INTERNATIONAL STANDARD

ISO 13469

First edition
2014-07-01

Mechanical joining — Form-fit blind rivets and (lock) bolt joints — Specifications and qualification of testing procedures

Assemblage mécanique — Rivets aveugles et boulons à filetage autofreinant — Spécifications et qualification des modes opératoires d'essai

Reference number
ISO 13469:2014(E)

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Published in Switzerland

Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 6, *Resistance welding and allied mechanical joining*.

Mechanical joining — Form-fit blind rivets and (lock) bolt joints — Specifications and qualification of testing procedures

1 Scope

This International Standard specifies the requirements for the testing procedures for interference-fit/form-fit blind rivet joints and lock bolt joints made of metallic and non-metallic materials.

The tests required for a particular joint depend upon the performance requirements of the component/assembly and shall be established before any testing is undertaken.

The term sheet as used in this International Standard includes extrusions, cast material, plastics, and fibre-reinforced plastics, e. g. carbon and glass fibre-reinforced plastics.

NOTE Specific service, material, or manufacturing conditions can require more comprehensive testing than specified in this International Standard. Such tests can include macro and micro sections, fatigue, and/or endurance tests.

This International Standard does not apply to civil engineering applications such as metal building and steel construction which are covered by other applicable International Standards.

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.

ISO 12996, *Mechanical joining — Destructive testing of joints — Specimen dimensions and test procedure for tensile shear testing of single joints*

ISO 14588, *Blind rivets — Terminology and definitions*

ISO 16237, *Mechanical joining — Destructive testing of joints — Specimen dimensions and test procedure for cross-tension testing of single joints*

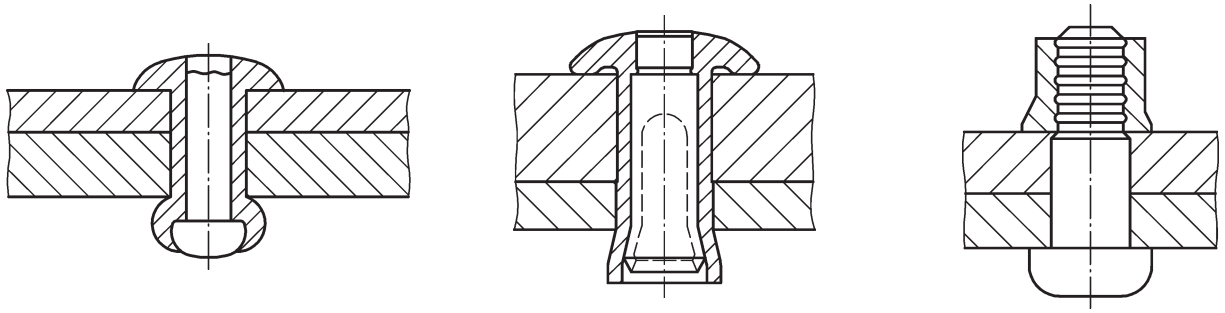
3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14588 and the following apply.

3.1
interference-fit joint
form-fit joint
property of a joint in which the transmission of external forces, in particular shear forces, is effected by geometrical elements which prevent the movement of the components relative to one another

Note 1 to entry: This condition is frequently achieved by the fastener's outer diameter surface having complete contact with the joint's component holes.

[SOURCE: ISO 12996:2013, 3.12 modified — Figure 1 has been added.]



a) Blind rivet joint with bulbing blind head

b) Blind rivet joint with flaring blind head

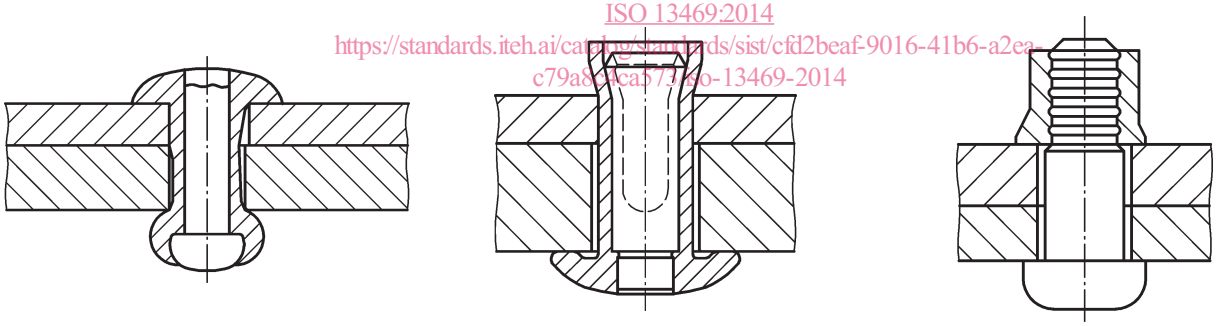
c) Lock bolt joint

Figure 1 — Examples of interference-fit/form-fit joints

3.2
clearance-fit joint
force-fit joint
property of a joint in which external forces, in particular shear forces, are transmitted through friction and, if the force to be transmitted is greater than the frictional force, then frictional locking is overcome and the components move relative to one another

Note 1 to entry: This condition is frequently achieved by the fastener's outer diameter surface having incomplete contact with the joint's component holes.

[SOURCE: ISO 12996:2013, 3.13 modified — Figure 2 has been added.]



a) Blind rivet joint with bulbing head

b) Blind rivet joint with flaring blind head

c) Lock bolt joint

Figure 2 — Examples of clearance-fit/force-fit joints

3.3
clearance bridging capability
ability to fill the clearance between the rivet and the work piece to eliminate displacement in the shear plane

4 Technical contents of the joining procedure specification (JPS)

4.1 General

The performance of at least two samples of the joint to be tested shall be evaluated in accordance with the tests specified in this International Standard and the results recorded.

The following variables affect the performance of the joints and shall be agreed upon by the contracting parties before testing:

— hole diameters in sheets;

— nominal and measured diameters of blind rivets and lock bolts;

— sheets thicknesses;

— mechanical properties of sheets, blind rivets, and lock bolts;

— degree of clearance in the rivet or lock bolt joint (see Figure 1 and Figure 2);

— percentages of the sheet thickness over which the clearances are bridged;

— methods of assembly of the joints.

The joining procedure specification (JPS) shall provide the necessary information required to make the joint. The minimum information required in a JPS for riveting processes is listed in 4.2 to 4.4.

For some applications, it might be necessary to supplement the list. All relevant information shall be specified in the JPS.

Permissible tolerance ranges shall be specified.

An example of a JPS form is shown in Annex B; these forms should be modified according to actual practice.

4.2 Related to the fastener manufacturer

— identification of the fastener manufacturer;

— identification of JPS.

4.3 Related to parent materials

4.3.1 Composition and characteristics of parent materials

— designation and type(s) of the material(s) and referenced standard(s);

— in the case of coating(s), material(s), types, thicknesses, location, single- or double-sided.

4.3.2 Dimension of parent materials/test pieces

— thickness of material(s);

— dimensions and cross section(s) of profile(s) or extrusion(s).

4.4 Common to all joining processes

4.4.1 Joining process

— Joining process(es) specified shall be designated as manual, mechanized, automated, or robotic.

4.4.2 Machine specification

— type of setting machine/equipment used and appropriate identification.

4.4.3 Joint design

The overlap, edge distance, distance between two hole axes, sequence and pattern, rivet or bolt design, type, and manufacturer shall be specified and comply with the appropriate standards and/or application, as applicable.

NOTE A sketch can be used showing the joint design/configuration.

5 Requirements for joints

5.1 General

The following tests for the joints shall be carried out in accordance with the design requirements.

5.2 Test specimen

The dimensions of the test specimens for tensile shear tests shall be in accordance with ISO 12996, for cross tension tests, in accordance with ISO/DIS 16237, for mechanized peel tests, see for example ISO 14270, and for fatigue tests, see for example ISO 18592.

For ease of testing, the use of specimens is to be given preference over the use of any cut pieces taken from actual components.

5.3 Joining of assembly components, test pieces, or test specimens

Preparation of assembly components, test pieces taken from an assembly, or test specimens and joining of the test pieces or specimens shall be carried out in accordance with the requirements specified.

6 Testing and examinations

6.1 General

The testing and examination can include both non-destructive and destructive tests.

The scope of examination shall be specified by the contracting parties before starting with the tests. These tests and examinations can include visual examination, macro-section, tensile-shear tests, cross-tension testing, fatigue testing, and/or ultrasonic examination.

6.2 Visual examination

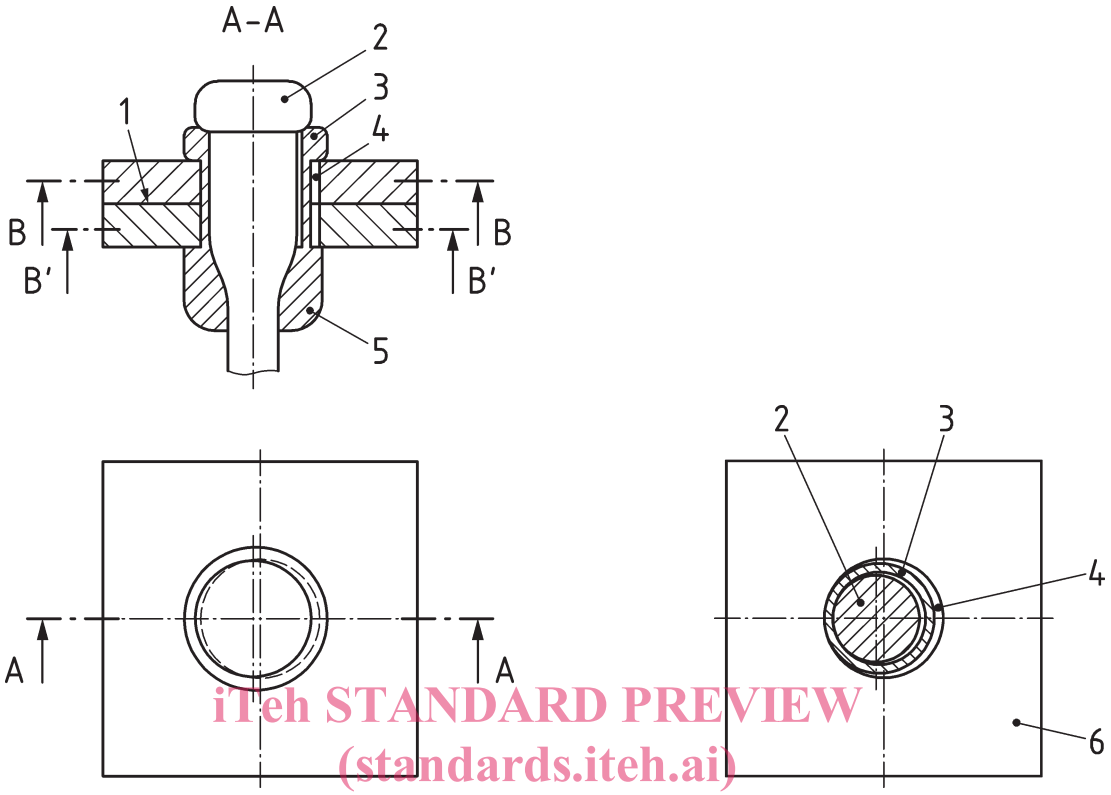
The test pieces or specimens shall be visually examined to check the misalignment of holes and rivet head, rivet end, bolt head, or collar end prior to testing the test specimens.

6.3 Macro-section/macroscopic examination

Macroscopic examination of joint cross section shall be carried out at a suitable magnification to verify the presence or the elimination of clearances between rivet and the work piece component holes. The clearance or interference/form fit characteristics of rivet joints can be ascertained by the examination of macrographs of cross section of the joints.

Towards this purpose, sections, normal to the mechanical fastener axis, shall be made 0,5 mm from the faying surface or in the middle of the sheet thickness, whichever is smaller. The sections shall show the

amount of clearance or absence of radial play between the components of the rivet and the work piece hole. Examples of such macro-sections are shown in Figure 3 and Figure 4.



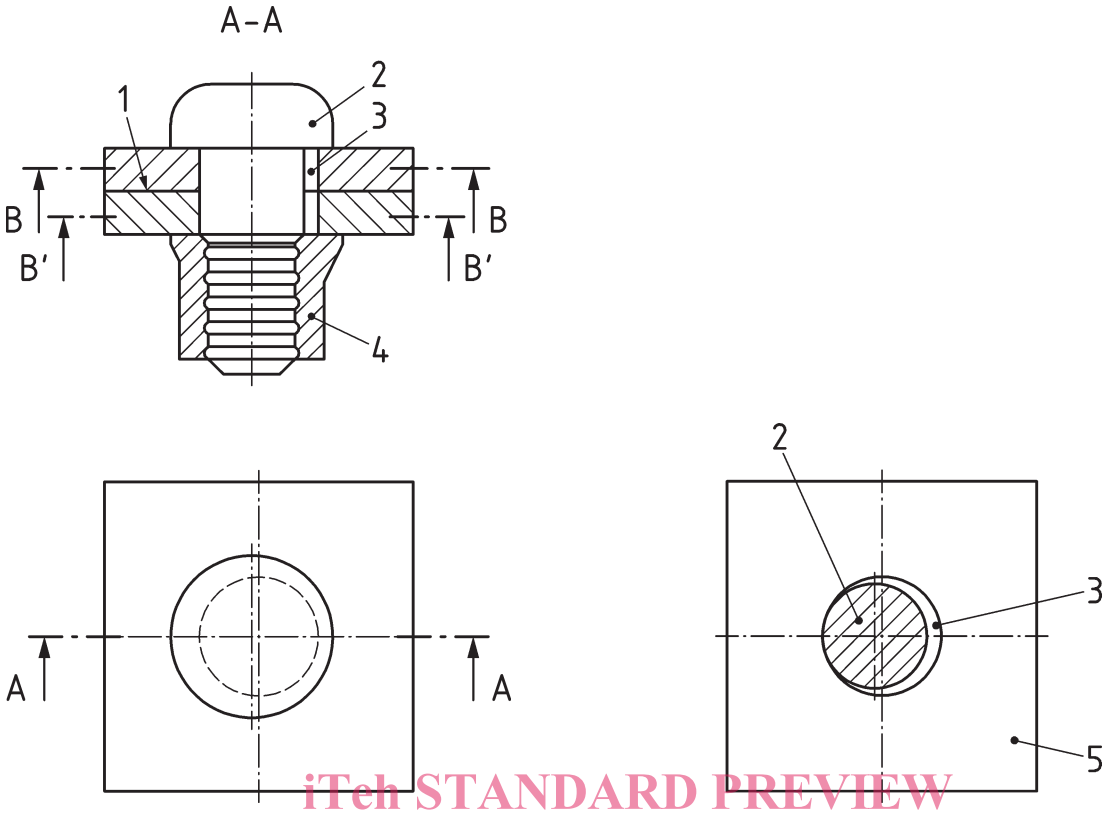
a) A–A cross section (body = sleeve + collar) and top view

b) B–B cross section or B′–B′ cross section

Key

1 faying surface
2 mandrel
3 sleeve
4 clearance
5 collar
6 sheet

Figure 3 — An example of a clearance-fit/force-fit blind rivet joint



a) A–A cross section and top view **b) B–B cross section or B′–B′ cross section**

Key

1 faying surface
2 pin
3 clearance
4 collar
5 sheet

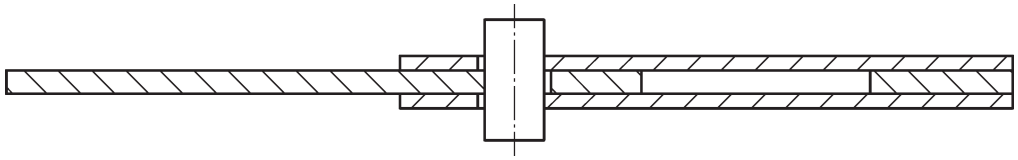
NOTE The lock bolt is a combination of the pin and collar.

Figure 4 — An example of a clearance-fit/force-fit lock bolt joint

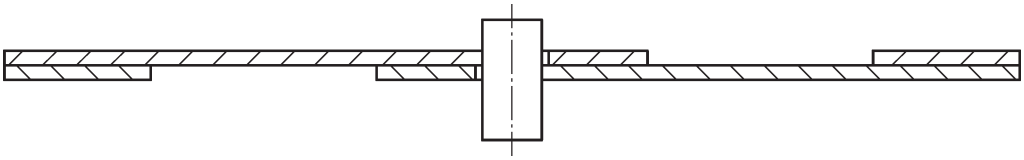
6.4 Tensile shear test

Tensile shear testing of the joined specimen shall be carried out in accordance with ISO 12996 as shown in Figure 5 a) and Figure 5 b).

NOTE 1 If identical test results can be achieved by other measures, shim plates can be omitted (e.g. by self-aligning clamps).



a) Double-shear test specimen



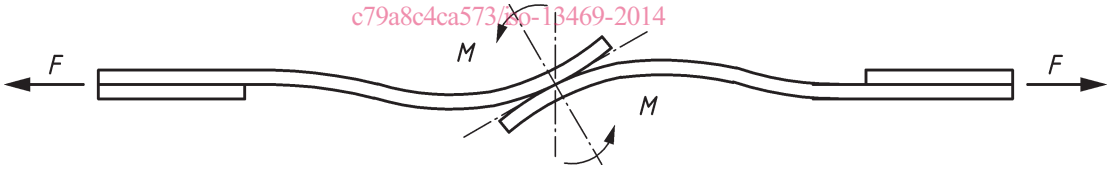
b) Single-shear test specimen

Figure 5 — Double-shear and single-shear lap test specimens

NOTE 2 Figure 5 shows the specimens before the actual setting operation, i.e. the rivet or lock bolt have been inserted into the bores but not set.

Possibilities of testing are shown in Figure 6.

a) At the start of the tensile shear test



b) During the tensile shear test

Figure 6 — Schematic illustration showing the deformation of a single-shear lap specimen due to the deflection of the force lines under tensile load

If slipping occurs during the testing, this will show up in the force vs. elongation diagram as is to be seen in Figure 7. The corresponding force, F_S, shall be recorded in the test report or the JPQR.

NOTE 3 Slippage can occur in single and multiple fastener assemblies.