BS ISO 16237:2015

BSI Standards Publication

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

National foreword

This British Standard is the UK implementation of ISO 16237:2015.

The UK participation in its preparation was entrusted to Technical Committee WEE/29, Resistance welding.

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

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Date	Text affected

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ISO 16237

First edition
2015-05-01

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

Assemblage mécanique — Essais destructifs des soudures — Dimensions des éprouvettes et mode opératoire d'essai de traction sur éprouvettes en croix

Reference number
ISO 16237:2015(E)

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Foreword

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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*.

Introduction

This International standard specifies the testing procedure and the specimen shapes for cross-tension testing of mechanical joints. Items to be reported after testing are the cross tension strength as well as the fracture modes, which are given as drawings as the type of joint failure. The International Standard also includes normative references, terms and definitions and an example for a test report.

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

1 Scope

This International Standard specifies the geometry of the test specimens and the method for the cross-tension testing of single mechanical joints on single-lap test specimens up to a single sheet thickness of 4,5 mm.

The term “sheet”, as used in this International Standard, includes extrusions and cast materials.

The purpose of the cross-tension test is to determine the mechanical characteristics and the failure types of the joints made with different joining methods.

This International Standard does not apply to civil engineering applications such as metal building and steel construction which are covered by other applicable 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 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

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

3 Terms and definitions

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

3.1
cross-tension strength
CTS
F_{max}
maximum force, recorded in the test

3.2
cross-tension force
F
force, recorded in the test

3.3
crosshead displacement
s
displacement of the crosshead of the test equipment during the cross-tension test

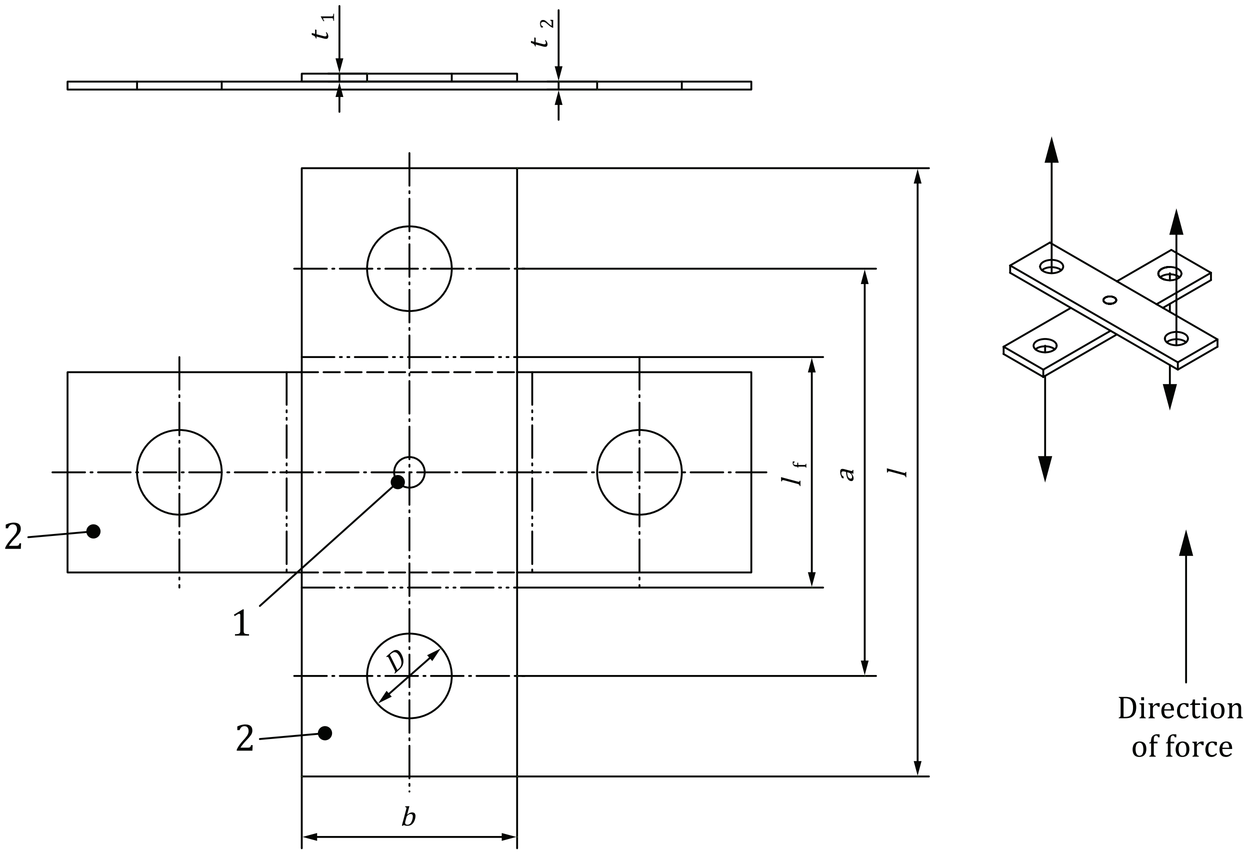
3.4
crosshead displacement at maximum force
s_{Fmax}
displacement at which the maximum force F_{max} is recorded

3.5
crosshead displacement at 0,3 F_{max}
$s_{0,3Fmax}$
displacement at which $0{,}3F_{max}$ is recorded after the peak value is achieved

3.6
crosshead displacement at fracture
$s_{fracture}$
displacement at which fracture occurs

4 Test specimens and types of tests

The configuration and dimensions are shown in Figure 1 and Table 1.



Key

a	hole distance	*l*	specimen length	t_2	thickness sheet 2
b	specimen width	l_f	free clamping length	1	mechanical joint
D	hole diameters	t_1	thickness sheet 1	2	clamping area (shaded zone)

Figure 1 — Cross-tension specimen

Table 1 — Dimensions of specimen (tolerances according to ISO 2768-1)

Specimen width	*b*	50^{+1}_{0} mm
Specimen length	*l*	$150^{0}_{-0,5}$ mm
Hole distance	*a*	(100 ± 0,2) mm
Hole diameters[a]	*D*	$20^{+0,7}_{0}$ mm
Free clamping length	l_f	54^{0}_{-1} mm
[a] Holes may not be necessary depending on the clamping device used.		

5 Test equipment and test procedure

Testing is performed on a tensile testing machine, which satisfies the requirements given in ISO 7500-1. The cross-tension force and the displacement shall be simultaneously measured during testing. All tests shall be carried out at room temperature until the joint fails.

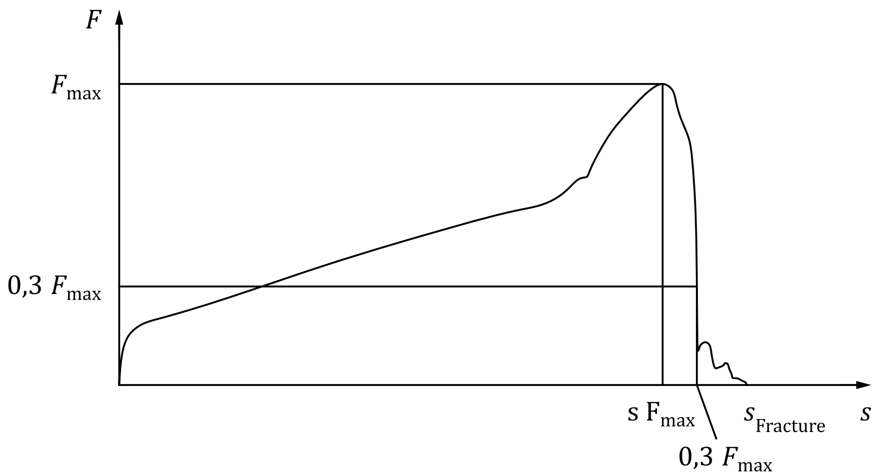
If a special clamping device is used, the shape and size shall be specified and recorded.

Crosshead separation rate of testing shall be (less than or) equal to 10 mm/min, and shall be kept constant during the test.

The specimen deformation shall be measured as the displacement of the crosshead or by using appropriate displacement sensing equipment either directly from the specimen or indirectly from the crosshead position. When using signals from the cross head position, the signal should be corrected by the stiffness of the testing machine in question. Results of measurements can only be compared when the tests are performed under identical conditions. The type of measurement and the initial length shall be noted in the test protocol.

The signals for force and specimen deformation during test shall be recorded as shown in Figure 2 so that each specific value shall be recorded in the test report.

NOTE 1 If required, further characteristic data, e.g. 0,3 F_{max}, can be determined according to the cross-tension diagram given in Figure 2.



Key

F force

s displacement

Figure 2 — Characteristic values of a force-displacement diagram for the cross-tension test

An example of a jig as shown in Figure 3 can be used for the cross-tension testing of flat specimens.

Dimensions in millimetres

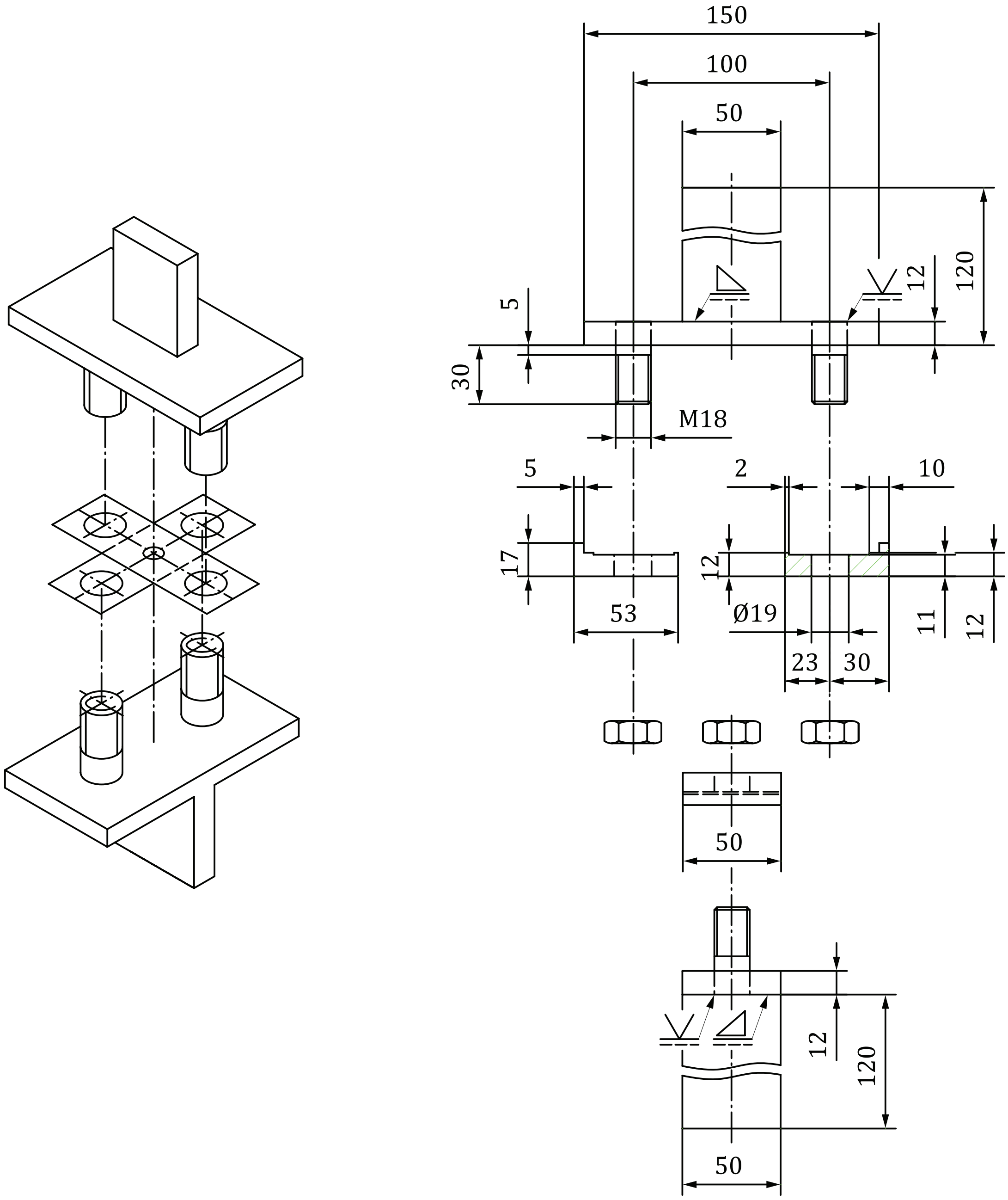


Figure 3 — Example of testing clamp

NOTE 2 It is important that no slippage occurs between the specimen and the clamping device during the test.

6 Failure mode

The failure mode after cross-tension testing shall be classified according to Annex A.

7 Test report

The test report shall contain at least the following information:

a) a reference to this International Standard, i.e. ISO 16237:2015;

b) name of the examiner and/or the examining body;

c) date and signature of the examiner and/or the examining body;

d) joining process and description of fasteners used;

e) joining parameters, type of joining equipment, and material designation and dimensions of auxiliary materials;

f) material designation of the joined parts or test specimen;

g) specimen dimensions (including sheet thicknesses t_1 and t_2);

h) joining direction, stacking order, location of coated sides;

i) type of testing equipment and settings;

j) method of displacement measurement;

k) individual, mean and standard deviations of the characteristic values, e.g. force, displacement, yield strength;

l) diagram force-displacement path;

m) failure mode;

n) deviations from this International Standard.

Annex A
(normative)

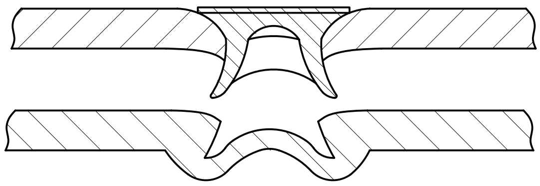
Types of joint failure

A.1 General

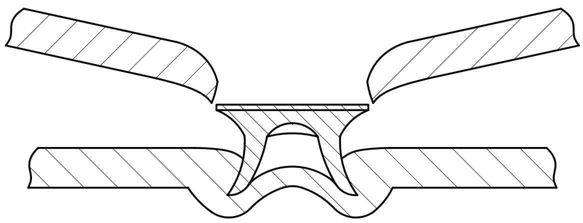
Depending on the joining technology, different types of failure can occur. Some of these are specific to the joining technology employed and should be recorded in the test protocol. Typical failure modes for different joints are shown, by way of example, in Figures A.1 to A.7.

In addition to the failure modes shown below, non-permissible sheet separation or deformation can be defined as a failure criterion by the contracting parties.

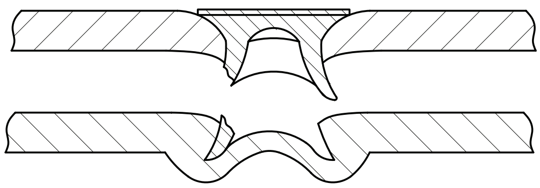
A.2 Typical failure modes of semi-tubular self-piercing rivet joints under cross-tension load



a) Rivet pull out from the bottom sheet16237_ed1figA1b.eps



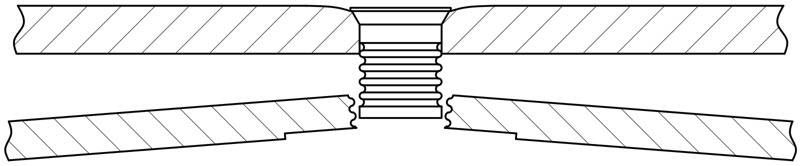
b) Pull out of the rivet head



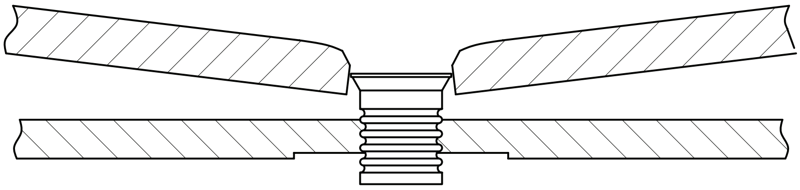
c) Rivet failure

Figure A.1 — Typical failure modes of semi-tubular self-piercing rivet joints under cross-tension load

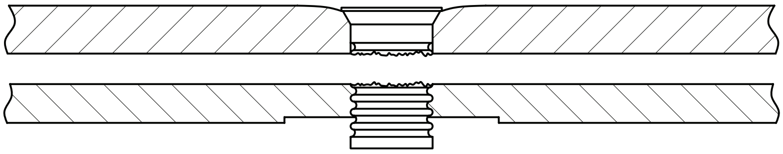
A.3 Typical failure modes of solid self-piercing rivet joints under cross-tension load



a) Rivet pull out from the bottom sheet



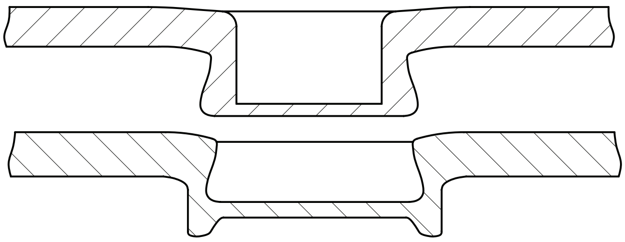
b) Pull out of the rivet head



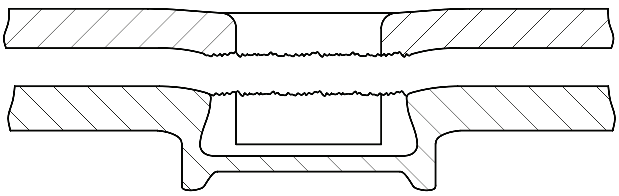
c) Rivet failure

Figure A.2 — Typical failure modes of solid self-piercing rivet joints under cross-tension load

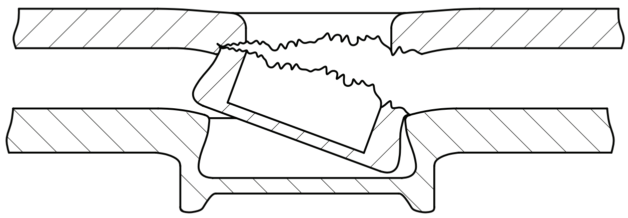
A.4 Typical failure modes of clinch joints under cross-tension load



a) Plug failure (pull out)



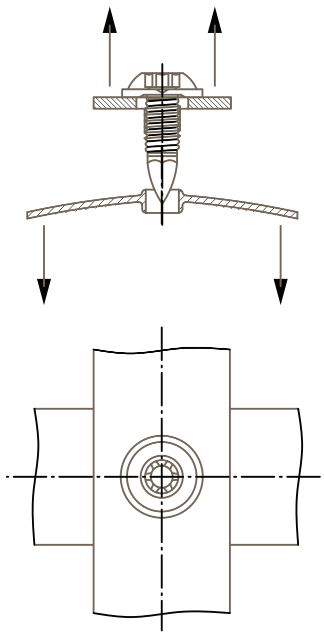
b) Neck fracture



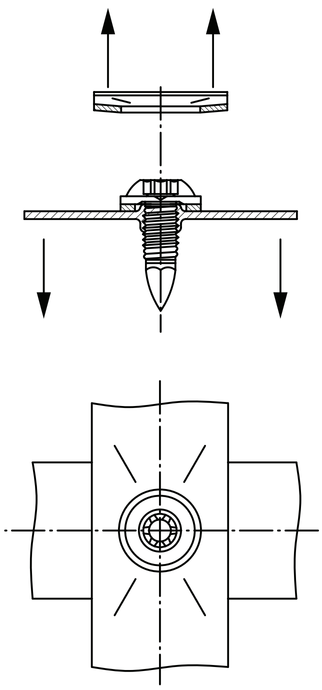
c) Neck fracture with plastic deformation (mixed mode failure)

Figure A.3 — Typical failure modes of clinch joints under cross-tension load

A.5 Typical failure modes of screwed joints under cross-tension load



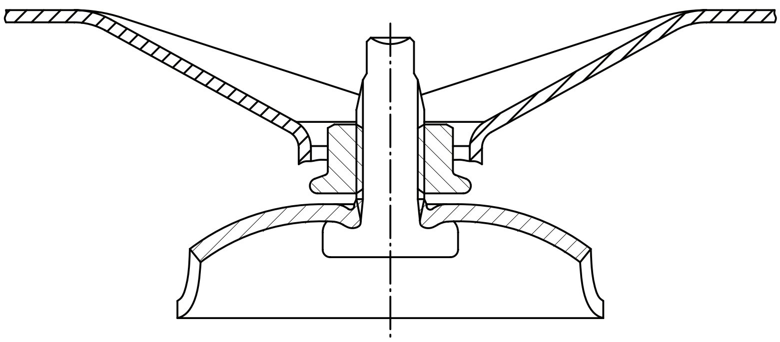
a) Thread in specimen stripped



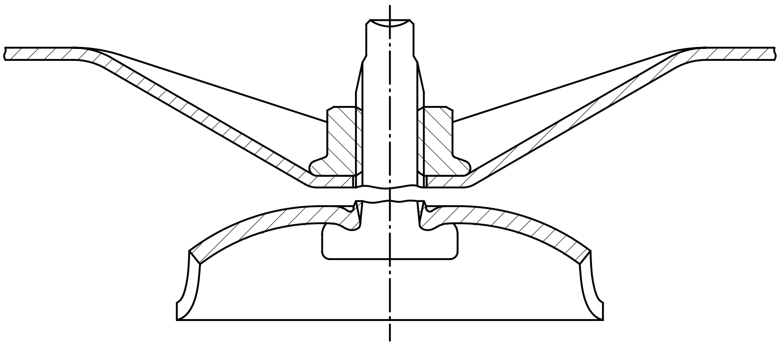
b) Clamped part fails

Figure A.4 — Examples of failure modes of screwed joints under cross-tension load

A.6 Typical failure modes of joints made with self-clinching or self-piercing bolts under cross-tension load



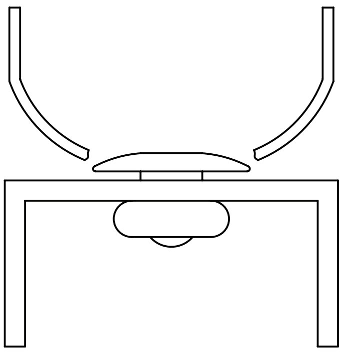
a) Failure by hole tearing out in the weaker sheet (or component)



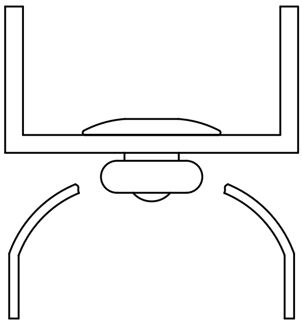
b) Failure due to fracture of bolt shank

Figure A.5 — Typical failure modes of joints made with self-clinching or self-piercing nuts and bolts under cross-tension load

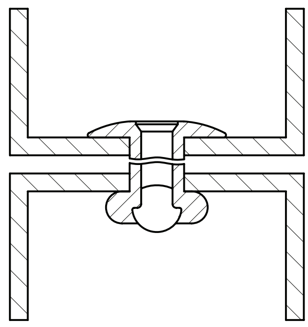
A.7 Typical failure modes of blind rivet joints under cross-tension load



a) Case 1: Pull out of the blind rivet head



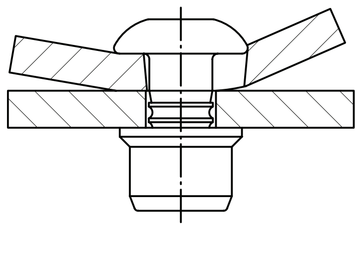
b) Case 2: Blind rivet pull out from the bottom sheet



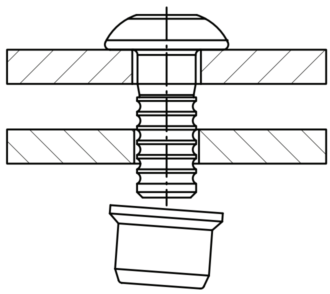
c) Case 3: Failure of the blind rivet

Figure A.6 — Typical failure modes of blind rivet joints under cross-tension load

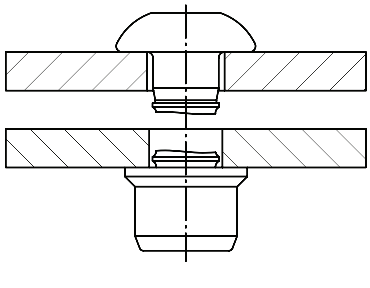
A.8 Typical failure modes of lock bolt joints under cross-tension load



a) Case 1: Pull out of the lock bolt head



b) Case 2: Lock bolt collar loosening



c) Case 3: Lock bolt failure

Figure A.7 — Typical failure modes of lock bolt joints under cross-tension load

Bibliography

[1] ISO 14272, *Resistance welding — Destructive testing of welds — Specimen dimensions and procedure for cross tension testing of resistance spot and embossed projection welds*

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