INTERNATIONAL STANDARD

ISO 9788

Second edition
2017-12

Air cargo — Double stud tie-down fittings — Design and testing requirements

Fret aérien — Ferrures d'arrimage à pion double — Exigences de conception et d'essais

Reference number
ISO 9788:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

This second edition cancels and replaces the first edition (ISO 9788:1990), which has been technically revised.

The main changes compared to the previous edition are as follows:

— change in title to reflect the amended scope;

— expansion of scope to cover complete double-stud fittings, regardless of material used, instead of only their cast components;

— new Figure 4, examples of ring shapes;

— drawing attention in 4.2.4 to zinc chromate's toxicity; and

— addition of a new Clause 8 on Quality Control.

Introduction

This document specifies the design, performance and testing requirements for double stud tie-down fittings intended to be used for cargo restraint on board civil transport aircraft. At the time of publication, no formal Civil Aviation Authority approval (certification) procedure applicable to tie-down fittings.

The civil aviation requirements referred to in this document are those concerning certification of transport aircraft and appliances to be installed aboard them, and constitute the set of design and operation requirements internationally agreed in application of International Civil Aviation Organization (ICAO) Annexes 6, *Operation of aircraft* and 8, *Airworthiness of aircraft*, to the Convention on International Civil Aviation. This document provides one means of compliance for double stud tie-down fittings.

Throughout this document, the minimum essential criteria are identified by use of the key word "shall". Recommended criteria are identified by use of the key word "should" and, while not mandatory, are considered to be of primary importance in providing safe restraint arrangements on board aircraft. Deviation from recommended criteria should only occur after careful consideration and thorough service evaluation have shown alternate methods to provide an equivalent level of safety.

Dimensions and tolerances are expressed in millimetres.

Air cargo — Double stud tie-down fittings — Design and testing requirements

1 Scope

This document specifies the geometry, performance and testing requirements for a double stud tie-down fitting assembly, having a load capacity of 22 250 N (5 000 lbf), when installed in rail or track conforming to ISO 7166.

Other materials than those specified can alternatively be used, provided the performance and testing requirements of this document are complied with.

Double stud tie-down fittings are intended to be used as either:

a) loose items to be attached to an air cargo pallet's track or an aircraft's floor rail in order to constitute a tie-down arrangement together with cargo restraint straps meeting the requirements of ISO 16049-1 or cargo restraint slings (steel cables) meeting the requirements of ISO 20291-1,

b) or permanently attached tie-down components of pallet nets meeting the requirements of ISO 4115 or ISO 4170.

In this case, where deemed appropriate, the stud geometry can alternatively conform to ISO 7166, and the breaking strength requirement can be limited to the value necessary to meet the net's airworthiness approval/certification in accordance with ISO 21100.

Single stud tie-down fittings are not covered by this document.

They nevertheless can, where deemed appropriate, use the same stud geometry alternatively to the stud configuration specified in applicable ISO 7166.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951, *Sampling procedures and charts for inspection by variables for percent nonconforming*

ISO 5922, *Malleable cast iron*

ISO 6982, *Metallic materials — Tensile testing*

ISO 7166, *Aircraft — Rail and stud configuration for passenger equipment and cargo restraint*

ISO 10254, *Air cargo and ground equipment — Vocabulary*

ISO 16049-1:2013, *Air cargo equipment — Restraint straps — Part 1: Design criteria and testing methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10254 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
casting
part shaped by solidification of molten metal in a mould

3.2
rough casting
casting which has not been machined or not yet been finished

3.3
rail
<floor> rail conforming to ISO 7166, which is part of an aircraft's floor and designed to take passenger seats, tie-down fittings, or other devices

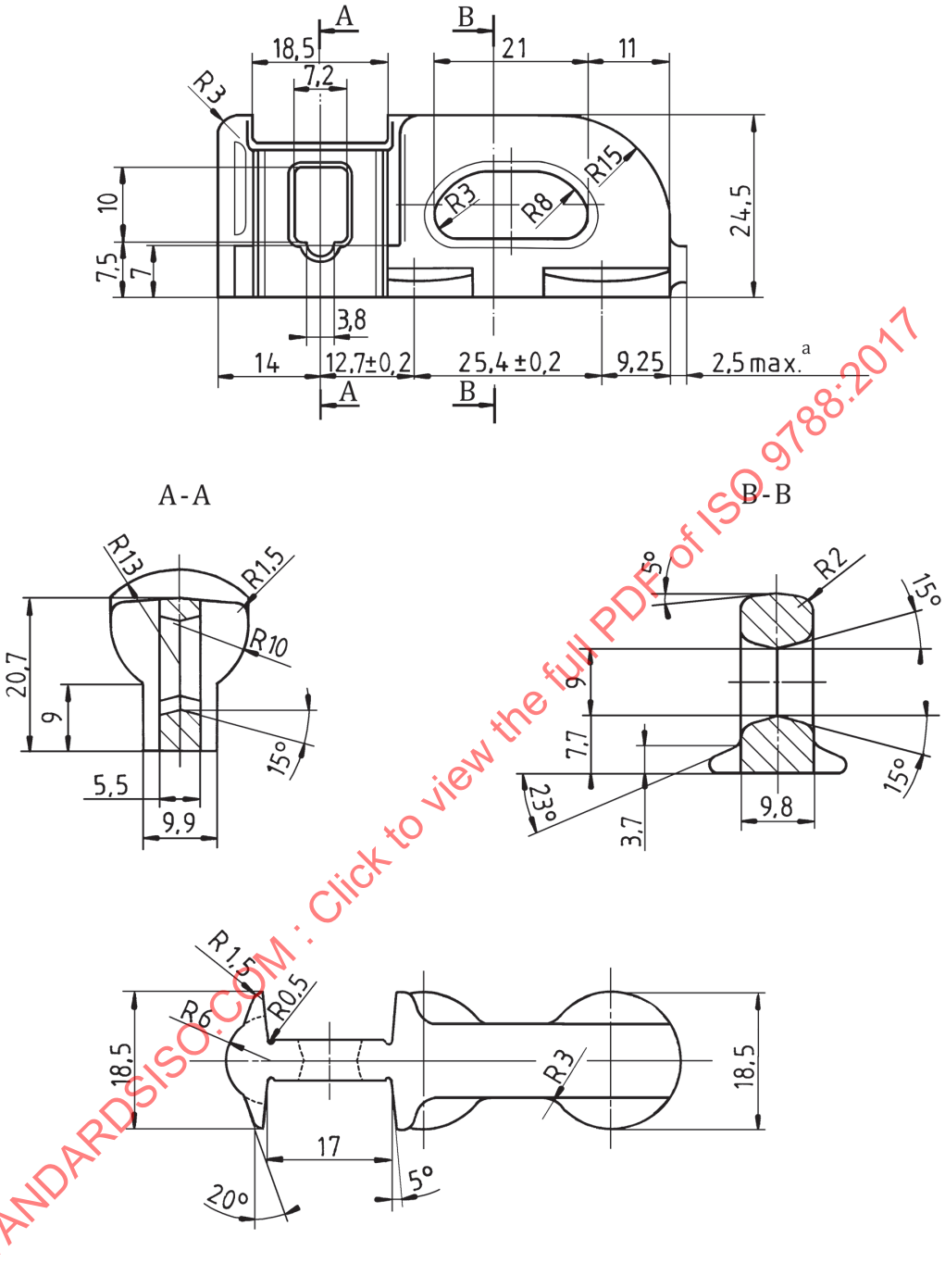
3.4
track
<pallet> track conforming to ISO 7166, which is part of a unit load device and designed to take tie-down fittings

4 Requirements

4.1 Configuration

4.1.1 The configuration geometry shall comply with Figures 1 to 3. Only maximum envelope dimensions and those affecting interchangeability are imposed. The minimum dimensions are limited by the strength requirements.

Dimensions in millimetres

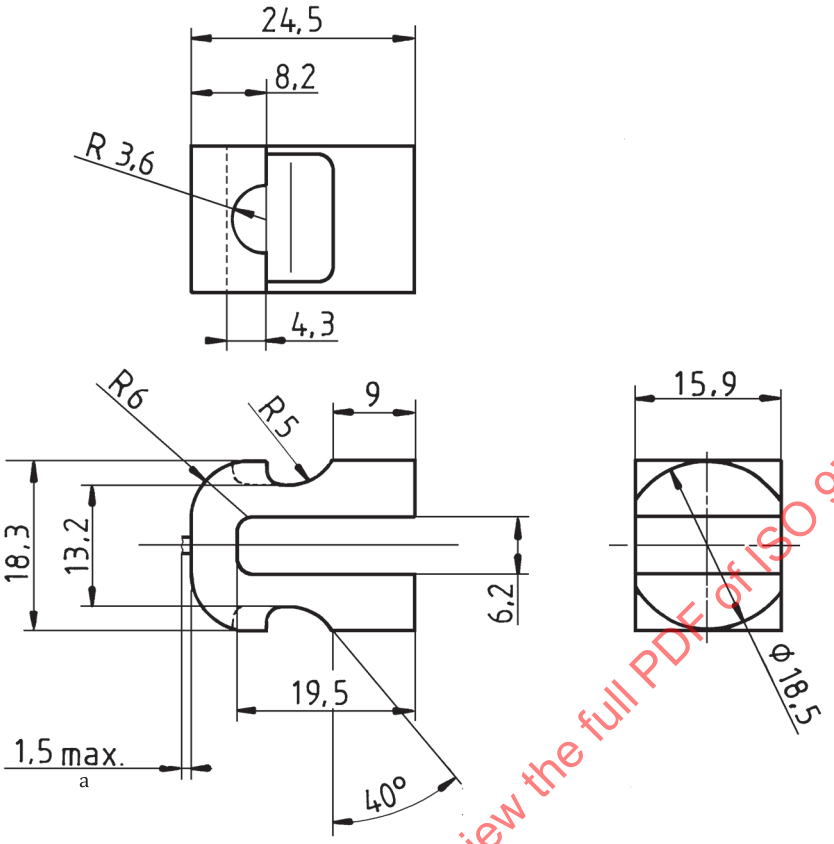


Tolerances: ±0,3 unless otherwise stated
The edges shall be broken (R 0,5)
Draft angle: 2° ± 0,5°
Radii: 1,5 unless otherwise stated

[a] Ingate area.

Figure 1 — Double stud body

Dimensions in millimetres

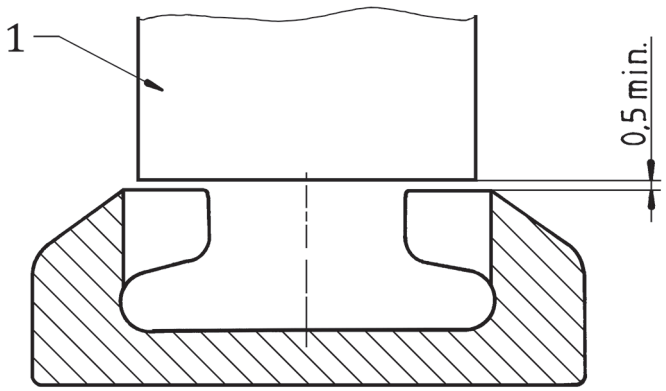


Tolerances: ±0,3 unless otherwise stated
The edges shall be broken (R 0,5)
Draft angle: 2° ± 0,5°
Radii: 1,5 unless otherwise stated

[a] Ingate area.

Figure 2 — Plunger

Dimensions in millimetres



Key

1 plunger (up position)

Figure 3 — Clearance of plunger in rail or track

4.1.2 The tie-down fitting may consist of only body and plunger, e.g. when intended to be sewn on a cargo restraint strap (see item D3 in ISO 16049-1:2013, Figure 1), or it may be equipped with a ring in order to receive the hook of a strap or sling.

4.1.3 The ring, or equivalent attachment device, shall be made of steel wire, stainless or otherwise protected against corrosion, and shall be welded. No open ring or attachment is allowable.

4.1.4 Since in various circumstances the fitting shall be installed in a confined space, it is recommended that the ring shape be not circular, but oblong in order to reduce its overall width and thereby minimize the risks of interference with aircraft restraint hardware at pallet loading. See examples in Figure 4.

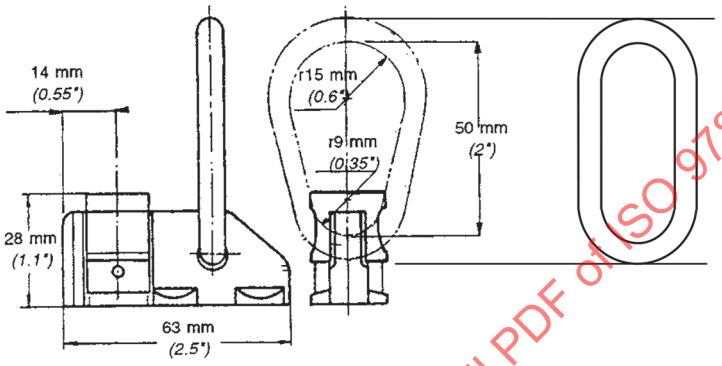


Figure 4 — Examples of ring shapes

4.2 Materials

4.2.1 Body

The body shall be made of forged steel, malleable cast iron of grade P70-02 (see ISO 5922), or equivalent tensile strength material.

Minor surface irregularities, for example small sand and slaggy patches, small cold shuts, barnacles, shrinkages, concentrations of small voids, remainders of moulding material, discontinuities and burrs, are generally acceptable in non-critical areas. Any marginal cases shall be arbitrated by tensile tests.

Physical and/or pictorial reference samples and descriptions may be used for comparison to quantify those features difficult to express numerically.

4.2.2 Cast plunger

The plunger shall be made of malleable cast iron of grade B35-10 (see ISO 5922), or equivalent shear strength material.

4.2.3 Other components

Other components may be made of any suitable material meeting the geometrical and strength requirements.

4.2.4 Surface treatment

Components made of non-corrosion resistant material shall be treated to have a performance equal to or better than that provided by a zinc chromate layer of 12 µm minimum thickness.

Zinc chromate (CAS N° 13530–65–9, European EC List N° 236–878–9) is classified under European (REACH Regulation) and US (Toxic Substances Control Act) regulations as a potential carcinogen and

to be avoided. Use of other surface treatments providing an equivalent level of corrosion protection is recommended.

4.3 Load requirements

Double stud fitting assemblies complying with this document are designed to resist a minimum breaking strength of 22 250 N (5 000 lbf) in any direction.

Where the fitting's body is made of malleable cast iron, a casting factor approved by the controlling airworthiness authority, as appropriate according to the quality control procedures and non-destructive inspections applied, shall be included in order to determine the breaking strength.

The value of the casting factor varies between 1 and 2 according to the quality control procedure and non-destructive inspections applied, and shall meet the applicable civil aviation requirements. Examples of these general requirements are:

— in the USA: 14 CFR Part 25 § 25.621 (d);

— in the EU: EASA Certification Specification CS-25 § 25.621.

5 Certification and testing

5.1 Certification

For certification, the load specified in 4.3 shall be applied as shown in Figure 5, in separate tests in each of the directions P1, P2, P3 and P4.

A statement of compliance with this document or a test report shall be provided.

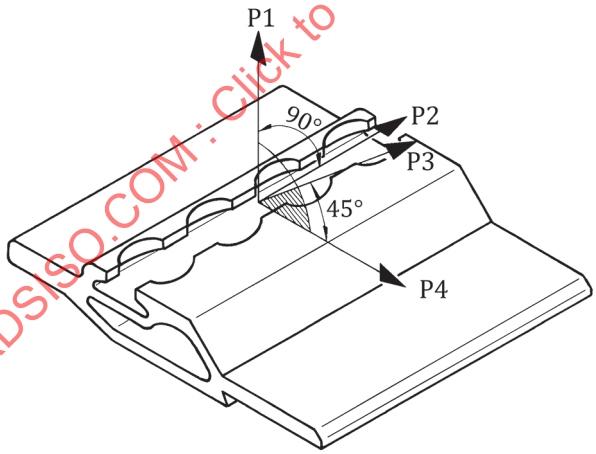


Figure 5 — Load directions for qualification testing

5.2 Testing

5.2.1 General

The components shall be tested by the manufacturer.

The components shall be combined into production batches and samples shall be selected at random for testing.

5.2.2 Sampling — Cast components

Sampling for cast components shall be carried out in accordance with ISO 2859-1, for inspection by attributes, and ISO 3951, for inspection by variables, taking into account the regulatory casting factors requirements (see 4.3).

5.2.3 Load test

The complete double stud assembly, including any ring or other attachment device permanently affixed to it, shall be installed in a rail or track meeting the dimensional and tolerance requirements specified in ISO 7166, and shall be tested mechanically in accordance with ISO 5922 and ISO 6892.

A progressively increasing pulling strength shall be applied to the assembly in the load direction concerned with respect to rail/track references. The pulling strength shall be increased until the first fitting component fails. The breaking strength shall be recorded for each test. A new specimen shall be used for each test.

No component of the complete fitting assembly shall fail before the minimum required load capacity specified in 4.3, including casting factor where applicable, is attained.

Permanent deformation of components is acceptable, as long as:

a) it does not result in either rupture or complete disengagement of the fitting from the rail or track;

b) it does not occur up to the limit load (2/3 of the minimum required ultimate load capacity).

5.2.4 Retests

In case of failure, retests shall be carried out in accordance with the following.

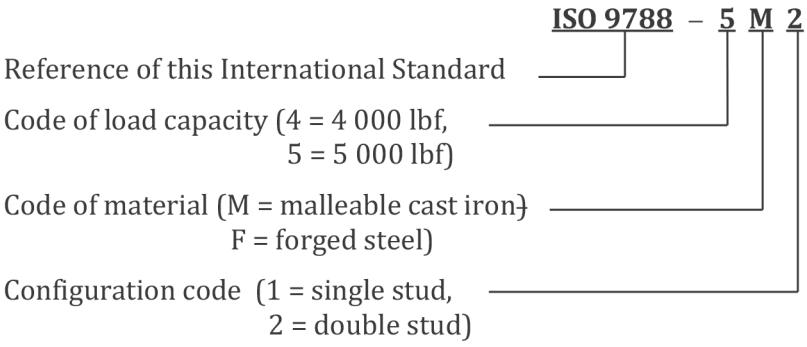
The test specimens for the retests shall be taken from the same test units as the first test samples.

For any test showing unsatisfactory results, two re-tests shall be carried out. Both results shall meet the required characteristics.

When a series of similar tests has to be performed, the terms “test” and “test specimen” imply the total test or test sample series.

6 Designation

The designation of a double stud fitting assembly complying with this document shall be as follows:



7 Identification

In addition to any manufacturer’s marking (optional), the double stud fitting assembly shall carry the designation code specified in Clause 6.

The position and method of marking are left to the manufacturer’s discretion.

Where the fitting entirely meets the requirements of this document, the marked identification may be abridged to "ISO 9788" (no "- 5F2" or "- 5M2" alphanumeric code), if space available for the marking method used only so allows.

8 Quality control

8.1 Design and production

8.1.1 Continuous quality control is essential in obtaining safe and dependable tie-down fittings: seemingly minor or random changes in materials or fabrication processes have been known to significantly affect final product dependability and performance.

8.1.2 Design, testing and production of tie-down fittings complying with this document should be performed within the framework of design and manufacturing quality assurance systems as specified for airworthiness by the general civil aviation requirements.

Whenever the manufacturer operates under such a authority recognized quality assurance system, the test sampling rates specified in 8.1.4 may vary, but shall provide at least the same level of confidence.

8.1.3 For fitting initial type testing, at least 12 specimens randomly selected from a batch produced according to the intended series production locations and methods shall constitute one sample, and be tested in accordance with Clause 5 with at least three tests in each of the four specified directions. See 5.2.4 for required retesting in the event of a failure to meet the specified minimum breaking strength.

8.1.4 For continuous production control, samples shall consist of a set of four specimens randomly selected from the current production batch, and be tested prior to delivery, in accordance with Clause 5 in each of the four specified directions. The recommended minimum number of such samples to be tested is given in Table 1.

Table 1 — Recommended minimum number of samples

Number of units	Number of samples
up to 10 000	1
10 000 to 50 000	2
50 000 to 100 000	3
100 000 to 200 000	4
over 200 000	add 1 every 100 000

8.1.5 In addition, for fittings with cast iron bodies, sampling shall be carried out in accordance with ISO 2859-1 for visual inspection, and ISO 3951 for performance testing. It is recommended that a visual inspection of bodies for possible defects be systematically performed before assembly of the fittings.

NOTE See 4.3 for relationship between 14 CFR Part 25 / CS-25 § 25.621 (d) casting factors and non-destructive inspection programs.

8.2 Operation

8.2.1 The fittings shall be used for cargo tie-down, either to pallet tracks or to floor rail or other aircraft structural attachment points, in accordance with the general tie-down guidelines specified in ISO 16049-2.

8.2.2 The air carrier (operator) shall be responsible for ensuring procurement and exclusive use of tie-down fittings complying with this document.