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Aerospace — Bolts — Test methods

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Contents

		Page
1	Scope	**1**
2	Normative reference	**1**
3	Tests	**1**
3.1	Tensile test at ambient temperature	**1**
3.2	Double shear test	**4**
3.3	Tension fatigue test	**7**
3.4	Stress durability test of ambient temperature	**8**
3.5	Inspection for grinding burns	**8**
3.6	Tensile test at elevated temperature	**9**
3.7	Stress relaxation test at elevated temperature	**9**
3.8	Stress corrosion test	**10**
3.9	Stress rupture test at elevated temperature	**12**
4	Test validity	**12**
5	Test reports	**12**

Annexes

A	Calibration of apparatus	**13**
B	Test reports	**14**
C	Formulae	**15**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7961 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Sub-Committee SC 4, *Aerospace fastener systems*.

Annexes A and B form an integral part of this International Standard. Annex C is for information only.

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Aerospace — Bolts — Test methods

1 Scope

This International Standard specifies test methods for bolts for aerospace constructions.

It is applicable whenever quoted in reference.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7500-1:1986, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tensile testing machines.*

3 Tests

3.1 Tensile test at ambient temperature

3.1.1 Apparatus

3.1.1.1 Test device (see figure 1).

The test device shall be centred such that the stress at four equi-spaced points around the test sample is uniform within 1 %, or such that the coaxiality between the bolt and the clearance holes is less than or equal to 0,025 mm to ensure the application of the tensile load along the axis of the bolt[1].

Other types of device may be used provided they respect the requirements of figure 3.

3.1.1.1.1 Cups, fixed or removable, in conformity with figure 3, which specifies only functional requirements.

3.1.1.1.2 Test nut (free-running or self-locking) or **threaded part** (assuming the role of a nut), of sufficient strength to guarantee bolt failure.

3.1.1.2 Tapered spacer, placed under the head during the test, when required by the procurement specification or definition document to evaluate the effect of angularity. The minimum clearance between the hole and the bolt shank shall be 0,13 mm. At least 90 % of the bolt bearing area shall be supported by the spacer which shall have a diameter sufficient to support the width across the corners of the bolt. The tolerance on the hole diameter in the spacer shall be $^{+0,08}_{0}$ mm.

3.1.1.3 Washers, used under bolt heads or nuts only in the case outlined in 3.1.1.2.

3.1.1.4 Tensile or compressive test machine, depending on the fixture, capable of applying the test loads.

3.1.2 Procedure

3.1.2.1 Assemble the bolt in the test device (3.1.1.1) as shown in figure 1. Install the nut (3.1.1.1.2) as shown in figure 2. Place the complete assembly between the loading platens of the machine.

3.1.2.2 Apply the load specified in the procurement specification or definition document at the rate specified in table 1[1], in a controlled way.

1) Calibration requirements: see ISO 7500-1:1986 and annex A of this International Standard.

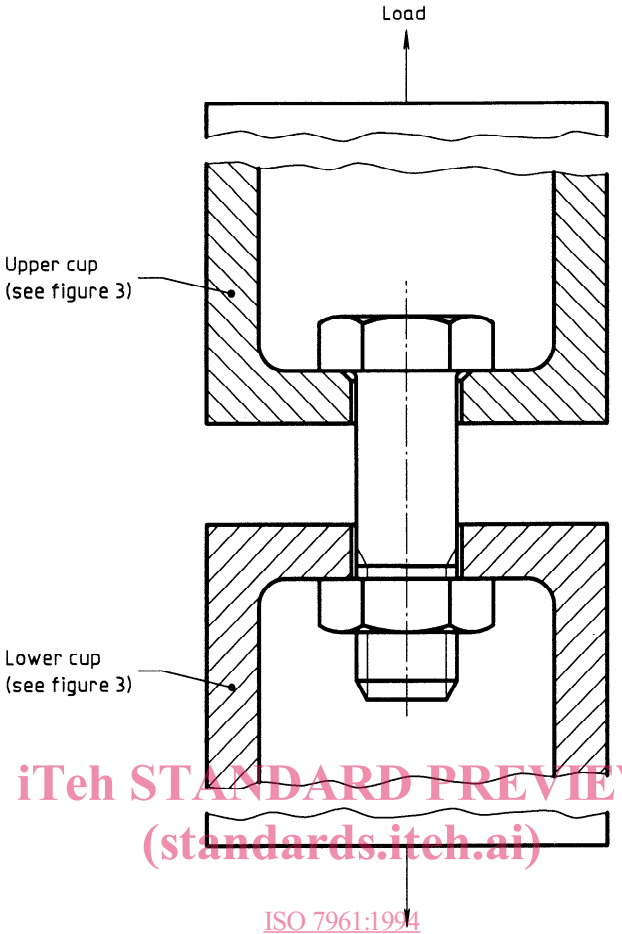


Figure 1 — Tensile test — Test device

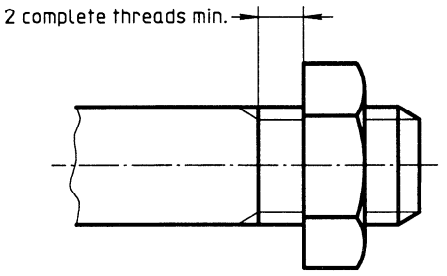
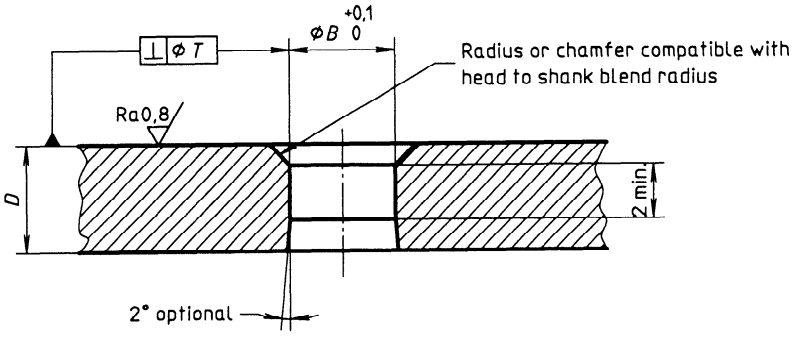
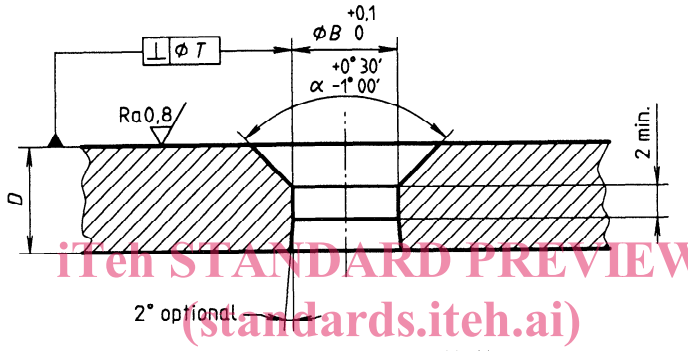


Figure 2 — Tensile test — Position of the nut in relation to the complete threads (shank side)

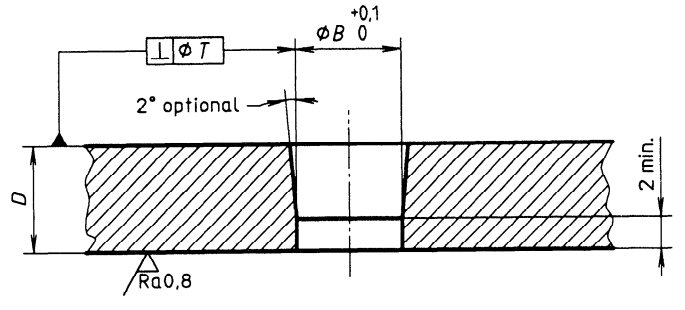
Dimensions in millimetres,
surface roughness in micrometres



Upper cup for protruding head bolts



Upper cup for flush head bolts



Lower cup

B nom. $= D + 0{,}025$

D = Nominal diameter of bolt

T = Perpendicularity tolerance corresponding to 2°

α = Nominal angle of countersunk head

Break sharp edges

Material: Steel of hardness > 43 HRC

Figure 3 — Tensile test — Upper and lower cup details

Table 1 — Rates of load application — Tensile test

Nominal shank diameter[1)]	Rate kN/min	Nominal shank diameter[1)]	Rate kN/min	Nominal shank diameter[1)]	Rate kN/min
3	5	12	80	27	400
4	9	14	110	30	500
5	14	16	140	33	600
6	20	18	180	36	700
7	27	20	220	39	850
8	35	22	270		
10	55	24	320		

1) For other shank diameters, bolts shall be tested at a loading rate, accurate to ± 10 %, of 750 N per minute per 1 mm^2 of nominal shank cross-section.

3.2 Double shear test

3.2.1 Apparatus

See figures 4 and 5, the latter only defining functional requirements.

NOTE 1 Totally enclosed top and bottom blades may be used as an alternative.

3.2.2 Procedure

3.2.2.1 Assemble the bolt into the lower part of the guillotine. The blend radius under the head and the threaded portion shall not be in contact with the lower part of the guillotine (see figure 4).

3.2.2.2 Apply the load required in the procurement specification or definition document at the rate specified in table 2, in a controlled way.

If this load is attained without breakage of the bolt, the test may be terminated[1)].

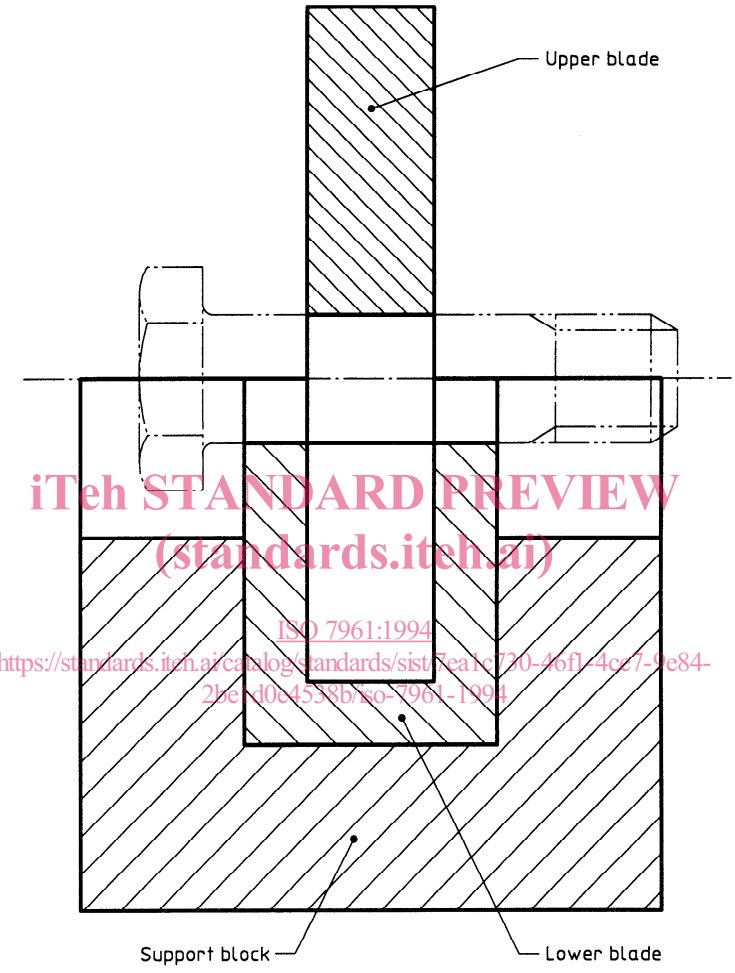
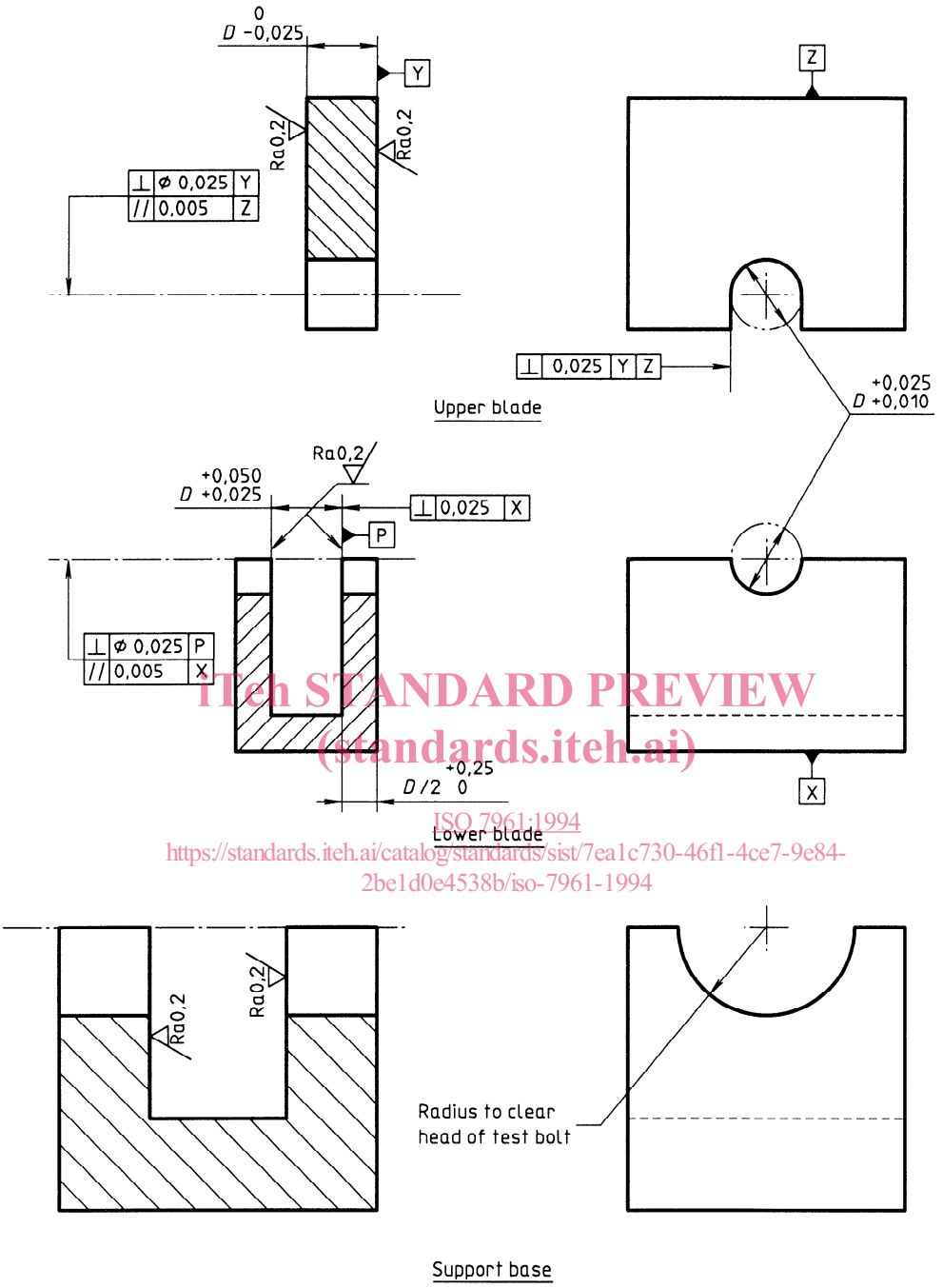


Figure 4 — Double shear test — Test device

Dimensions in millimetres,
surface roughness in micrometres



Shear edges radius or break edge 0,13 max.

Rework when edges reach a radius of or break edge of 0,25 max.

D = Nominal diameter of the bolt

Material: Steel of hardness 60 HRC to 62 HRC

Figure 5 — Double shear test — Upper and lower blocks

Table 2 — Rates of load application — Double shear test

Nominal shank diameter[1]	Rate kN/min	Nominal shank diameter[1]	Rate kN/min	Nominal shank diameter[1]	Rate kN/min
3	10	12	160	27	800
4	18	14	215	30	990
5	27	16	280	33	1 200
6	40	18	350	36	1 400
7	54	20	440	39	1 700
8	70	22	530		
10	110	24	630		

1) For other shank diameters, bolts shall be tested at a loading rate, accurate to ± 10 %, of 750 N per minute per 1 mm^2 of double the nominal shank cross-section.

3.3 Tension fatigue test

3.3.1 Apparatus

3.3.1.1 Test device (see figure 1).

Universal joints and spherical seats shall not be used in the test column. The test device shall be centred such that the stress at four equi-spaced points around the test sample shall be uniform within 3 % of the mean stress value[1].

Other types of device may be used provided they respect the requirements of figure 3.

Test bolts shall not be re-used.

3.3.1.1.1 Cups, fixed or removeable, in conformity with figure 3, which specifies only functional requirements.

3.3.1.1.2 Test nut or **threaded part** (assuming the role of a nut), with a height greater than or equal to 0,8*D* and of sufficient strength to ensure bolt breakage.

NOTE 2 Test nuts or threaded parts may be re-used provided that it meets the dimensional requirements and has not been damaged by a previous test.

For referee purposes, only unused nuts or threaded parts shall be used.

3.3.1.2 Load measuring system, of an accuracy within ± 2 % of the applied maximum load[1].

3.3.1.3 Automatic load maintaining system.

3.3.1.4 Fixtures, designed to incorporate the features indicated in figure 3.

3.3.2 Procedure

3.3.2.1 Installation

Test bolts shall be assembled so that a minimum of two and a maximum of three complete threads are exposed between the nut or threaded part (3.3.1.1.2) bearing face and incomplete threads on the shank side.

In the case of flush head bolts, the bearing between the bolt head and the loading cup in which it is to be tested shall be uniform.

There shall be no contact in the head-shank junction area.

3.3.2.2 Test conditions

3.3.2.2.1 Torque

There shall be no tensile stress due to torque or any other installation procedure.

3.3.2.2.2 Load level

The fatigue test loads shall comply with the values specified in the procurement specification or definition document.

3.3.2.2.3 Frequency

The frequency of the test shall conform with the requirements of the procurement specification or definition document. The maximum temperature of the bolt during test shall not exceed 50 °C.