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Air cargo — Restraint slings —

Part 2: Utilization guidelines and lashing calculations

Fret aérien — Elingues d'arrimage —

Partie 2: Guide d'utilisation et calculs d'arrimage

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CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	2
3 Terms and definitions	3
4 General requirements	4
5 Specific requirements	5
6 Rejection criteria	7
7 Inspection	7
8 Operator's responsibilities	8
Bibliography	9

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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 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. (standards.iteh.ai)

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

ISO 20291-2 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

This is the first edition of this document.

ISO 20291 consists of the following parts, under the general title *Air cargo — Restraint slings*:

- *Part 1: Design and testing*
- *Part 2: Utilization guidelines and lashing calculations*

Introduction

This International Standard, constituting part 2 of International Standard ISO 20291, *Air cargo – Restraint slings*, specifies utilization guidelines and the principles to be used in tie-down/lashing strength calculations when using air cargo restraint slings on board civil transport aircraft.

Throughout this International Standard, 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 slings utilization. Deviation from recommended criteria should only occur after careful consideration, extensive testing, and thorough service evaluation have shown alternate methods to be satisfactory.

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Air cargo — Restraint slings —

Part 2: Utilization guidelines and lashing calculations

1 Scope

1.1 This International Standard aims at providing general utilization guidelines and calculation methods adequate to guarantee the effectiveness and ultimate strength of tie-down / lashing arrangements performed to restrain cargo on board civil transport aircraft during flight:

- a) cargo loaded and tied down onto airworthiness approved air cargo pallets, themselves restrained into aircraft lower deck or main deck or upper deck cargo systems meeting the restraint requirements of air cargo pallets approved in accordance with ISO 8097 (NAS3610) or ISO 21100, or
- b) additional tie-down on aircraft structure when necessitated by pallet maximum gross mass or center of gravity limits, or
- c) 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,

when using for this purpose restraint slings (wire rope cables) specified in Part 1 of this International Standard.

ISO/DIS 20291-2

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1.2 Restraint slings can also be used for permanent or semi-permanent attachment of a special purpose device, such as aircraft engine transport stand (see ISO 11241), horse stall (see ISO 9469), automobile transport device (see ISO 8268) or other, whether or not airworthiness approved, onto an aircraft pallet.

1.3 This International Standard applies to cargo tie-down/lashing arrangements using exclusively air cargo restraint slings conforming to International Standard ISO 20291-1, *Air cargo – Restraint slings — Part 1: Design and testing requirements*.

NOTE 1 Where tie-down is performed onto aircraft structure as per [1.1](#) (b) or (c), additional restrictions may be stated in the aircraft's Authority approved Weight and Balance Manual, and shall be complied with.

NOTE 2 The use of chains or other rigid devices for tie-down onto civil transport aircraft floor tracks is not part of the scope of this International Standard, since not recommended due to the possibility of generating excessive stresses in the aircraft structure, and allowable only where explicitly approved in aircraft's Authority approved Weight and Balance Manual.

1.4 Sling assemblies made of steel wire rope are intended to be used in lieu of cargo restraint straps meeting the requirements of ISO 16049-1 where straps elongation under tension appears unadvisable for a given tie-down arrangement. Typical examples of loads where substitution of slings for straps is advisable are: heavy vehicles, aircraft engine stands, helicopters, machinery, heavy loads close to the maximum aircraft loading envelope etc.

1.5 This International Standard aims at providing industry recognized means of complying with Airworthiness Authorities general regulations applicable to load securing on board civil transport aircraft (see 14 CFR Part 25 and EASA CS-25, CCAR-25 or Japanese Airworthiness Standard Part 3), and aircraft manufacturers Authority approved Weight and Balance Manuals for each aircraft type as specified therein.

1.6 On the date of publication of this International Standard, no TSO / CTSO / ETSO / JTSO airworthiness approval procedure by Civil Aviation Authorities is applicable to restraint slings. Their use for cargo restraint, however, remains under the requirements of the Authority approved aircraft Weight and Balance Manual, which shall be strictly complied with and always take precedence in the event of a difference with this International Standard.

1.7 The wire rope slings in this International Standard are intended exclusively for restraint purposes on board aircraft, and not to be allowed for use as lifting slings for handling nor any other purpose.

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

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

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

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

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

ISO 16049-2, *Air cargo equipment — Restraint straps — Part 2: Utilization guidelines and lashing calculations*

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

AC 120-59, ²⁾ Air Carriers Internal Evaluation Programs

CAAC CCAR-25, ³⁾ Airworthiness Standards — Transport Category Airplanes

CS-25, ⁴⁾ Certification Specifications for Large Aeroplanes

EU-OPS 1.035, Quality system ⁴⁾

JAS Part 3 (Civil Aeronautics Law Article 10 § 4) ⁵⁾

14PART CFR, 25, Airworthiness Standards: Transport Category Airplanes ²⁾

TSO/ETSO-C-90d, Cargo Pallets, Nets and Containers ⁴⁾

1) Endorsement of NAS 3610 revision 10, TSO/ETSO/CTSO/JTSO C-90c.

2) 14 CFR Part 25 constitutes the U.S.A. government transport aircraft airworthiness approval Standards, and can be obtained from: U.S. Government Printing Office, Mail Stop SSOP, Washington DC 20402-9328, or at www.gpoaccess.gov/ec.fr.

3) CAAC CCAR-25 constitutes the Chinese government transport aircraft airworthiness approval Standards, and can be obtained from the Civil Aviation Authority of China (CAAC).

4) EASA CS-25 constitutes the European governments transport aircraft airworthiness approval Standards, and can be obtained from: European Aviation Safety Agency (EASA), Otto Platz 1, Postfach 101253, D-50452 Cologne, Germany, or at www.easa.europa.eu.

5) The Japanese Airworthiness Standard Part 3 (ISBN 4-89279-661-1) constitutes the Japanese government transport aircraft airworthiness approval Regulations, and can be obtained from the Civil Aviation Bureau (CAB) of the Ministry of Land, Infrastructure, Tourism and Transport, Tokyo, Japan, or its web site at <http://www.mlit.go.jp/en>.

3 Terms and definitions

For the purpose of this document, the 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

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

3.2

lashing

equivalent to "tie-down"

3.3

tie-down arrangement

geometric layout of an assembly of elementary tie-down devices affixed and tensioned around a piece of cargo in order to ensure its tie-down against each direction of restraint

3.4

flight envelope

for a given aircraft type or sub-type, the set of allowable values for accelerations which may be encountered during flight in the various directions relative to the aircraft's structure, as determined during the aircraft certification flight testing and certified by the Airworthiness Authority within the aircraft's type certificate

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3.5

limit load (LL)

the maximum load to be expected in service as a result of the certified allowable flight envelope of the aircraft.

Note 1 to entry: See 14 CFR Part 25 and CS-25, paragraph 25.301(a)^{1) 2)}. It is two thirds of the ultimate load (see hereafter).

3.6

ultimate load (UL)

the limit load multiplied by a safety factor of 1,5

Note 1 to entry: See 14 CFR Part 25 and CS-25, paragraph 25.303^{1) 2)}. It is used for calculation of cargo tie-down arrangements, based on the ultimate load factors defined in the Airworthiness Authority approved Weight and Balance Manual, in each direction of restraint, throughout the certified flight envelope of the aircraft type.

3.7

fore and aft

the directions of restraint, relative to the aircraft structure, determined parallel to the aircraft centreline towards the direction of flight, or opposed to it

3.8

sides

the directions of restraint, relative to the aircraft structure, determined perpendicular to the aircraft centreline and parallel to its floor, lefthand or righthand

3.9

upward

the upward direction relative to the aircraft structure