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Air cargo equipment — Restraint straps —

Part 1: Design criteria and testing methods

Équipement pour le fret aérien — Sangles d'arrimage —

Partie 1: Critères de conception et méthodes d'essai

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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.

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).

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For an explanation of 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 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 third edition cancels and replaces the second edition (ISO 16049-1:2013), which has been technically revised. The main changes compared to the previous edition are as follows:

— in Figure 1, deletion of items D5 and D6, required by TSO/ETSO-C172a, and amendment of item D2;

— in 4.4, updating of flammability requirement to the latest amended Regulations.

A list of all parts in the ISO 16049 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document specifies the design criteria and testing methods applicable to air cargo restraint straps to be used for tie-down of unitized or non-unitized cargo on board civil transport aircraft.

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 straps. Deviation from recommended criteria should only occur after careful consideration, extensive testing, and thorough service evaluation have shown alternate methods to be satisfactory.

The requirements of this document are expressed in the applicable SI units, with approximate inch-pound units conversion between brackets for convenience in those countries using that system.

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Air cargo equipment — Restraint straps —

Part 1: Design criteria and testing methods

1 Scope

This document specifies the design criteria and testing methods adequate to guarantee the ultimate load and operational dependability of cargo restraint strap assemblies with a typical 22 250 N (5 000 lbf) rated ultimate tension load capability, as used by the airline industry. These restraint straps are used in civil transport aircraft during flight for:

a) cargo loaded and tied down onto airworthiness approved air cargo pallets, themselves restrained into aircraft lower deck, main deck or upper deck cargo systems and meeting the requirements of ISO 8097 (NAS 3610) or ISO 21100, or

b) non unitized individual pieces of cargo, or pieces of cargo placed onto an unrestrained ("floating") pallet into either lower deck, main deck or upper deck containerized cargo compartments of an aircraft,

c) the same restraint strap assemblies can also be used in other applications such as:

   1) non containerized (bulk loaded) baggage and cargo compartments;

   2) to ensure cargo restraint inside an airworthiness approved air cargo container.

NOTE The ultimate loads allowable on the attachment points available in most aircraft bulk compartments and inside many air cargo containers are significantly lower than 22 250 N (5 000 lbf). This results in the restraint arrangements ultimate load capability being dictated by the weakest element, i.e. the attachment points: typical 22 250 N ultimate load restraint straps will therefore be in excess of the requirements for such applications.

Compliance with this document provides one means of cargo restraint straps airworthiness approval by Civil Aviation Authorities under TSO/ETSO-C172a, in addition to the other requirements therein.

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 4117, *Air and air/land cargo pallets — Specification and testing*

ISO 4171, *Air cargo equipment — Interline pallets*

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

ISO 8097:2001[1)], *Aircraft — Minimum airworthiness requirements and test conditions for certified air cargo unit load devices*

ISO/TR 8647, *Environmental degradation of textiles used in air cargo restraint equipment*

ISO 9788, *Air cargo — Double stud tie-down fittings — Design and testing requirements*

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

1) Endorsement of NAS 3610 revision 10, TSO/ETSO/CTSO/JTSO-C90c.

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ISO 21100, *Air cargo unit load devices — Performance requirements and testing parameters*

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 https://www.iso.org/obp

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

3.1
restraint strap assembly
elementary *tie-down* (3.2) unit consisting of *flat woven textile webbing* (3.3) (one *fixed length* (3.8.1) end and one adjustable end), one *tensioning device* (3.4) and two *end fittings* (3.6), used for restraint of cargo on board civil transport aircraft

3.2
tie-down
fact of restraining cargo movements in relation to an aircraft's structure, throughout the range of relative accelerations resulting from the allowable flight envelope, by means of an appropriate use of a number of elementary tie-down devices against each direction of restraint

3.3
flat woven textile webbing
conventional or shuttle-less woven narrow fabric made of continuous textile fibres, generally with multiple plies, and the prime function of which is load bearing

Note 1 to entry: A characteristic of webbing is its tight woven fabric selvedge.

3.4
tensioning device
mechanical device inducing a tensile force in the load restraint assembly

EXAMPLE Ratchets, winches, over-centre buckles, see examples in Figure 1, items C1 and C6.

3.5
tension retaining device
metallic part connecting the webbing by clamping action and retaining the force induced in the *tensioning device* (3.4) by hand

EXAMPLE Cam buckles, sliding bar buckles, see example in Figure 1, item F.

3.6
end fitting
metallic device connecting the webbing or the *tensioning device* (3.4) to the attachment point on the aircraft structure, the pallet edge rail or the load

Note 1 to entry: See examples in Figure 1, items D1 to D4.

Note 2 to entry: The end fittings most commonly used on air cargo restraint straps include:

a) retainer equipped flat hook (see example in Figure 1, item D1);

b) air cargo *tie-down* (3.2) double stud (male) fitting conforming to ISO 9788, connected directly (sewn to the webbing, see example in Figure 1, item D3) or by an intermediate ring;

c) piece of aircraft restraint (female) rail conforming to ISO 7166.

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3.7
tension force indicator
device that indicates the tensile force applied to the *restraint strap assembly* (3.1) by means of the *tensioning device* (3.4) and movement of the load acting on the load restraint device

3.8
length of restraint strap assembly

3.8.1
fixed length
l_{GF}
length of a fixed end, measured from the force bearing point of the *end fitting* (3.6) to the outer turning radius of the connection of the webbing to the *tensioning device* (3.4)

Note 1 to entry: See Figure 2.

Note 2 to entry: This length can be zero, i.e. the end fitting directly attached to the tensioning device.

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