INTERNATIONAL STANDARD

ISO 10327

Second edition
2014-05-01

Air cargo — Main deck containers — Design and testing

Fret aérien — Conteneurs de pont principal — Conception et essais

Reference number
ISO 10327:2014(E)

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Published in Switzerland

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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).

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 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 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

This second edition cancels and replaces the first edition (ISO 10327:1995), which has been technically revised.

Introduction

The basic functions of main deck air cargo containers are

a) the unitization of cargo during ground handling and transportation, and

b) the restraint of their contents against accelerations encountered in flight.

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, economical, and usable air transport containers. 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.

The requirements of this International Standard are expressed in the applicable SI units, with approximate inch-pound units conversion between brackets for convenience in those countries using that system. Where it is deemed necessary to use exact values, the SI unit ones are to be used. Per exception, the exact figures are those in inches for container base overall outside dimensions.

Air cargo — Main deck containers — Design and testing

1 Scope

1.1 This International Standard covers the minimum design and operational testing requirements for general purpose, base-restrained containers exclusively intended for the main or upper deck cargo compartments of main line civil transport aircraft, capable of being used by either airlines or shippers and requiring an airworthiness authority approval (certification).

NOTE 1 The metric equivalents for dimensions have been rounded up or down to the nearest millimetre, except in critical dimensions. Masses have been rounded up to the nearest kilogram and forces have been rounded up to the nearest 10 N.

NOTE 2 Though nothing technically prevents their being used for baggage, main deck containers are generally used only for carriage of freight.

1.2 This International Standard does not cover the performance requirements and ultimate load testing parameters for airworthiness authorities approval (certification), which are covered in ISO 21100 or, for units approved prior to 2012, ISO 8097:2001. The design and operational testing requirements of this International Standard are additional to the performance and certification testing requirements of these International Standards.

1.3 This International Standard does not cover containers with an overall height of 1 625 mm (64 in) or less, that can be loaded on the lower deck compartments of main line civil transport aircraft, which are specified in ISO 6517, nor air-surface main deck containers, which are specified in ISO 4128 and ISO 8323.

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 4116:1986, *Air cargo equipment — Ground equipment requirements for compatibility with aircraft unit load devices*

ISO 4128:1985, *Aircraft — Air mode modular containers*

ISO 4171:1993, *Air cargo equipment — Interline pallets*

ISO 6517:1992, *Air cargo equipment — Base-restrained certified containers exclusively for the lower deck of high-capacity aircraft*

ISO 7137:1995, *Aircraft — Environmental conditions and test procedures for airborne equipment*

ISO 7166:1985, *Aircraft — Rail and stud configuration for passenger equipment and cargo restraint*

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

ISO 8323:1985, *Freight containers — Air/surface (intermodal) general purpose containers — Specification and tests*

ISO/TR 8647:1990, *Environmental degradation of textiles used in air cargo restraint equipment*

ISO 10046:1996, *Aircraft — Methodology of calculating cargo compartment volumes*

ISO 11242:1996, *Aircraft — Pressure equalization requirements for cargo containers*

ISO/PAS 21100:2011, *Air cargo unit load devices — Performance requirements and test parameters*

CAAC CCAR-21, *Certification Procedures for Products and Parts*[1)]

CAAC CCAR-25, *Airworthiness Standards —Transport Category Airplanes*[1)]

CAAC CCAR-121, *Air Carriers Certification and Operations system*[1)]

CAAC Chinese Technical Standard Order CTSO C90d — *Cargo pallets, nets and containers*[1)]

EASA Part 21, *Certification of aircraft and related products, parts and appliances, and of design and production organisations* (Commission Regulation (EU) No. 748/2012*)*[2)]

EASA CS-25, *Certification Specifications for Large Aeroplanes*[2)]

EASA, *(European Aviation Safety Agency) EU-OPS 1035 — Quality system*[2)]

EASA, *European Technical Standard Order ETSO C90d — Cargo pallets, nets and containers (Unit Load Devices)*[2)]

Japanese Airworthiness Standard Part 3 (Civil Aeronautics Law Article 10 § 4)[3)]

U.S. Code of Federal Regulations Title 14 CFR Part 21, *Certification Procedures for Products and Parts*[4)]

U.S. Code of Federal Regulations Title 14 Part 25, *Airworthiness Standards: Transport Category Airplanes*[4)]

U.S. Code of Federal Regulations Title 14 CFR Part 121, *Air carriers certification and operation*[4)]

U.S. Federal Aviation Administration Advisory Circular AC 120-59, *Air carriers internal evaluation programs*[4)]

U.S. FAA Technical Standard Order TSO C90d, *Cargo Pallets, Nets and Containers*[4)]

EUROCAE ED-14G, *Environmental conditions and test procedures for airborne equipment*[5)]

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1) Civil Aviation Administration of China (CAAC) listed documents constitute the Chinese government transport aircraft airworthiness approval Regulations.

2) The listed EASA documents constitute the European transport aircraft airworthiness approval Regulations, and can be obtained from the European Aviation Safety Agency (EASA), Otto Platz 1, Postfach 101253, D-50452 Cologne, Germany, or its web site at www.easa.europa.eu.int.

3) 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 and Transport, Tokyo, Japan, or its website at www.mlit.go.jp/en.

4) The listed FAA documents constitute the U.S.A. government transport aircraft airworthiness approval Regulations, and can be obtained from the U.S. Government Printing Office, Mail Stop SSOP, Washington DC 20402-9328, or its website at www.gpoaccess.gov/ecfr.

5) EUROCAE ED-14G can be obtained from the European Organisation for Civil Aviation Equipment, 102 rue Etienne Dolet, 92240 Malakoff, France, or its website at www.eurocae.eu.

3 Container sizes and identification

3.1 This International Standard specifies the basic requirements for design and operational testing of containers that have the nominal base sizes shown in Table 1.

Table 1 — Sizes

Size code of base in accordance with ISO/PAS 21100	Container base size	
	mm	in
A	2 235 × 3 175	88 × 125
B	2 235 × 2 743	88 × 108
M	2 438 × 3 175	96 × 125

3.2 Maximum container contours shall be determined in accordance with ISO 10046 for the aircraft type(s) where they are intended to be carried. The resulting overall maximum dimensions are shown in Figures 4 to 6 for some of the mostly used container contours able to fit several aircraft types. Many other contours are allowed and present a large variety to adapt to specific aircraft types or aircraft configurations. The maximum contours given for examples only in Figures 4 to 6 are:

— contour A: overall height 2 438 mm (96 in), width 2 337 mm (92 in) (see Figure 4);

— contour D: overall height 2 997 mm (118 in), width 2 438 mm (96 in) (see Figure 5);

— contour Y: overall height 2 083 mm (82 in), width 3 175 mm (125 in) (see Figure 6).

Base size A and M containers with an overall height of 1 625 mm (64 in) or less of contours F, K, P, or U can be loaded on the lower deck and, regardless of their certification status, shall comply with the relevant requirements of ISO 6517 in addition to those of the present International Standard.

3.3 Container types complying with this International Standard are identified according to their ISO/PAS 21100 configuration by a type code composed of three letters[6]:

a) the first letter A denoting a certified aircraft container complying with the performance requirements of ISO/PAS 21100 type 2 or, for units approved prior to 2012, ISO 8097 type II;

b) the second letter denoting the base size, in accordance with ISO/PAS 21100;

c) the third letter denoting the contour determined, in accordance with ISO 10046 (see NOTE).

The identification code shall be prominently marked on two opposite sides of the container (see Clause 6).

EXAMPLE A certified aircraft container (A) of base size 3 175 mm × 2 438 mm (125 in × 96 in) (size M) and of overall height 2 438 mm (96 in) (contour A) shall be designated as AMA.

NOTE The containers type code's third (contour) digit is subject to change to accommodate evolving airline needs. Check the latest yearly edition of IATA Unit Load Devices Regulations Standard Specifications 40/1 and 50/0 Appendix E (see Reference [6] and Reference [7]) for any code changes.

6) The type code is, by industry consensus, under custody of and assigned by International Air Transport Association (IATA), ULD Registrar, 800 Place Victoria, P.O. Box 113, Montréal, Québec H4Z 1M1, Canada, web site www.iata.org. See IATA Standard Specification 40/1 (Reference [6] in Bibliography).

4 Requirements

4.1 General

4.1.1 The container shall consist of a complete structural enclosure meeting ISO/PAS 21100 type 2 or ISO 8097 type II performance requirements, and all the requirements of the present clause.

4.1.2 The container manufacturer shall provide the user instructions for the maintenance and repair of the container necessary to maintain its continuing airworthiness qualification (see 8.2).

4.1.3 The container manufacturer shall provide the user instructions for installation, operation, and servicing of the container (see 8.2), which shall comply with load distribution and centre of gravity conditions of ISO/PAS 21100 and refer to methods to achieve the centre of gravity location control requirements.

4.1.4 The design, materials, and construction of the container shall be of aircraft quality. Maintainability and reparability shall be a factor in the design to ensure the minimum need for maintenance, and shall ensure that such maintenance and repair can be accomplished with ease and at minimum cost.

4.1.5 The structure shall be designed to make the maximum internal cross-section available for loading cargo, within the limits of structural design and the space required for latching.

4.1.6 The materials and design shall be selected to provide for an empty (tare) weight as low as possible, consistent with maintainability objectives (see 4.1.4).

NOTE A direct environmental impact of containers use is that their weight results in additional fuel burn by aircraft. Therefore, apart from economic advantages, reducing containers weight as much as possible to still meet performance objectives is a highly effective environmental contribution and shall be pursued.

4.2 Airworthiness approval

4.2.1 The mostly used method for this purpose is applying for a TSO/CTSO/ETSO/JTSO C90d Technical Standard Order authorization in reference to ISO/PAS 21100 (containers certified prior to 2012 were approved under TSO C90c in reference to ISO 8097). In special instances, other approval methods can be used. Airworthiness approval procedures and requirements shall, in any event, be in accordance with CCAR/EASA/14 CFR Part 21 Regulations.

4.3 Materials

4.3.1 The materials and processes selected shall provide for maximum service life by giving consideration to the extremely hard usage to which the container will be subjected. All metal parts shall be suitably protected against corrosion. All non-metallic liquid absorbent materials shall be sealed or treated to prevent liquid absorption. Materials shall be fire resistant per 4.3.2 and shall withstand environmental degradation (see 4.7.4).

4.3.2 All container and components materials shall meet the requirements of CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraphs (a)(1)(v) and (a)(2)(iv), i.e. shall not have a burn rate greater than 100 mm (4 in) per minute when flame is tested horizontally in accordance with Appendix F, Part I paragraphs (b)(5), (b)(2), (b)(3), and (b)(8). The test specified therein shall be performed on each material and results recorded. In accordance with TSO requirements, the measured burn rate shall be marked on the container (see 6.1).

4.4 Construction

4.4.1 Base

4.4.1.1 The base shall be enclosed on all four sides by an aluminium extrusion. The corner's integrity with its edges shall be a prime concern. The corner radius shall be 51 mm (2 in). The base shall not contain rough or sharp edges potentially dangerous to personnel, cargo, airplane, or terminal handling equipment. The construction of the base shall be designed for strength and durability, to withstand harsh treatment in service. The base shall be structurally attached to, and an integral part of, the container assembly. The base shall be removable with hand tools and shall be interchangeable.

The base shall comply with the performance criteria specified in ISO 4171.

4.4.1.2 The base shall comply with the indentation performance requirements of 4.5.1 and 4.5.2, and shall have a minimum area load capacity of 10 kPa (209 lb/ft^2). This load shall be applicable to any area representing at least 10 percent (10 %) of the total base area, and the base shall not exhibit any significant deformation of this area while the container is supported by the aircraft restraint system.

4.4.1.3 The base edges shall conform with the dimensional requirements shown in Figure 7. The recess over the base edge shall be maintained continuous all around the base periphery.

4.4.1.4 The minimum core stiffness of the base shall be 429 N·m^2/m (3 800 lbf.in^2/in) width/length of core. Its stiffness shall aim at not exceeding a maximum area load of 10 kPa (209 lb/ft^2) on the underlying conveying system.

4.4.2 Body

4.4.2.1 The container's body shall not contain rough or sharp edges potentially dangerous to personnel, cargo, airplane, or terminal handling equipment. Any attachments between the base and the panels shall be designed to have a minimum intrusion into the door area, and none in the continuous recess all around the base periphery (see Figure 7). Gussets are allowed at the junctions of panels and base or top to allow the transfer of bending moments. The size of all gussets, particularly where in the door opening, shall be the minimum consistent with structural requirements.

4.4.2.2 The top of the container shall be self-draining. The top surface shall be designed to be easily cleared of snow.

4.4.2.3 To facilitate repair and assembly, component parts shall be readily removable with hand tools and shall be replaceable by interchange with new or repaired ones.

4.4.2.4 In addition to those on the door (see 4.4.3.3), two non-protruding handles or straps shall be located on each side panel for manual handling of the container by one person. Each handle shall provide 150 mm (6 in) wide by 75 mm (3 in) deep space for gripping with a gloved hand, and shall have a minimum capacity of 445 daN (1 000 lbf) pull in any direction.

4.4.2.5 The contour shall conform with the maximum allowable ULD contour. All dimensions shown are external maximum dimensions and provide minimum acceptable airplane clearance (see 3.2 and Figures 4 to 6). Any deviation or tolerance shall be to the low side to prevent reduction of clearance.

NOTE The maximum allowable ULD contours are shown in the IATA ULD Regulations Standard Specification 50/0, Appendix E (see Reference [7]).

4.4.2.6 One or more placard holders shall be fitted to the body to accommodate a destination and contents placard of standard size A5 [210 mm × 148 mm (8,1/4 in × 5,7/8 in)].

4.4.2.1 Cargo restraint

Securing points shall be provided around the interior walls, spaced approximately 500 mm (approximately 20 in) apart, at the following points:

— near the base (not required if equivalent provisions are available at the base);

— at approximately half height.

Each of these points shall be capable of reacting an omni-directional load of 2 225 daN (5 000 Ibf) near or at the base, and 890 daN (2 000 Ibf) at half height. These points shall comply with ISO 7166.

4.4.3 Door

4.4.3.1 The door should be designed to make a maximum possible internal cross-section available for loading and shall ensure no interference of the door, latches, and/or hardware occurs with ground equipment in accordance with ISO 4116 (stops and guides 102 mm (4 in) high).

4.4.3.2 It shall be possible for one person to open or close the door and any associated net or hardware in no more than one minute.

The door shall be capable of being opened with a 102 mm (4 in) high obstacle adjacent to the base.

Where hinges are used, the design shall not allow fingers to be trapped.

4.4.3.3 Handles, straps, or hand-holds shall be provided on each door for handling the door and for manual movement of the container. These devices shall be able to withstand a 450 daN (1 000 Ibf) pull in any direction, and shall provide 150 mm (6 in) wide by 75 mm (3 in) deep space for gripping with a gloved hand. These devices shall be designed not to exceed the maximum outer contour, and to cause no damage to adjacent units.

4.4.3.4 Door latch and restraint hardware design shall preclude damage to container body or door during door stowage and installation/removal with no special attention.

The door latching and installation mechanisms shall be designed to allow door installation and removal while the container is sitting on uneven surfaces varying by as much as 13 mm (0,5 in) over the length of the base.

No tools shall be required to open and close the doors or latches.

4.4.3.5 Unless the door is entirely removable, means of retention in the open position shall be provided, which shall be able to maintain the door in the open and stowed position in wind and blast up to a minimum of 110 km/h (60 kn).

4.4.3.6 It shall be possible to lock (discourage entry) and seal the door, so as to give visual indication of unauthorized entry. See Clause 7 hereafter.

4.4.3.7 Particular design attention should be given to prevention of water intrusion through door-to-container assembly interface areas.

4.4.4 Pressure equalization

The container design shall comply with the specifications of ISO 11242, as follows.

4.4.4.1 Normal flight conditions

For normal flight conditions, a minimum venting area of 5 cm^2 per m^3 (0,02 in^2 per cu ft) of container internal volume shall be provided in accordance with ISO 11242, if the door seal venting area does not allow for sufficient air circulation between the interior and the exterior of the container. This venting area shall be adequately protected from cargo load shift to ensure that the minimum area is maintained during all normal flight conditions.

4.4.4.2 Emergency flight conditions

For rapid decompression in the event of an aircraft emergency, the container shall, in accordance with ISO 11242, provide a minimum venting area of 100 cm^2 per m^3 (0,45 in^2/cu ft) of container internal volume, to become open in a duration of less than 0,2 s when submitted to a maximum pressure differential from inside of 14 kPa (2,0 Ib/in^2), if the door seal venting area does not allow for sufficient air circulation between the interior and the exterior of the container to fulfil this venting requirement.

This opening area shall be adequately protected from cargo load shift to ensure its proper functioning in the event of an emergency. If the specific design requires a “blowout” device to achieve the required vent area, the “blowout” device shall remain attached to the container after activation.

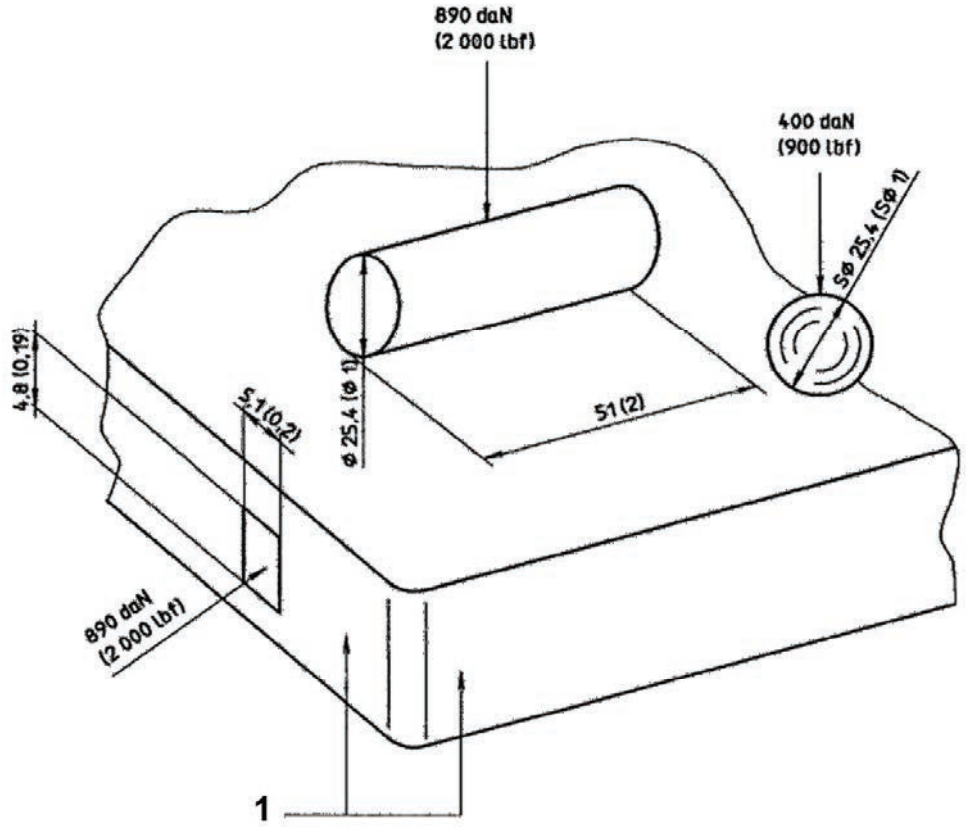
4.5 Performance

4.5.1 Base indentation

4.5.1.1 Local indentation of the container base panel

The maximum indentation (permanent set) at any location of the base panel when subjected to a 890 daN (2 000 Ibf) force by a steel roller 50 mm (2 in) long of 25 mm (1 in) diameter (see Figure 1) shall not exceed 0,25 mm (0,01 in), and when subjected to a 400 daN (900 Ibf) force by a steel ball of 25 mm (1 in) diameter shall not exceed 0,5 mm (0,02 in). See Figure 1.

Dimensions in millimetres (inches)



Key

1 base edge (ref.)

Figure 1 — Local indentation loading

4.5.1.2 Indentation along the periphery of the base edge

The maximum indentation at any location along the periphery of the base edge shall not exceed 0,13 mm (0,005 in) when subjected to a 890 daN (2 000 lbf) force applied parallel to the base over an area 5 mm (0,2 in) long by 5 mm (0,2 in) wide. See Figure 1.

4.5.2 Traversing between levels

The container assembly loaded to its maximum gross mass shall be capable of traversing from one item of conveyor equipment to another when there is a height difference of 180 mm (7 in) between the two levels, with no detrimental permanent deformation (see 5.2.4).

4.6 Design loads

4.6.1 The container shall satisfy the design and performance (ultimate load testing) criteria specified in ISO/PAS 21100, appropriate to the base size and configuration of the container, for type 2 units.

4.6.2 The container shall be designed and used to unitize and restrain its contents at the maximum operational gross mass specified in Table 2.

NOTE The maximum allowable gross mass of a container on any given aircraft position is the lowest of the values obtained dividing the certification ultimate loads (as per ISO/PAS 21100 or, for units approved prior to 2012, ISO 8097) by the flight load factors in the relevant direction of restraint (as stated by the aircraft type's approved Weight and Balance Manual). The result can vary according to aircraft type and position.

Because this value is aircraft-type dependent, airlines through IATA have agreed, principally for interlining purposes, to define for each ULD size a maximum operational gross mass independent from the aircraft type, which is often higher or sometimes lower than the maximum allowable one on a specific aircraft type.

Table 2 — Maximum operational gross mass

Base size code in accordance with ISO/PAS 21100	Base dimensions		Maximum operational gross mass	
	mm	in	kg	lb
A	2 235 × 3 175	88 × 125	6 804[a]	15 000[a]
B	2 235 × 2 743	88 × 108	4 536	10 000
M	2 438 × 3 175	96 × 125	6 804[ab]	15 000[b]

[a] 4 625 kg/10 200 lb for F, K, P, or U lower deck contour (ISO/PAS 21100 UC A8 approval).

[b] 5 100 kg/11 250 lb for F, K, P, or U lower deck contour (ISO/PAS 21100 UC M5 approval).

4.7 Environment

4.7.1 The container shall be designed and built using materials which will provide maximum serviceability and protection of contents under the intended environmental conditions, as follows.

4.7.2 The structural and operational integrity of the container shall be maintained at temperatures from −40 °C to 60 °C (−40 °F to 140 °F). These are the mean temperature and humidity figures worldwide without taking into account extremes in temperature such as those experienced in arctic, sub-polar, or desert regions. This, however, is not a test requirement.

4.7.3 All components of the container shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion, or other causes where the type of material used requires such protection.

4.7.4 Where non-metallic materials are used for the container's structure or components, they shall be assessed for potential strength deterioration due to weathering or other environmental factors, including U.V. and chemicals (e.g. kerosene, solvents, lubricants, aircraft hydraulic fluid, glycol-based de-icing, or anti-icing fluid), temperature variations, humidity, or fungus exposure, likely to be encountered in the course of worldwide air cargo operations, taking into account the information of ISO/TR 8647. The manufacturer shall inform the purchaser about expected performance degradation and any identified chemical incompatibility.

NOTE For textile materials, the information provided in ISO/TR 8647 can also be found in SAE AIR 1490, Reference [9], equivalent.

4.7.5 Where materials deterioration testing is performed, the requirements of ISO 7137, recognizing the EUROCAE ED-14G standard, should be taken into account, and materials be accordingly subject to an environment qualification form identifying the performed tests.

NOTE RTCA DO-160G, Reference [15], is equivalent to EUROCAE ED-14G and can alternately be used.

4.7.6 Particular design attention shall be given to prevent the entry of water through door-to-container assembly interface areas, and at panel joints (see 5.2.7).

4.7.7 During material selection, preference shall be given to recyclable materials and materials that minimize overall environmental impact as well as carbon dioxide production, where this does not compromise container performance and weight. The container's components and materials should be selected in order to allow identified recycling methods when out of use. Instructions for recycling should be provided by the manufacturer (see 8.1).

4.8 Hanging loads (optional)

4.8.1 General requirements

Containers can, as an option, be equipped with ancillary devices and/or attachments to support items of load in a hanging position, for example garments on hangers.

Depending on design, such devices can consist either of cargo hanging bars or frames directly attached to the container structure (with or without additional posts to prevent container deflection, as required) or a separate structure to be installed in the container to bring load to bear onto the container base.

In either case, it shall be noted that load distribution on the base undersurface and ease of movement of the loaded container on aircraft or ground equipment conveyor systems will be much improved if the container is equipped with a stiff (for example forkliftable) type of base. A base core stiffness significantly exceeding the minimum of 429 $N \cdot m^2/m$ (3 800 $lbf \cdot in^2/in$) width/length of core is highly recommended.

4.8.2 Loading requirements

The load path of hanging loads into the container and the supporting aircraft structure can be significantly different from that of loads resting on the base, as taken into account at container airworthiness certification. As a result, particularly in the event of major downward gusts during flight, parts of the aircraft structure or conveyor equipment can be damaged by uneven load distribution. In order to protect the aircraft structure:

a) unless specific allowances are provided by the aircraft manufacturer to carry hanging loads at certain positions, the maximum hanging load shall not exceed 50 % of the container's certified maximum gross weight if the container is equipped with a thin (for example aluminium plate) base.

   NOTE The above requirement applies to the use of general purpose containers, but certain stiff base container types specially designed for carrying hanging loads can allow up to 100 % of certified maximum gross weight.

b) in addition, elements used to hang the loads from the supporting structure shall be designed to break away under a down load equivalent to twice the maximum allowed hanging load.

Notwithstanding the above minimum requirements, care should be taken that the maximum allowable area loads defined in the aircraft type's Weight and Balance Manual are not exceeded as a result of uneven or concentrated load distribution. If they are, guidance and approval from the aircraft manufacturer should be obtained prior to using the container with hanging loads.

4.8.3 Testing requirements

Test N° 6 (see 5.2.6) shall be successfully conducted in reference to the intended maximum hanging load.

4.8.4 Additional marking requirements

In addition to the mandatory container marking requirements given in 6.1, the container shall be marked, in the immediate vicinity of its maximum gross weight marking and in the same characters size, with the following marking:

"MAXIMUM HANGING LOAD XXXX KG (XXXX LB)"

5 Testing

5.1 Ultimate load tests

5.1.1 Airworthiness approval tests shall be conducted using the maximum ultimate loads and centre of gravity deviations shown in ISO/PAS 21100 for the container configuration (UC), with the container being restrained in accordance with the indicated testing restraint condition(s) (RC). Analysis or numeric simulation, if used, shall use the same assumptions.

5.1.2 The method(s) used for testing any container configuration shall ensure conformity with the testing conditions and ultimate load parameters specified for that configuration in ISO/PAS 21100. Analysis or numeric simulation, if used, shall provide an equivalent assurance of conformity. A test and/or analysis report shall be established to record the details of the method(s) used and shall substantiate the results obtained.

5.1.3 Under ultimate load, the tested container or parts thereof can exhibit damage or permanent deformation, but shall not rupture to the extent of discharging its contents. Analysis or numeric simulation, if used, shall be based on yield stress values for the materials concerned and shall confirm that the analysed container would not deform or rupture to the extent its contents would be discharged under test conditions.

5.2 Operational tests

The tests specified in 5.2.1 to 5.2.6 hereafter shall be conducted to demonstrate the ability of the container to withstand without excessive deflection or detrimental permanent deformation the maximum operational loads that can be experienced during handling and transportation. They do not substitute the in-flight ultimate load performance tests required for container airworthiness approval (certification) in accordance with ISO/PAS 21100, as per 5.1.

Tests and/or analysis or numeric simulation shall be conducted as necessary to show compliance with the present International Standard.

5.2.1 Test No. 1 — Horizontal load test

5.2.1.1 General

The test shall be carried out to prove the ability of the container to withstand maximum operational horizontal loads that can be experienced during handling and transportation.

5.2.1.2 Procedure

Secure the container under test to the aircraft restraint system or a system equivalent to the applicable testing restraint configuration in ISO/PAS 21100.

Apply horizontally to one side of the container a test load evenly distributed equal to the maximum gross weight, less tare.

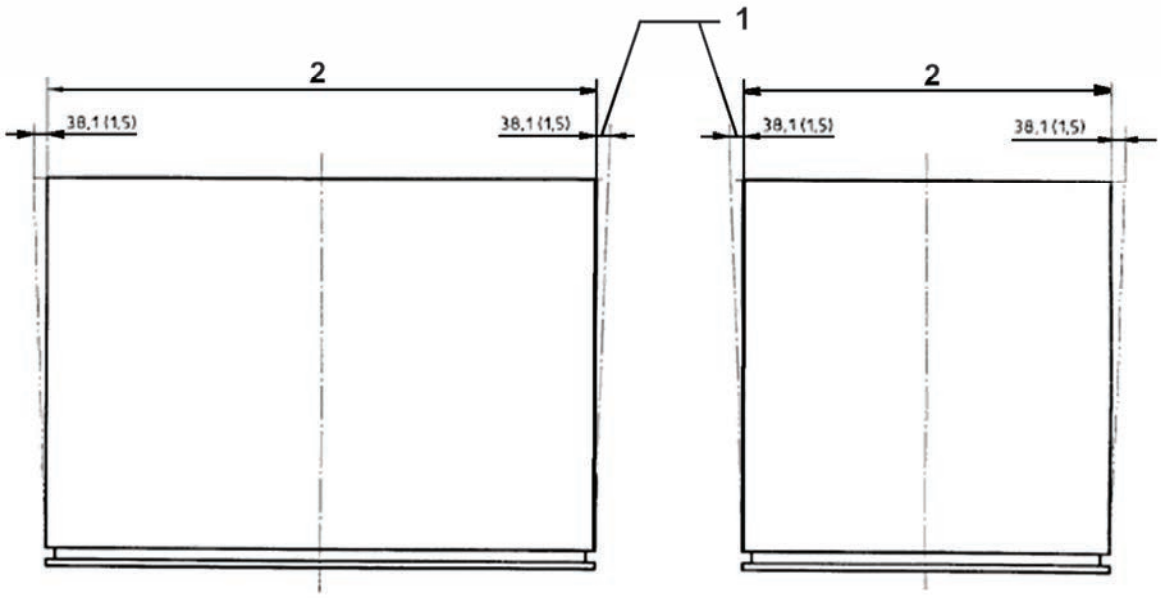
Repeat the test with the test load applied to the side perpendicular to the previous one.

Should their structure not be identical, test the opposite sides in the same manner.

5.2.1.3 Requirements

The deflection of the intersection of the top and side panel shall not exceed 38,1 mm (1,5 in) out of the maximum allowable contour (see Figure 2), and the door(s) shall not be released.

Dimensions in millimetres (inches)



Key

1 deflection limitation

2 maximum allowable contour

Figure 2 — Deflection limits out of the maximum ULD contour

Upon completion of the test, the container shall show neither detrimental permanent deformation, nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing, and interchange shall be satisfied.

5.2.2 Test No. 2 — Upward load test

5.2.2.1 General

The test shall be carried out to prove the ability of the container to withstand maximum operational upward loads that can be experienced during handling and transportation.

5.2.2.2 Procedure

Secure the container under test to the aircraft restraint system or a system equivalent to the applicable testing restraint configuration in ISO/PAS 21100.

Apply upwards to the container a test load evenly distributed equal to the maximum gross weight less tare.

5.2.2.3 Requirements

Upon completion of the test, the container shall show neither detrimental permanent deformation, nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing, and interchange shall be satisfied.

5.2.3 Test No. 3 — Base strength

5.2.3.1 General

This test shall be carried out to prove the ability of the container to withstand maximum operational loads that can be experienced during handling and transportation.

5.2.3.2 Procedure

5.2.3.2.1 All containers

Rest the container under test on the aircraft loading system or its equivalent, consisting of four rows of rollers approximately equally spaced over a minimum width of 1 930 mm (78 in) measured between centres, with each row composed of 38 mm (1,5 in) diameter rollers 75 mm (3 in) long uncrowned with edge radius R = 1,5 mm (0,06 in), spaced on 254 mm (10 in) centres. The container travels perpendicular to the rollers axis.

Load the container floor uniformly to 5 750 daN/m^2 (1 200 lb/ft^2). The load shall be applied to an area 1 500 mm (5 ft) wide centred in the container, and the load shall equal but not exceed three times the container maximum payload.

5.2.3.2.2 Additional test for containers 2 438 to 2 997 mm (96 to 118 in) high

Place the container on a roller system compatible with the minimum requirements of ISO 4116, and in such a way that the industrial truck can easily drive into the container.

Manoeuvre, over an area extending at least 457 mm (1,5 ft) inside the container, an industrial truck loaded to an axle weight of not less than 5 380 daN (12 000 lbf) (including the weight of the truck) or 2 670 daN (6 000 lbf) per wheel, applied to a contact area not greater than 140 cm^2 (22 in^2), and assuming a wheel width of not less than 180 mm (7 in) and wheel centres of 750 mm (30 in).

5.2.3.3 Requirements

Upon completion of the test, the container shall show neither detrimental permanent deformation, nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing, and interchange shall be satisfied.

The doors shall open and close with no prevalent binding, and the locks shall engage and disengage.

5.2.4 Test No. 4 — Cyclic test and bridging and cresting

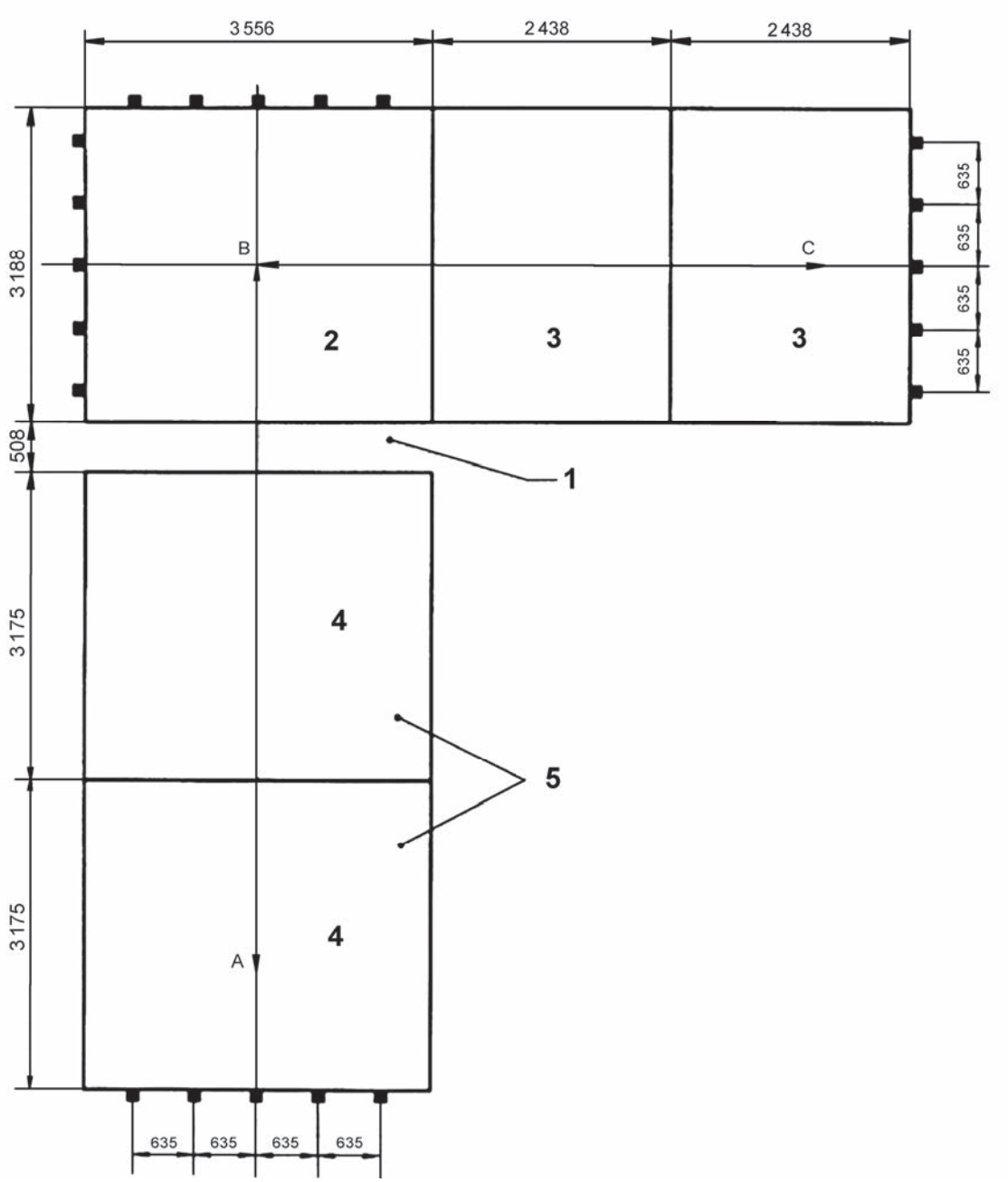
5.2.4.1 General

This test shall be carried out to prove the ability of the container to withstand maximum operational loads that can be experienced during handling.

5.2.4.2 Procedure

Uniformly load the container to its maximum gross weight. The height of the centre of gravity shall be 50 % of the height specified in ISO/PAS 21100. The maximum weight of a single load shall not exceed 25 daN (56 lbf) and shall have a maximum base of 1 000 cm^2 (155 in^2). Cycle the container 100 times over the system defined in Figure 3, at a speed of 0,3 m·s^{-1}(1 ft/s).

Dimensions in millimetres



Key

■ stop (height 100 mm/4 in, width 32 mm/1,25 in to 50 mm/2 in)

1 area 1 (to be left unsupported)

2 ball mat (ball diameter 25 mm/1 in, basic ball pitch 125 mm/5 in)

3 roller system – aircraft side

Four rows of rollers approximately equally spaced over a width of 2 030 mm (80 in) and measured between centres, with each row composed of 38 mm (1,5 in) diameter rollers 76 mm (3 in) long, uncrowned with edge radius of 1,5 mm (0,06 in) spaced on 254 mm (10 in) centres. The container travels perpendicular to the rollers axis

4 roller system – Ground handling side

roller diameter: 50 mm (2 in)

effective roller bearing length: 100 mm (4 in) to 200 mm (8 in)

The cumulative length of any number of rollers on a common axis supports 50 % of the corresponding device dimension. A staggered pattern of rollers shall provide equivalent support

maximum lateral spacing between roller ends: 400 mm (16 in)

maximum distance between centreline of rollers: 254 mm (10 in)

maximum radius at roller edges: 3 mm (0,125 in)

device overhang (distance between roller edge and guide): 150 mm (6 in)

5 platform adjustable in height

Figure 3 — Cycling test device

Each cycle shall be equal to at least the distance between A and C (or C and A). The test shall be such that the container bumps twice per cycle at the above-mentioned speed against the end stops. Twenty cycles shall include a 180 mm (7 in) high stepped junction in area 1 (see Figure 3).

5.2.4.3 Requirements

Upon completion of the test, the container shall show neither detrimental permanent deformation, nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied. The doors shall open and close with no prevalent binding, and the locks shall engage and disengage.

5.2.5 Test No. 5 — Resistance to racking

5.2.5.1 General

This test shall be carried out to prove the ability of the container to withstand maximum operational loads that can be experienced during handling and transportation.

5.2.5.2 Procedure

Restrain the container loaded to maximum gross weight at the base along one side against sideways movement.

Subject the top edge of the opposite side of the container to horizontal uniformly distributed forces along its length sufficient to reduce to zero the pressure between the bottom of the container and the aircraft system on the side opposite to that which is restrained against sideways movement.

5.2.5.3 Requirements

Upon completion of the test, the container shall show neither detrimental permanent deformation, nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing, and interchange shall be satisfied.

5.2.6 Test No. 6 — Hanging load test (optional)

5.2.6.1 General

This test shall be carried out to prove the ability of a container with provisions for hanging loads in the roof to withstand the maximum operational roof loads that can be experienced during handling and transportation of hanging loads.

5.2.6.2 Procedure

Secure the container under test to the aircraft restraint system or a system equivalent to the applicable testing restraint configuration in ISO/PAS 21100.

Evenly load the provisions for hanging loads to 200 % of the maximum required roof load. The centre of gravity location shall be as required by the applicable ISO/PAS 21100 ULD configuration.

Repeat the test for one side and the side perpendicular to this with the test load applied at an angle of 15° to the vertical. Should their structure not be identical, test the opposite sides in the same manner.

5.2.6.3 Requirements

The deflection of the intersection of the top and side panel shall not exceed 38 mm (1,5 in) (see Figure 1).

Upon completion of the test, the container shall show neither detrimental permanent deformation, nor abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing, and interchange shall be satisfied.

5.2.7 Test No. 7 — Water tightness

5.2.7.1 General

This test shall be carried out to prove the ability of the container to withstand inclement weather.

5.2.7.2 Procedure

Apply a stream of water on all joints and seams of the container from a nozzle of 12,7 mm (0,5 in) inside diameter at a pressure of about 1 bar[7] [corresponding to a height of about 10 m (33 ft) of water on the upstream side of the nozzle]. Hold the nozzle at a distance of 1,5 m (5 ft) from the container under test, and the traverse speed of the stream shall be 100 $mm \cdot s^{-1}$ (4 in/s).

Procedures involving the use of several nozzles are acceptable providing that each joint or seam is subjected to a water loading no less than that which would be given by a single nozzle.

5.2.7.3 Requirements

Upon completion of the test, containers with rigid doors shall be free from any penetration of water. Limited water ingress is allowable in the door area on containers with flexible doors.

7) 1 bar = 100 kPa.

6 Markings

6.1 Markings required

Each container shall carry at least the following markings:

a) ULD identification code[8];

b) Maximum gross weight (MGW), in kilograms and pounds in the format: "MGW: _____ kg (_____ lb)";

c) nominal (production average) tare weight (TARE), to the nearest kilogram and even number of pounds, in the format: "WEIGHT: _____ kg (_____ lb)";

d) TSO markings [TSO number and ISO/PAS 21100 classification, or (where applicable) alternate basis of certification (e.g. STC) with any applicable limitations][8];

e) burning rate in mm (in) per minute measured in accordance with 4.3.2;

f) name and address of the manufacturer;

g) container part/model number and serial number;

h) where applicable, maximum allowed hanging load (see 4.8.3);

i) (optional) internal volume to the nearest 1/10 m^3 and cubic foot.

6.2 Size of markings

All markings shall be in characters:

a) not less than 100 mm (4 in) high for ULD ID Code;

b) not less than 25 mm (1 in) high for the maximum gross weight and tare weight;

c) not less than 6 mm (1/4 in) high for all other markings.

All characters shall be of proportionate width and thickness, durable, and in a colour contrasting with that of the container or the data plate's background.

6.3 Markings location

The ULD identification code marking shall be prominently marked at the top centre of at least two, preferably three, of the fixed panel sides, in such a manner that good readability is ensured during all phases of handling.

Top contoured units shall have identification code markings of no less than two sides of the unit at a height between 1 150 mm and 1 650 mm (45 in and 65 in) above the base. The markings should be on the sloe of the contour for readability when several units are butted together.

All other markings shall be shown on the container's data plate. This data plate's positioning is optional but shall be in an area clearly visible after the article is loaded with cargo or other contents.

7 Customs/security sealing

The container shall be designed, constructed, and equipped in such a manner that

a) customs/security seals can be applied to all container doors,

8) See IATA Standard Specification 40/0 (Reference [5]). The type code is, by industry consensus, under custody of and assigned by the International Air Transport Association (IATA), ULD Registrar, 800 Place Victoria, P.O. Box 113, Montréal, Québec H4Z 1M1, Canada, web site www.iata.org.

b) no goods can be removed from, or introduced into the sealed container without leaving obvious traces of tampering or breaking the customs or security seal,

c) customs and security seals can be simply and effectively affixed,

d) the container contains no concealed space where goods can be hidden, and

e) all spaces capable of holding goods are readily accessible for customs or security inspection.

8 Manufacturer's instructions

8.1 The manufacturer shall deliver to the purchaser together with the first batch of containers a set of written instructions including at least

a) a certificate of compliance with the requirements of the present International Standard,

b) authority approval (TSO Authorization, Letter of Design Approval (LODA), or equivalent),

c) appropriate instructions to the operators (see 8.2 hereafter), and

d) recycling instructions (see 4.7.7 above).

The tests record file shall be provided to the approval authority, and should be made available to the purchaser on request.

Document a) shall be renewed at each subsequent delivery.

8.2 Instructions to the operators under 8.1 c) should include at least

a) intended conditions of use, and any exclusions there from if applicable,

b) environmental assessment, health, and safety precautions, known chemical incompatibilities,

c) appropriate aircraft installation instructions,

d) operational use recommendations referring to recognized applicable industry standards,

e) continued airworthiness inspection requirements and authority approved serviceability limits (maximum allowable damage), and

f) authority approved repair instructions with parts and materials procurement information (Component Maintenance Manual and Illustrated Parts List).

9 Quality control

9.1 Design and production

9.1.1 The manufacturer shall ensure design, testing, production, and first article inspection of the container are performed within the framework of a quality control program meeting the requirements for airworthiness approval by Civil Aviation Authorities (see CCAR-21/EASA/14 CFR Part 21).

9.1.2 Industry experience further demonstrates the essential character of continuous quality control in obtaining safe and dependable products beyond certification and production approval process requirements defined by CCAR-21/EASA/14 CFR Part 21. The operational performance requirements of the present International Standard are not covered by the airworthiness quality control process.

9.1.3 Quality control programs meeting the detailed requirements, as appropriate for aircraft containers, of national standards AS 9100 and AS 9102, EN 9100 and EN 9102, or JIS Q9100 and SJAC

9102 (see Bibliography) can be considered an acceptable means of complying with the requirements for airworthiness approval, and are recommended for the broader purpose of comprehensive quality control of all aspects, airworthiness, and operational performance, of the design, testing, production, and inspection of the containers covered by the present International Standard.

9.2 Operations

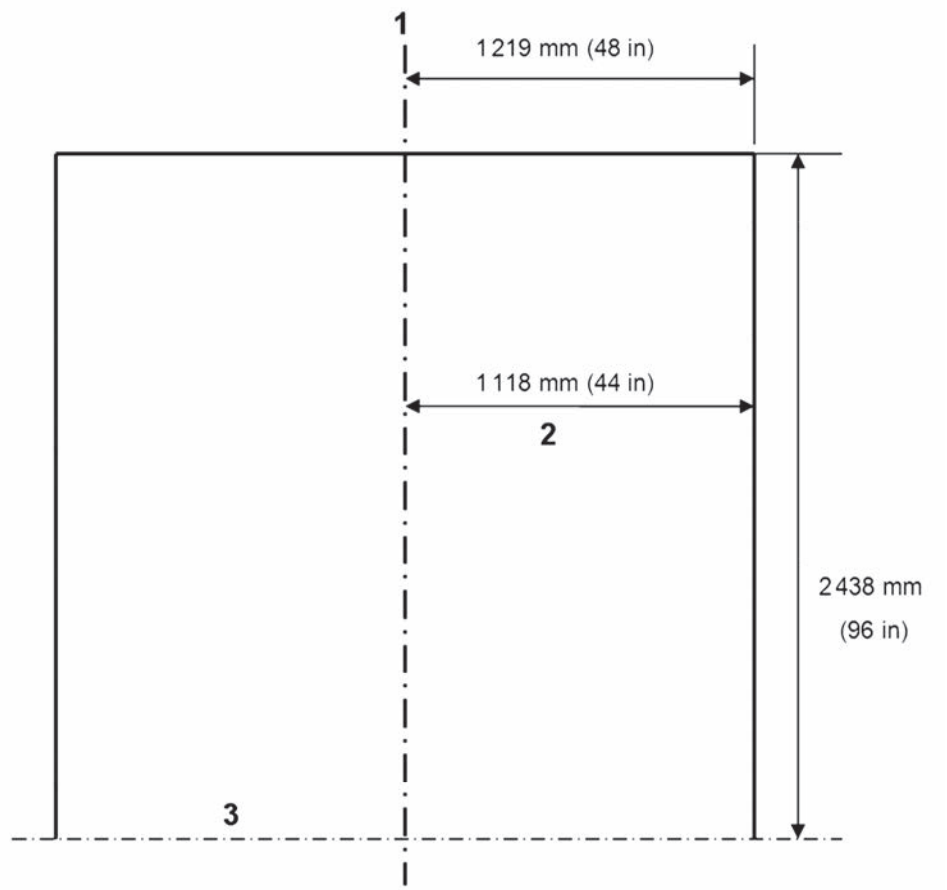
9.2.1 As regards containers operations, installation, and in-service inspection processes shall be monitored and their quality and effectiveness be regularly assessed by an independent organization in the framework of the air carrier's internal evaluation and quality control program (see CCAR-121/14 CFR Part 121 and AC 120-59, EU-OPS 1.035 and its AMC and IEM).

9.2.2 Accordingly, each container build-up site, including when it is located at a sub-contractor's premises, should be subject to inspection, investigation, or audit from the air carrier's quality control department.

9.2.3 It is also recommended airport handling agencies facilities performing installation of containers on board an air carrier's aircraft maintain their own continuous quality control program meeting the requirements of ISO 9001 (see Reference [3]), or an equivalent pertinent industry standard.

9.2.4 In addition, it is recommended any significant incident, in flight or on the ground at aircraft loading or offloading, resulting from or related to improper performance, installation or inspection of (a) containers(s) be reported and subject to carrier's quality control department investigation, in order to be analysed and corrective action to be taken to avoid its reoccurrence.

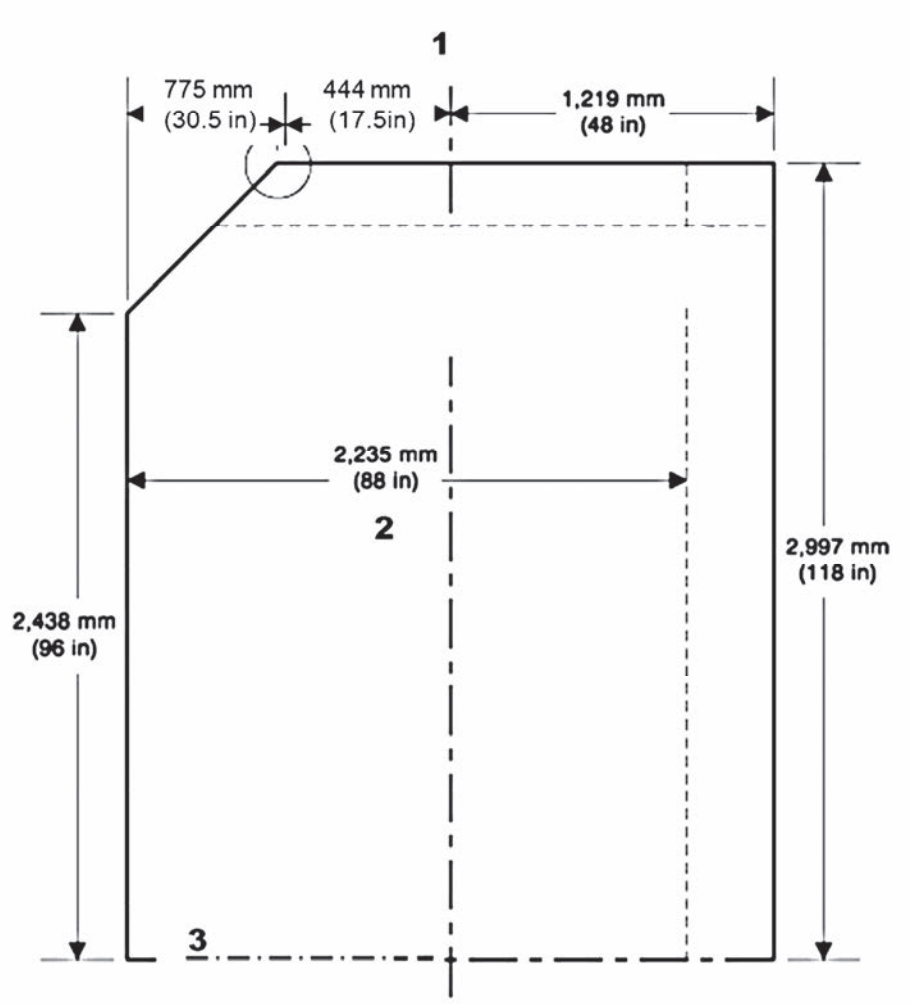
9.2.5 Any occurrence of damage to an aircraft due to an improperly designed, maintained, or operated container shall be immediately reported to the air carrier's quality control department to be investigated as a flight safety occurrence. The container involved shall be kept aside for the investigation, and shall not be returned to service prior to being inspected by qualified personnel and found within serviceability limits.



Key

1 centre line
2 alternate width
3 top of conveyor plane

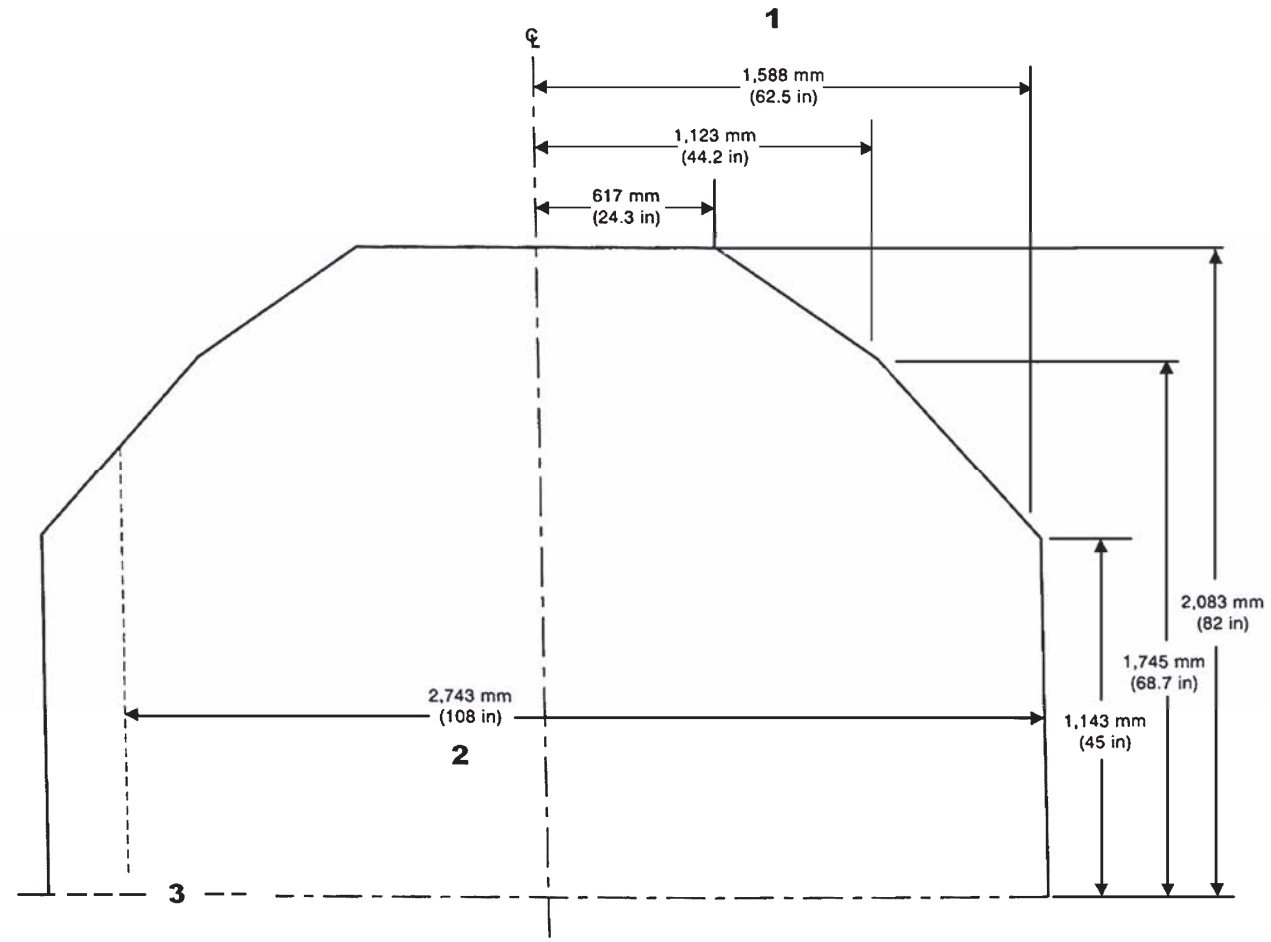
Figure 4 — Code A wide-body aircraft main deck maximum contour



Key

1 centre line
2 alternate width
3 top of conveyor plane

Figure 5 — Code D wide-body aircraft main deck maximum contour

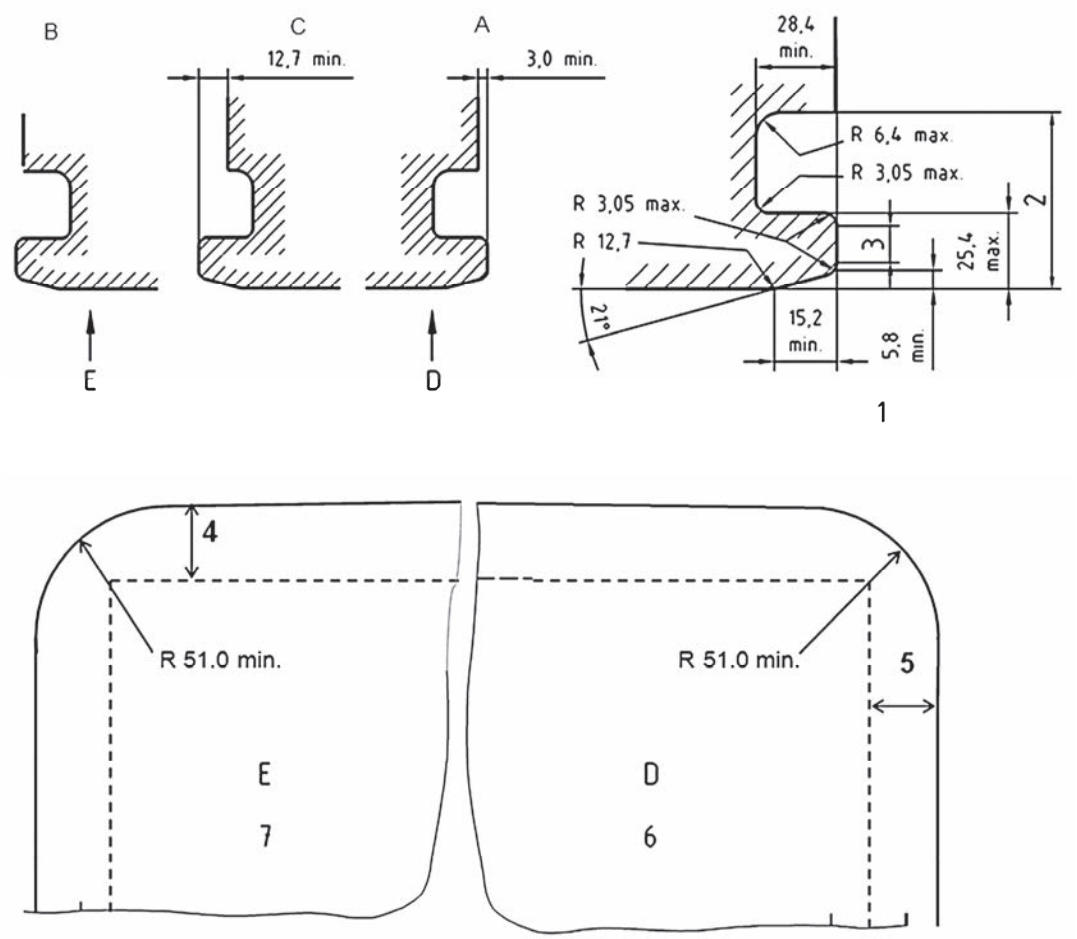


Key

1 centre line
2 alternate width
3 top of conveyor plane

Figure 6 — Code Y narrow-body aircraft main deck maximum contour (Typical)

Dimensions in millimetres



Key

A inboard edge (detail)
B outboard edge (detail)
C fwd and oft edges (detail)
1 base details typical for all edges
2 63,5 min.
3 10 min. flat
4 28,4 min. recess parallel to outer edge of base except at corner radius
5 28,4 min. recess parallel to outer edge of base shall be kept clear around complete base periphery
6 radiused corner only
7 radiused corner only

Figure 7 — Container base dimensional requirements

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[1] ISO 8058:1999, *Air cargo — Insulated container — Thermal efficiency requirements*

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

[3] ISO 9001:2008, *Quality management systems — Requirements*

[4] ISO 10254:1995, *Air cargo and ground equipment — Vocabulary*

[5] IATA ULD Regulations Standard Specification 40/0, *Unit Load Devices Markings*[9)]

[6] IATA ULD Regulations Standard Specification 40/1, *IATA Identification Code for Unit Load Devices*

[7] IATA ULD Regulations Standard Specification 50/0, *Requirements for interlining of ULD*

[8] IATA ULD Regulations Standard Specification 50/4, *Certified Aircraft Container*

[9] SAE AIR 1490, *Environmental degradation of textiles* [10)]

[10] SAE AS 9100, *Quality Systems — Aerospace — Model for Quality Assurance in Design, Development, Production, Installation and Servicing*

[11] SAE AS 9102, *Aerospace First Article Inspection Requirement*

[12] SAE AS 36100A, *Air Cargo Unit Load Devices — Performance Requirements and Test Parameters*

[13] EN 9100, *Quality Management Systems — Requirements for Aviation, Space and Defense Organizations*[11)]

[14] EN 9102, *Aerospace First Article Inspection Requirement*

[15] RTCA DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*[12)]

9) IATA Publications are available from the International Air Transport Association, Publications Assistant, 800 Place Victoria, P.O. Box 113, Montréal, Québec, CANADA H4Z 1M1, or its web site www.iata.org.

10) SAE Publications are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001, U.S.A., or its web site www.sae.org.

11) Equivalent to EUROCAE ED-14G, can be obtained from RTCA Inc, 1828 L Street, NW, Suite 805, Washington, DC 20036, USA, or its web site www.rtca.org.

12) EN 9100 and EN 9102 are available from Comité Européen de Normalisation, Avenue Marnix 17, B-1000 Brussels, Belgium, http://esearch.cen.eu, or any of the 28 European national standardization institutes, members of CEN.

ICS 55.180.30

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