

INTERNATIONAL
STANDARD

ISO
14589

First edition
2000-12-15

Blind rivets — Mechanical testing

Rivets aveugles — Essais mécaniques



Reference number
ISO 14589:2000(E)

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Printed in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14589 was prepared by Technical Committee ISO/TC 2, *Fasteners*.

Annex A of this International Standard is for information only.

Blind rivets — Mechanical testing

1 Scope

This International Standard specifies the methods of mechanical testing of blind rivets including:

- shear test (see clause 3),
- tensile test (see clause 3),
- mandrel head retention capability test (see clause 4),
- mandrel push out resistance test (prior to setting) (see clause 5), and
- mandrel break load test (see clause 6),

at an ambient temperature of 10 °C to 35 °C.

It applies to blind rivets with nominal diameters up to and including 6,4 mm.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 7500-1:1999, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system.*

3 Shear and tensile tests

3.1 Principle of shear and tensile tests

The tests consist of straining a blind rivet which is set in a test fixture by a shear load or tensile load to failure.

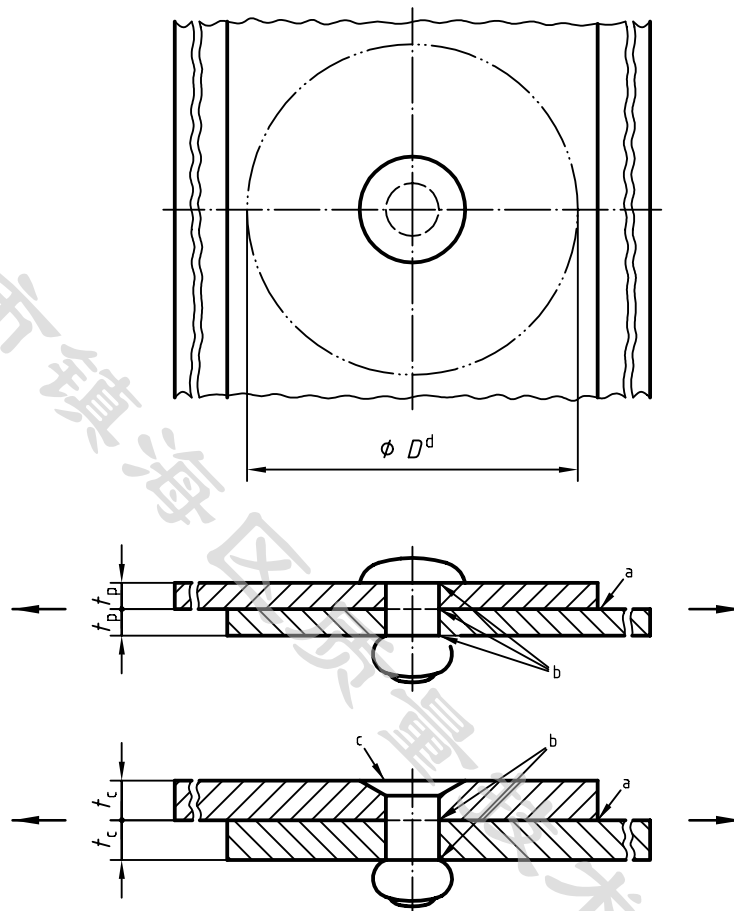
3.2 Test fixtures for shear and tensile tests

Two test fixtures are specified for each of both test methods. The test fixtures specified in 3.2.1.1 and 3.2.2.1 may be used for routine testing. The test fixtures specified in 3.2.1.2 and 3.2.2.2 may also be used for routine testing but are decisive in the case of dispute and are the referee test fixtures in such cases.

3.2.1 Test fixtures for shear testing

3.2.1.1 Routine shear testing

See Figure 1 for basic dimensions.



- a R_z4
- b There shall be no burrs at the corners of the test clearance holes.
- c Countersink angle shall be the nominal angle of the rivet head with the tolerance $_{-2^{\circ}}^0$.
- d Minimum circular plane area around the axis of the specimen with diameter $D = 25$ mm.

Figure 1 — Test fixture for routine shear testing

The test plates shall be made of steel having a hardness of not less than 420 HV30. To minimize the effect of distortion under load, fitted steel bolts should be used for attachment to the testing machine.

Test plates shall be discarded when the test clearance holes to accommodate the test rivet are no longer round, show signs of wear or damage or exceed the maximum diameter specified in Table 2.

For plate thicknesses and test clearance hole diameters see 3.2.3.

3.2.1.2 Referee shear testing

The inserts used in the test fixture according to Figure 3 shall have dimensions and finish as given in Figure 2.

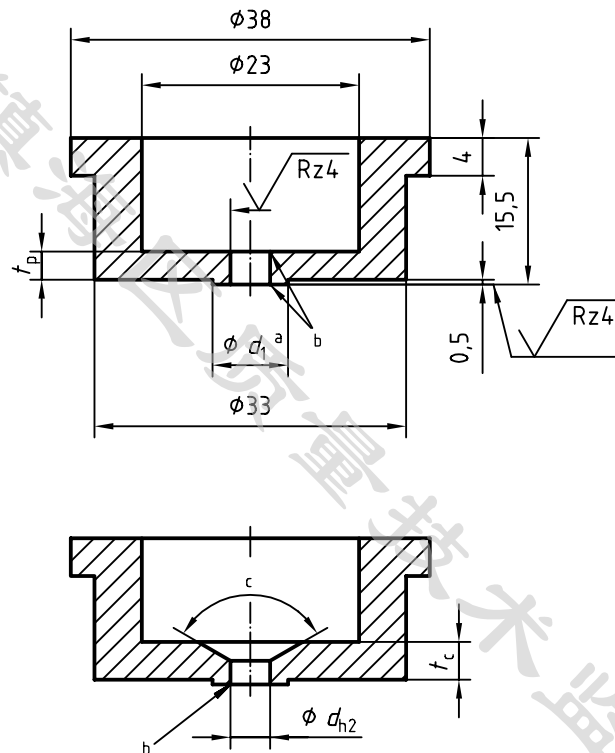
The inserts shall be made of hardened and tempered steel and shall have a hardness of 700 HV30 minimum. The test fixture which accommodates the test inserts shall be self-aligning when mounted in the tensile testing machine.

New inserts shall be used for each referee test programme.

If the test fixture according to Figure 3 is used for routine testing, test inserts shall be discarded when the test clearance holes to accommodate the test rivet are no longer round, show signs of wear or damage or exceed the maximum diameter specified in Table 2.

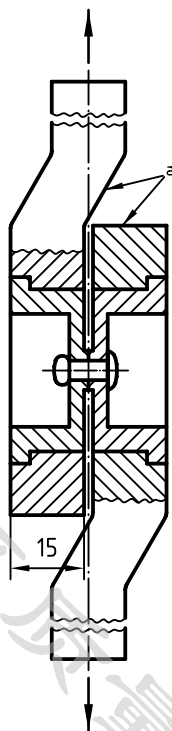
For insert thicknesses and test clearance hole diameters see 3.2.3.

Dimensions in millimetres,
surface roughness in micrometres



- a $d_1 = 2d$, where d is the nominal diameter of the rivet.
- b There shall be no burrs at the corners of the test clearance holes.
- c Countersink angle shall be the nominal angle of the rivet head with the tolerance 0
 -2° .

Figure 2 — Test inserts for blind rivets with protruding head and with countersunk head



a Width 50 mm

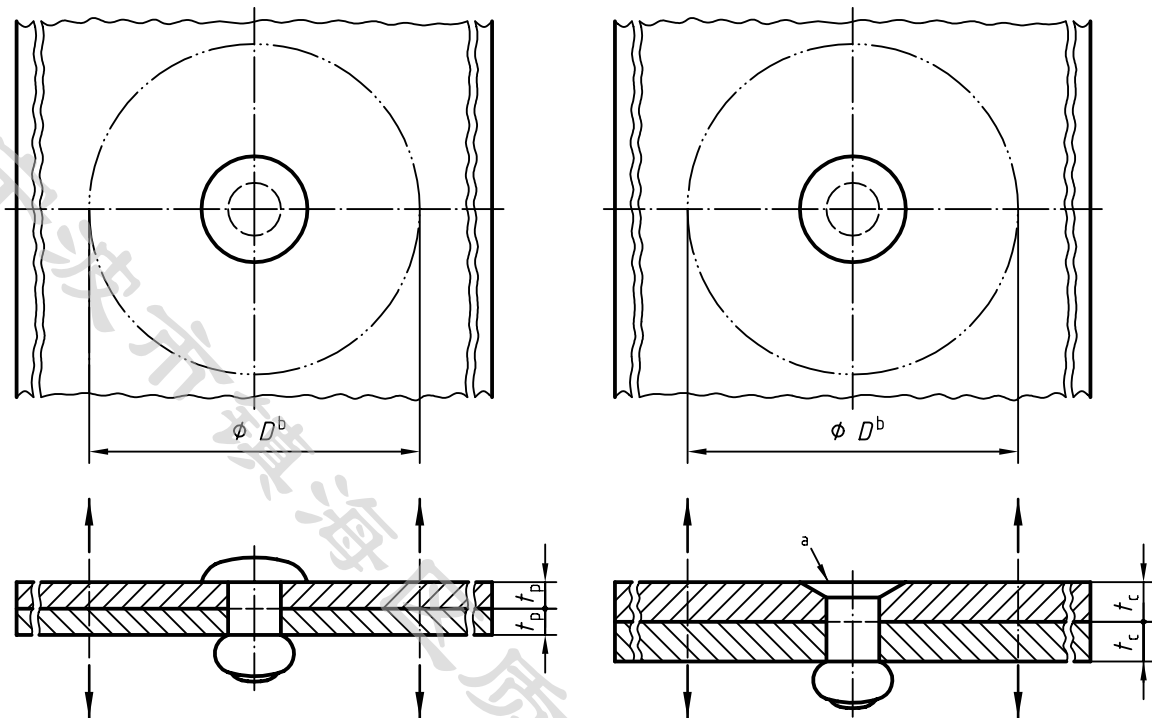
Figure 3 — Test fixture with riveted test assembly for referee shear testing

3.2.2 Test fixtures for tensile testing

3.2.2.1 Routine tensile testing

See Figure 4 for basic dimensions.

NOTE An example of a suitable test fixture is shown in annex A (informative).



- a Countersink angle shall be the nominal angle of the rivet head with the tolerance $_{-2^{\circ}}^0$.
- b Minimum circular plane area around the axis of the specimen with diameter $D = 25$ mm.

Figure 4 — Test fixture for routine tensile testing

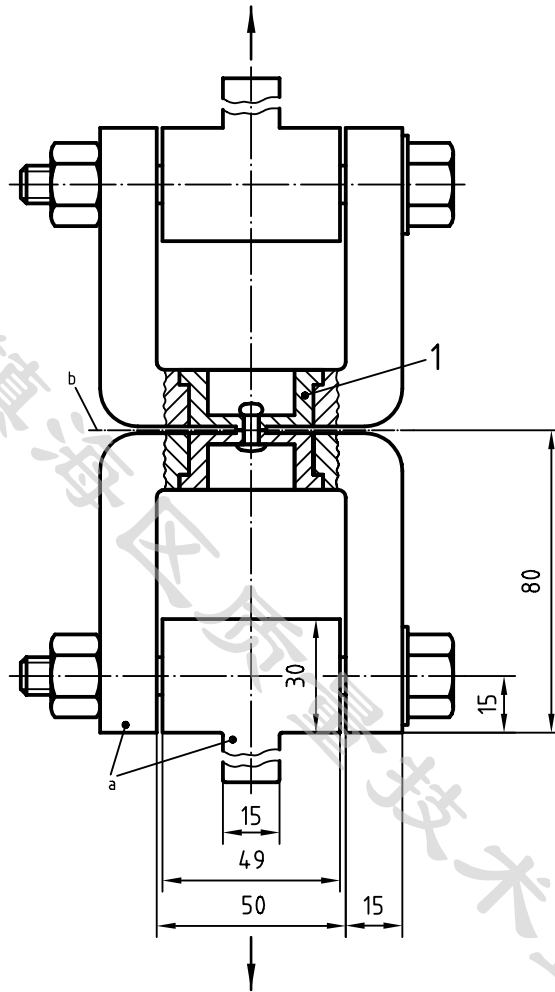
The test plates shall be made of steel having a hardness of not less than 420 HV30. To minimize the effect of distortion under load, fitted steel bolts should be used for attachment to the testing machine.

Test plates shall be discarded when the test clearance holes to accommodate the test rivet are no longer round, show signs of wear or damage or exceed the maximum diameter specified in Table 2.

For plate thicknesses and test clearance hole diameters see 3.2.3.

3.2.2.2 Referee tensile testing

For the inserts used in the test fixture according to Figure 5, the specifications of 3.2.1.2 apply.



Key

- 1 Insert (for details see Figure 2)
- a Width 50 mm
- b A spacer may be inserted to test longer rivets.

Figure 5 — Test fixture with riveted test assembly for referee tensile testing

3.2.3 Thickness of test plates/inserts and diameters of test clearance holes

For all test fixtures, the thicknesses of the test plates or test inserts respectively shall be in accordance with Table 1 and the diameters of the test clearance holes shall be in accordance with Table 2.

Table 1 — Thickness of test plates/inserts in relation to blind rivet types

Blind rivet type	Plate/insert thickness min.	
	t_p	t_c
Pull through mandrel Break pull mandrel (including extended set) Non break pull mandrel	$0,5d$	$0,75d$
Structural flush break self plugging pull mandrel	$0,75d$	$1,0d$
Multi-grip flush break positive lock pull mandrel	$0,65d$	$0,75d$
Drive pin	$0,5d$	$0,75d$
t_p is the thickness for rivets with protruding head. t_c is the thickness for rivets with countersunk head. d is the nominal rivet diameter.		

Table 2 — Diameter of test clearance holes for test plates/inserts

Dimensions in millimetres

d nom.	d_{h2}	
	max.	min.
2,4	2,60	2,55
3	3,20	3,15
3,2	3,40	3,35
4	4,20	4,15
4,8	5,00	4,95
5	5,20	5,15
6	6,20	6,15
6,4	6,60	6,55
d is the nominal rivet diameter. d_{h2} is the diameter of the test clearance hole.		

3.2.4 Forming the test assembly

The two test plates/test inserts which have the same nominal thickness shall be assembled to form a riveted assembly using the blind rivet to be tested. The rivet should be set with a setting tool and nose assembly in accordance with the setting procedure recommended by the blind rivet manufacturer.

The total thickness of the test assembly shall not exceed the maximum grip length specified for the rivet which is to be tested.

3.3 Test procedure for shear and tensile testing

The test assembly shall be mounted in a tensile testing machine which shall comply with ISO 7500-1.

The attachment grips to the tensile testing machine shall be self-aligning and shall guarantee that the load is applied in a straight line along the shear plane of the shear test specimen or in a straight line along the centreline of a tensile test specimen.

The load shall be applied continuously with a speed of testing which shall be not less than 7 mm/min nor greater than 13 mm/min, until the specimen fails.

The maximum load is recorded as the ultimate shear or tensile load of the rivet.

If the rivet fails before the specified minimum shear or tensile load is reached, the rivet has not passed the test.

3.4 Testing of short rivets

For rivets with maximum grip lengths shorter than the relevant $2 t_{p \min}$ or $2 t_{c \min}$ as specified in Table 1, the combined thickness of the test plates or test inserts shall be equal to the specified maximum grip length of the rivets to be tested.

The forming of the test assembly and the test procedure shall be as specified in 3.2. The evaluation of the test is dependent upon whether the test plates/test inserts can sustain the ultimate shear or tensile load of the rivet to be tested. Consequently, test recording for short rivets has the following categories:

- a) If the test plates or test inserts remain intact until the rivet fails, the maximum load recorded is the ultimate shear or tensile load until the rivet fails. If this load is equal to or above the specified minimum shear or tensile load, the rivet has passed the test.
- b) If the rivet remains intact and the test plates or inserts fail at a load equal to or above the minimum specified shear or tensile load, the rivet has passed the test. However, in this case, the ultimate shear or tensile load of the rivet cannot be determined.
- c) If the rivet remains intact and the test plates or test inserts fail at a load less than the minimum specified shear or tensile load, the acceptability of the rivet may be agreed between supplier and user.
- d) If the rivet fails before the specified minimum shear or tensile load is reached, the rivet has not passed the test.

4 Mandrel head retention capability test

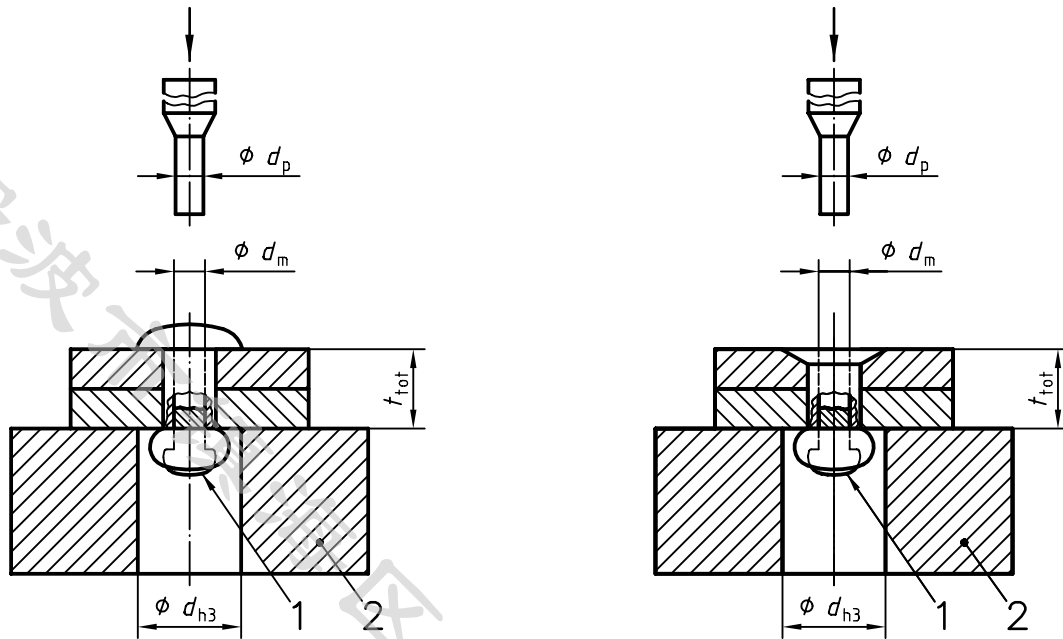
4.1 Principle of head retention capability test

The test consists of loading the mandrel axially, from the head side of a set blind rivet up to the head retention load.

NOTE This test is not applicable to closed end, drive pin, split end and slotted shank blind rivets.

4.2 Test fixture for head retention capability test

See Figure 6.



Key

- 1 Mandrel
- 2 Test block

Figure 6 — Test fixture for mandrel head retention capability test

The test assembly may comprise either one or more steel plates to give a total thickness t_{tot} equal to the specified maximum grip length of the rivet to be tested. No plate shall be less than 1,5 mm thick. The test plates shall have a width which provides a minimum circular plane with the diameter $D = 25$ mm around the axis of the specimen.

The diameter of the test clearance holes (d_{h2}) in the test plates to accommodate the rivet shall be in accordance with Table 2.

The rivet should be set with a setting tool and nose assembly in accordance with the setting procedure recommended by the blind rivet manufacturer.

The diameter of the punch d_p shall be 0,25 mm less than the mandrel diameter d_m .

The hole of the test block, on which the riveted assembly is seated, shall be able to accommodate the blind head but the diameter d_{h3} shall not be more than two times the nominal rivet diameter ($d_{h3} \leq 2d$).

4.3 Test procedure for head retention capability test

The test fixture shall be mounted in a testing machine which shall comply with ISO 7500-1 and which is equipped with a compression punch as shown in Figure 6.

The load shall be applied to the untrimmed mandrel end, continuously and without impact, directly in line with the axis of the mandrel and shall be continued until the mandrel starts moving in relation to the rivet body. The speed of testing shall be not less than 7 mm/min nor greater than 13 mm/min. The maximum load before moving of the mandrel shall be recorded as the mandrel head retention load of the blind rivet.

5 Mandrel push out resistance test (prior to setting)

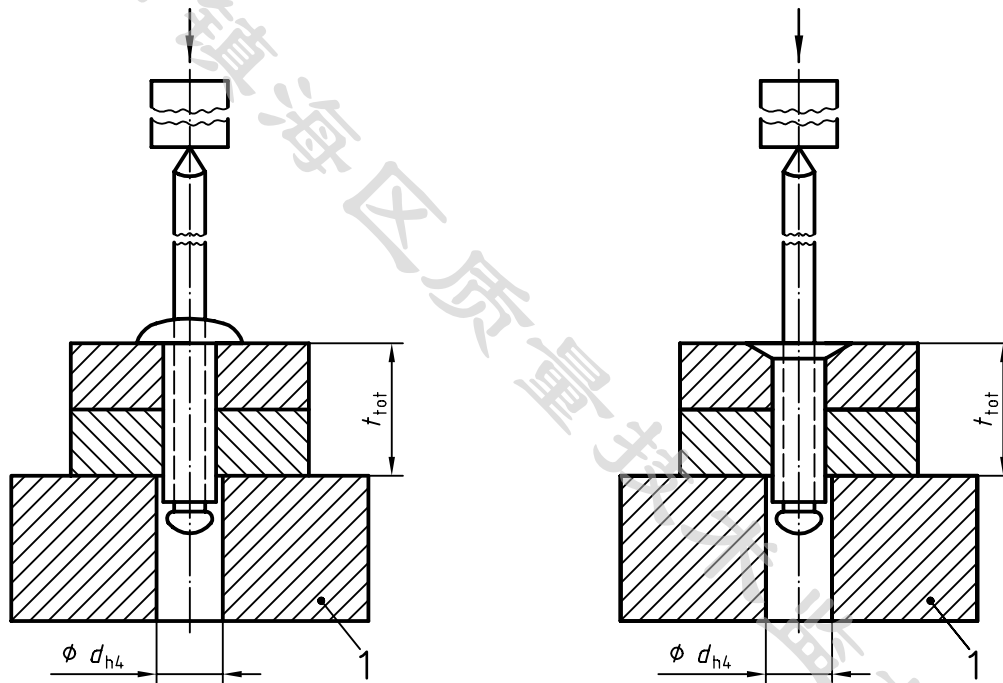
5.1 Principle of mandrel push out resistance test (prior to setting)

The test consists of loading the mandrel axially from the head side of a blind rivet until it is pushed out.

NOTE This test is not applicable to closed end and drive pin blind rivets.

5.2 Test fixture for mandrel push out resistance test (prior to setting)

See Figure 7.



Key

1 Test block

Figure 7 — Test fixture for mandrel push out resistance test

The test assembly may comprise either one or more steel plates to give a total thickness $t_{tot} \geq 10$ mm. No plate shall be less than 1,5 mm thick. The test plates shall have a width which provides a minimum circular plane with the diameter $D = 25$ mm around the axis of the specimen.

The diameter of the test clearance holes in the test plates to accommodate the rivet shall be in accordance with Table 2.

The diameter of the hole d_{h4} of the test block, on which the test plates with the rivet are seated, shall not be more than 1 mm larger than the maximum rivet shank diameter.

5.3 Test procedure for mandrel push out resistance test (prior to setting)

The test fixture shall be mounted in a testing machine which shall comply with ISO 7500-1 and which is equipped with a compression punch as shown in Figure 7.

The load shall be applied to the mandrel end, continuously and without impact, directly in line with the axis of the mandrel until the mandrel is moving in relation to the rivet body. The speed of testing shall be not less than 7 mm/min nor greater than 13 mm/min. The maximum load shall be recorded as the mandrel push out load of the blind rivet.

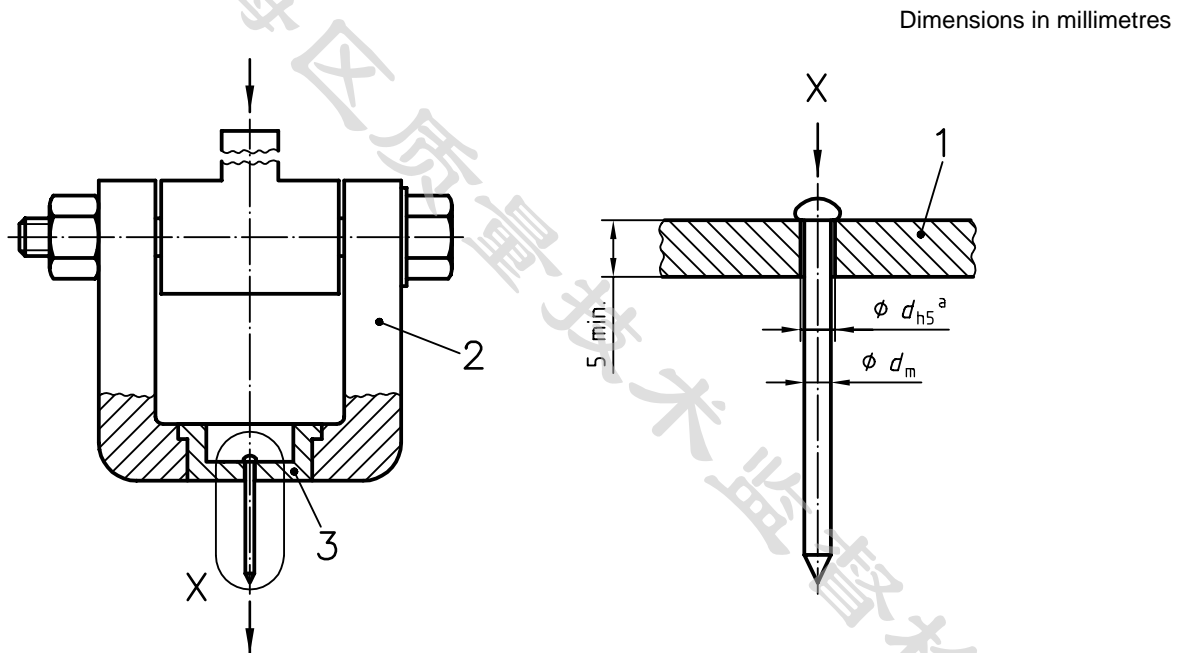
6 Mandrel break load test

6.1 Principle of the mandrel break load test

The test consists of straining the mandrel removed from the rivet body in a test fixture by a tensile load to fracture.

6.2 Test fixture for the mandrel break load test

See Figure 8.



Key

- 1 Test plate
- 2 Test fixture as given in Figure 5 (one part only)
- 3 Test insert

a Hole diameter $d_{h5} = d_m \begin{matrix} +0,4 \\ +0,2 \end{matrix}$ mm

Figure 8 — Test fixture for mandrel break load test

The test fixture shall consist of a steel test plate or test insert with a hardness of 700 HV30 minimum. The hole of the test plate or test insert to accommodate the mandrel shall be equal to the nominal diameter of the mandrel to be tested with the tolerance $\begin{matrix} +0,4 \\ +0,2 \end{matrix}$ mm. The thickness of the test plate or test insert shall be at least 5 mm but shall be sufficient to hold the test load without showing plastic deformation.

6.3 Test procedure

The test fixture shall be mounted in a testing machine which shall comply with ISO 7500-1 and which is equipped with a tool which is able to grip the mandrel.

The tensile load shall be applied to the mandrel, continuously and without impact, directly in line with the axis of the mandrel and shall be continued until the mandrel breaks. The speed of testing shall be not less than 7 mm/min nor greater than 13 mm/min. The maximum applied load shall be recorded as the mandrel break load of the blind rivet.

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Annex A (informative)

Example of a suitable test fixture for tensile testing of rivets

Two test plates as shown in Figure A.1, with the plate thickness and the test clearance hole diameter according to 3.2.2, are joined together with the rivet to be tested.

The riveted joint is placed in a test fixture as shown in Figure A.1 and the test fixture placed between the compression heads of a testing machine.

Dimensions in millimetres

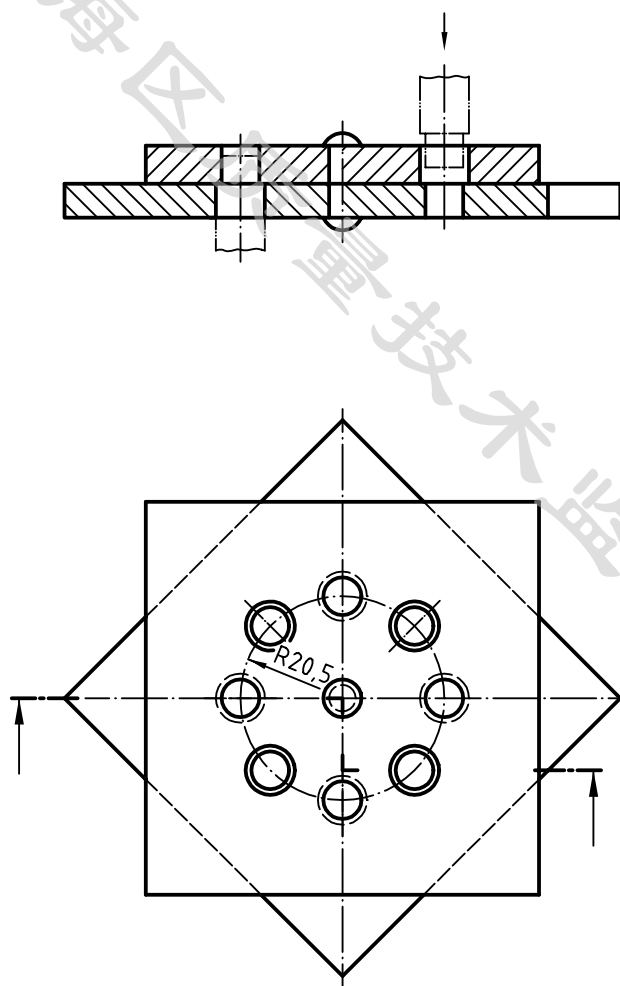


Figure A.1 — Test fixture for tensile testing of rivets

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