	X	X
10.4	Dimensional check	In accordance with the product standard or design documentation	See 10.4.1, 10.4.2 and 10.4.3.	X	X
10.5	Static load test of rod assembly	In accordance with 10.5 in this specification or design documentation	See 10.5.1 and 10.5.2.	X	X
10.6	Check of mass	In accordance with the product standard or design documentation	Suitable methods	X	X
10.7	Check of paint thickness	In accordance with the product standard or design documentation	Suitable methods	X	X
10.8	Tensile test	In accordance 10.8 in this specification or design documentation at 85 °C temperature	See 10.8.1, 10.8.2 and 10.8.3.	X	-
10.9	Compression tests	In accordance with 10.9 in this specification or design documentation at 85 °C temperature	See 10.9.1 and 10.9.2.	X	-
10.9.3	Check of buckling strength	In accordance with 10.9.3 in this specification or design documentation	See 10.9.3.	X	-
10.10	Break away torque test plastic insert	In accordance with 10.10 in this specification or design documentation	See 10.10.	X	X
10.11	Corrosion test	According EN ISO 9227 spray	See EN ISO 9227.	X	-

Clause	Characteristic	Requirement	Inspection and test method	Q ^a	A ^b
		time 192 h			
10.12	Fire worthiness requirements	According FAR/JAR/CS 25.853	See FAR/JAR/CS 25.853.	X	-
10.13	Environmental conditions	RTCA-DO160E Section 11 Category F	See 10.13.2 and 10.13.3.	X	-
10.14	Marking	According EN 2424 style A	Visual examination	X	X
13	Material	See 13.1.	See 13.2.	X	X
^a Q: Qualification test. ^b A: Acceptance test (per delivery batch).					

Sample plan for qualification and series production see Annex A.

6 Allowable static loads

All values are measured at a temperature of 85 °C.

Factor of safety between ultimate and limit load $s_1 = 1,5$.

Factor for manufacturing and material tolerances $s_2 = 1,1$.

6.1 Load calculation

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For ultimate and limit load calculation, see Equation (1) and Equation (2).

$$\text{Ultimate load} = \text{verified measured values} / s_2 \quad (1)$$

$$\text{Limit load} = \text{ultimate load} / s_1 \quad (2)$$

6.2 Static tension loads

For tension loads, see Table 2.

Table 2 — Tension loads

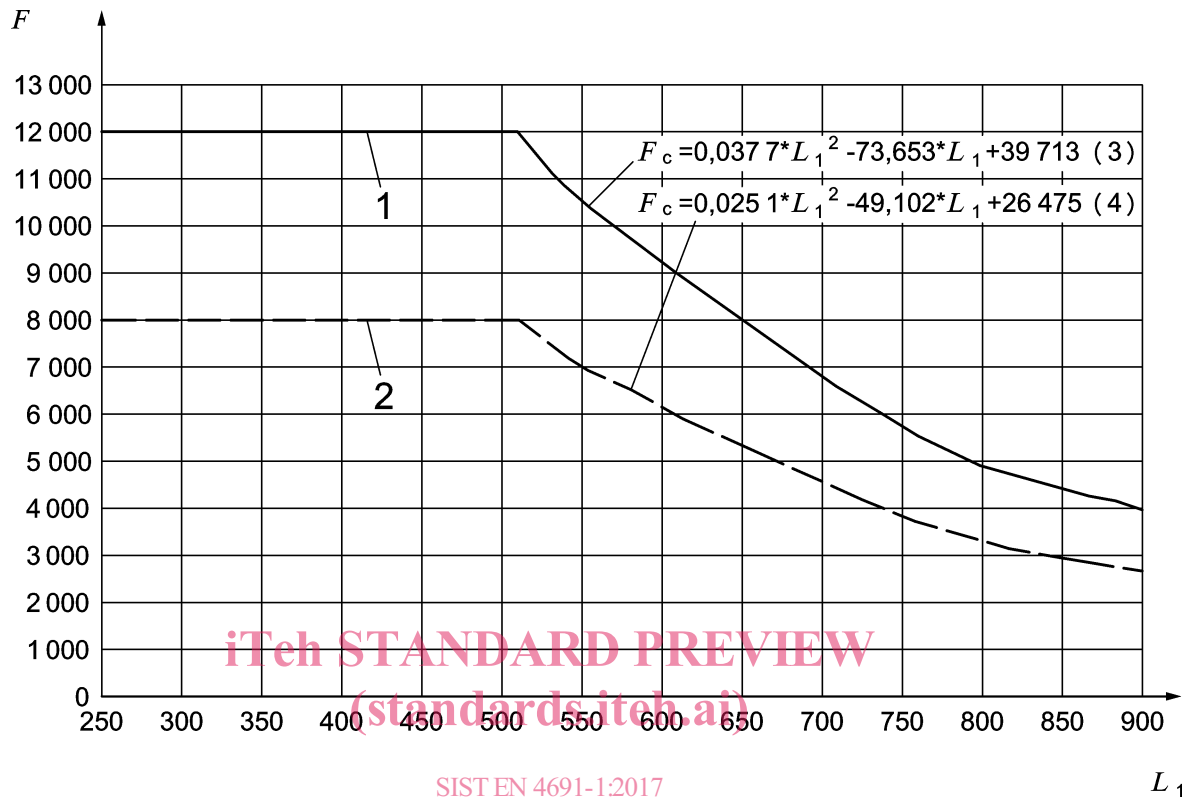
EN Standard	Assembly code	Material code	Pin diameter 0 -0,013 mm	Size code	Limit tension Load kN	Ultimate tension Load kN	Limit and ultimate compression Load
EN 4693	A, B, C	A, B	6,35	01	13,3	20	See Figure 1 and Figure 2.
				02			
				03			
				04			
				07			
				09			
				21			
				22			
				23			
				24			
				27			
				29			
				41			
				05			
				06			
				10			
				25			
				26			
				30			
			42				
			43				
			9,525	08			
				28			
				44			
EN 4694	D, E, F	A	6,35	01	13,3	20	See Figure 3.
				02			
				03			
				04			
				07			
				09			
				21			
				22			
				23			
				24			
				27			
				29			
				41			
				EN 4694			
06							

EN Standard	Assembly code	Material code	Pin diameter 0 -0,013 mm	Size code	Limit tension Load kN	Ultimate tension Load kN	Limit and ultimate compression Load
				10			
				25			
				26			
				30			
				42			
				43			
			9,525	08			
				28			
				44			
EN 4694	D, E, F	B	6,35	01	24	36	See Figure 4.
				02			
				03			
				04			
				07			
				09			
				21			
				22			
				23			
				24			
				27			
				29			
			41				
			7,938	05			
				06			
				10			
				25			
				26			
30							
9,525	42						
	43						
	08						
	28						
				44			
EN 4695	G, H, K	C	6,35	50	13,3	20	See Figure 5.
				51			
				60			
				61			
			7,938	70			
				52			
				62			

6.3 Static compression loads

For compression loads assembly code A, B, C, see Figure 1 and Figure 2.

For compression loads (F_c) calculation, see Equation (3), Equation (4), Equation (5) and Equation (6).



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Key

- 1 Curve ultimate load
- 2 Curve limit load

Figure 1 — Compression load assembly code A, B, C with material code A

For rod lengths smaller than 510 mm the load limitation is given by the thread of fork end, eye end in aluminium at ultimate load 12 kN and limit load 8 kN.