INTERNATIONAL STANDARD

ISO 19281

First edition
2016-02-01

Air cargo — Fire resistant containers — Design, performance and testing requirements

Fret aérien — Conteneurs résistant au feu — Exigences de conception, performances et essais

Reference number
ISO 19281:2016(E)

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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*.

Annex A and Annex B are normative.

Introduction

Fatal accidents have emphasized the risk to transport aircraft of uncontrolled fires occurring within cargo, and evidence that the use of fire protecting devices can improve flight safety.

This International Standard specifies the design and performance criteria and testing methods for fire resistant containers intended to be used in order to provide enhanced protection against cargo fires in civil transport aircraft cargo compartments.

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 fire resistant containers meeting the applicable regulatory requirements and ensuring effective protection against fires. 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 International Standard are expressed in the applicable SI units, with approximate inch-pound unit 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.

Air cargo — Fire resistant containers — Design, performance and testing requirements

1 Scope

This International Standard specifies the minimum design and performance criteria and testing methods of passive fire resistant containers (FRCs) for carriage on aircraft main deck, to be used on either of the following:

a) in those cargo compartments of civil transport aircraft where they constitute one means of complying with applicable airworthiness regulations;

b) on a voluntary basis, when deemed appropriate by operators to improve fire protection in aircraft cargo compartments where airworthiness regulations do not currently mandate their use.

The fire resistant containers (FRCs) specified by this International Standard are intended to be used to contain and restrain unitized cargo for loading into either of the following aircraft main deck cargo compartments:

a) Class B aircraft cargo compartments according to CS-25, CCAR-25, JAS Part 3 or 14CFR Part 25 25.857 (b), in accordance a) or b) above;

b) Class E aircraft cargo compartments according to CS-25, CCAR-25, JAS Part 3 or 14CFR Part 25 25.857 (e), in accordance with b) above;

c) Class F aircraft cargo compartments according to CS-25 § 25.857(f) and AMC to CS-25.855 and 25.857, or 14CFR Part 25 § 25.857(f) and FAA Advisory Circular AC25.857-X, in accordance with a) above.

NOTE 1 Though nothing formally prevents a fire resistant container (FRC) from being carried in a lower deck Class C aircraft cargo compartment, it is not intended for this use since its fire containment capability would be redundant with that of the aircraft's fire detection and suppression system, which it could hamper. Consult current regulatory guidance materials and aircraft type's Weight and Balance Manual whenever available.

Containers are specified in this International Standard only insofar as their flammability requirements and fire resistance performance are concerned. They are not otherwise specified in this International Standard, but still require meeting the applicable general standards.

NOTE 2 See Clause 2 and 4.1 and 4.2 for applicable containers airworthiness approval and general design standards.

This International Standard does not cover requirements for fire detection or suppression devices. The specified fire resistant containers (FRCs) are passive devices capable of containing a fire for the specified duration by themselves.

NOTE 3 Nothing, however, prevents additional use of self-contained fire detection or suppression devices within fire resistant containers (FRCs), but such devices are not specified herein (see 4.5.5).

This International Standard does not cover requirements for other types of fire resistant containers not specified therein.

The use of fire resistant containers meeting the requirements of this International Standard is not alone sufficient to ensure flight safety: this International Standard is based on the assumption that the approved fire resistant containers will be built up, installed, and checked prior to aircraft loading in accordance with appropriate operating instructions, by competent, suitably trained, personnel as defined for example in ISO 9001:2008, 6.2.2 (see 9.3).

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 877–1, *Plastics — Methods of exposure to solar radiation — Part 1: General guidance*

ISO 4892–1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 4892–3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

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

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

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

ISO 10327, *Air cargo — Main deck containers — Design and testing*

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

ISO 12236, *Geosynthetics — Static puncture test (CBR test)*

ISO 14186, *Air cargo — Fire containment covers — Design, performance and testing requirements*

ISO 21100,[1)] *Air cargo unit load devices — Performance requirements and test parameters*

CAAC CCAR-25, *Airworthiness Standards — Transport Category Airplanes*[2)]

CAAC Chinese Technical Standard Order CTSO C90, *Cargo pallets, nets and containers*

EASA CS-25, *Certification Specifications for Large Aeroplanes*[3)][2)]

EASA Acceptable Means of Compliance (AMC) to CS-25.855/25.857, *Cargo or baggage compartments*[3)]

EASA Technical Standard Order ETSO C90, *Cargo pallets, nets and containers (Unit Load Devices)*[3)]

Japanese Airworthiness Standard (JAS) Part 3 (*Civil Aeronautics Law Article 10 §*[2)] [4)]

USA. Code of Federal Regulations (CFR) Title 14 Part 25 — *Airworthiness Standards: Transport Category Airplanes ("14 CFR Part 25")*[2)] [5)]

US. FAA Advisory Circular AC 25.857-X, *Class B and F Cargo Compartments*[5)]

US. FAA Technical Standard Order TSO C90, *Cargo pallets, nets and containers (Unit Load Devices)*[5)]

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1) AS 36100[9] is an equivalent standard.

2) See 25.855, 25.857 and Appendix F.

3) EASA CS-25, abbreviated throughout this International Standard as "CS-25", constitutes the European government's transport aircraft airworthiness approval regulations and can be obtained, as well as its AMC, from the European Aviation safety Agency (EASA), Otto Platz 1, Postfach 101253, D-50452 Cologne, Germany, or its website at www.easa.europa.eu.

4) 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 www.mlit.go.jp/en.

5) Code of Federal Regulations (CFR) Title 14 Part 25, abbreviated throughout this standard as "14 CFR Part 25", constitutes 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, U.S.A., or its website at www.gpoaccess.gov. FAA Advisory Circulars and other documents can be obtained from its www.faa.gov web site.

EUROCAE ED-14G, *Environmental conditions and test procedures for airborne equipment*[6)]

3 Terms and definitions

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

3.1
fire containment
fire control
ensuring that a fire does not grow to a state where damage to the aeroplane or harm to passengers or crew occurs during the time for which the fire containment system is demonstrated to be effective

3.2
fire resistant container
FRC
completely enclosed container, airworthiness approved under applicable general performance criteria, with a demonstrated additional capability to contain a possible cargo fire within it for a rated period

Note 1 to entry: Guidance addressing the use of FRCs is provided in airworthiness regulatory guidance documents when they are one allowable means of compliance with *fire containment* (3.1) requirements in certain classes of aircraft cargo compartments

3.3
unit load device
ULD
device for grouping, transferring, and restraining cargo for transit

Note 1 to entry: It may consist of a pallet with a net or it may be a container.

Note 2 to entry: Within this International Standard, synonym of "container".

3.4
active unit load device
unit load device (3.3) incorporating energy systems operating during flight, e.g. in the case of FRC self-contained fire detection and/or fire extinguishing systems

3.5
passive unit load device
unit load device (3.3) (e.g. FRC) or accessory thereto (e.g. FCC) that includes neither fire detection nor fire extinguishing systems, and ensures *fire containment* (3.1) by its use of *fire resistant* (3.8) or *fire proof* (3.9) material and limiting the supply of air

Note 1 to entry: Antonym of *active unit load device* (3.4).

3.6
fire containment cover
FCC
passive device meeting the performance requirements of ISO 14186, used in conjunction with an air cargo pallet and net in order to contain for a rated period a possible cargo fire beneath it

3.7
class A fire
fire in ordinary combustible materials, such as wood, cloth, paper, rubber, and plastics, for which the quenching and cooling effects of quantities of water, or of solutions containing a large percentage of water, are of prime importance

6) 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. RTCA DO-160G[7] is equivalent. Both are recognized by ISO 7137.

3.8
fire resistant
grade designating components, equipment and structures capable of withstanding application of heat by a defined flame for 5 min, as opposed to *fire proof* (3.9)

Note 1 to entry: Not to be mistaken for *fire resistant container* (3.2), for which performance requirements are differently specified, for a longer duration, by the present International Standard.

Note 2 to entry: See ISO 2685 and EUROCAE ED-14G section 26.

3.9
fire proof
grade designating components, equipment, and structures capable of withstanding the application of heat by a defined flame for 15 min

Note 1 to entry: See ISO 2685 and EUROCAE ED-14G section 26.

3.10
burn length
distance from the original edge to the farthest evidence of damage on a test specimen due to flame impingement, including areas of partial or complete consumption, charring or embrittlement, but not including areas sooted, stained, warped, or discoloured, nor areas where material has shrunk or melted away from the heat source

4 General requirements

4.1 Approval

4.1.1 The fire resistant container's type design shall be approved for this purpose on the basis of demonstration of compliance with the present International Standard, and a Certificate of Conformity shall accordingly be delivered by the manufacturer. Where the fire resistant container is intended to constitute a means of complying with applicable airworthiness regulations as indicated in the Scope, container type approval shall be sought from the airworthiness authority concerned, which may include additional requirements.

4.1.2 The fire resistant container shall, in addition, be airworthiness approved under the ultimate load criteria of TSO/CTSO/ETSO/JTSO C90 in accordance with ISO 21100,or ISO 8097 if its size is not contained therein. TSO/ETSO C90 ultimate load requirements and the fire resistance requirements are not required to be met simultaneously because it is highly improbable that a cargo fire and maximum flight load condition would simultaneously occur. Any Authority approval as a fire resistant container, if required, shall be applied for by the responsible manufacturer (OEM) in addition to, or including, the approval of the container model concerned under TSO C90.

4.1.3 Amendments to the Aircraft Flight Manual (AFM) (see 9.2.6) are required and shall be approved even if FRCs are used on a voluntary basis in accordance with 1.1 b) by the airworthiness authority overseeing the operator (carrier). The authority can express additional requirements from the operator to ensure compliance with the relevant CS-25, CCAR-25 or 14 CFR Part 25 § 25.857 paragraph(s) in the aircraft compartment(s) concerned.

4.2 Construction

4.2.1 The fire resistant container may be constructed as either of the following:

— container designed and built on purpose with appropriate fire resistant or fire proof materials and door(s);

— conventional materials standard air cargo container that received (including the door(s) and, where necessary, the base) an appropriate additional inner fire resistant or fire proof coating or protective material.

Other construction methods may be used to achieve the fire containment performance requirements.

4.2.2 In the latter case, the expression "fire resistant container" exclusively designates throughout the present International Standard the complete assembly fully fitted with intended coating, protections, or other appurtenances. The coating or protective material shall be exclusively applied on new containers prior to delivery. The container's manufacturer shall be solely responsible for required testing and issuance of the Certificate of Conformity, and/or substantiation with the authority. See 4.3.1 NOTE with regard to applicable approval procedures.

In this case, inner coatings or protective materials are exposed to interference from stacking cargo in the container. Specific inner damage limits are required and can present container inspection and damage assessment difficulties, see applicable requirements in 5.3.5.

4.2.3 In either case, the minimum performance requirements to be met are identical, defined by the relevant clauses of the present International Standard, and the container shall satisfy all general design and testing requirements of ISO 10327 for main deck containers.

4.2.4 The present International Standard does not cover the possibility of placing over a container a Fire Containment Cover (FCC) meeting the requirements of ISO 14186.

4.2.5 The fire resistant container's dimensions and outer contour shall be within maximum allowable in accordance with ISO 10046, appropriate to the aircraft type(s) and loading positions it is designed for.

All other aspects shall meet the applicable requirements of ISO 10327 for main deck containers.

NOTE Industry standard maximum ULD contours applicable to containers are defined in Reference [4] and identified by alphabetic codes in its Appendix E.

4.3 Materials

4.3.1 The fire resistant container shall be constructed of fire proof or fire resistant materials meeting the fire resistance (flammability and flame penetration) requirements specified in 5.1.

NOTE With regard to container bases, bases consisting in a single aluminium alloy sheet are sufficient to meet the regulatory requirements [CS-25/14 CFR Part 25 Appendix F Part I (a)(2) (iii)] in 5.1.2 by themselves, and can be exempted from the testing requirements of 6.1.1.6, while subject to the FRC full scale test in 6.3.

4.3.2 Any other elements of the fire resistant container's construction or equipment (e.g. joints of sidewalls, roof and base panels, closure devices, seals, etc.) the failure of which would affect the capability of the container to safely contain a fire shall meet the requirements specified for them in 5.1.1.

4.3.3 Materials selection should ensure the highest possible wear, abrasion, shearing, tearing, and puncture resistance. See 6.1.2 for environmental tests, including puncture resistance, U.V. and humidity, and abrasion, applicable for non-metallic materials where used, e.g. flexible materials for doors.

4.3.4 During materials selection, preference shall be given to recyclable materials where this does not compromise best fire protection performance. Asbestos or asbestos compounds shall not be used. Other materials shall be assessed prior to selection as to potential detrimental effects on human health.

4.3.5 Where a composite material of a non-permanently attached component, e.g. closure, is such that one side shall be the inner one to withstand fire, the inner and outer colours shall be different to prevent inverted installation (see 7.4).

4.4 Weight

The fire resistant container's weight should be kept to a minimum, consistent with the airworthiness approval (see 4.1.2) ultimate load tests and fire and puncture resistance requirements.

4.5 General design

4.5.1 The fire resistant container's design shall be such that any inner features or components provide the minimum required fire resistance.

4.5.2 Container closure devices shall provide the minimum fire and flame resistance required in 5.1.1, and shall be protected by a sealing feature meeting the same requirements to restrict air entry once closed and fastened (see 4.5.4).

4.5.3 The fire resistant container's outer surface should be as smooth as possible to avoid any interference with the aircraft's doors, compartment linings, and lights, and/or risk of snagging on adjacent ULDs hardware.

4.5.4 The container's normal and emergency (rapid decompression) pressure equalization functions shall meet ISO 11242 requirements. The venting area for normal pressure equalization shall meet the minimum 5 cm^2/m^3 internal volume specified therein.

NOTE 5 cm^2/m^3 opening corresponds for typical main deck containers (inner volume between 13 m^3 and 21 m^3), to a minimum door seals clearance of approximately 1 mm to 1,5 mm, all around the door's periphery.

Based on extremely low combined probability, operation of the emergency (rapid decompression) panel, or equivalent overall container deformation, required by ISO 11242 does not require fire containment performance to be maintained.

4.5.5 Where the normal pressure equalization venting area is not permanent but operates under a pressure differential (e.g. door seals deformation), it shall open under a pressure differential between 3,5 kPa and 7 kPa (0,5 lbf/in^2 to 1 lbf/in^2) in accordance with ISO 11242.

4.5.6 If the fire resistant container is equipped with self-contained automatic fire detection and/or suppression device not specified by this International Standard or any other not specified device, devices installation shall not compromise the function and performance of the fire resistant container, which shall remain in compliance with the minimum performance and other requirements of this International Standard.

4.6 Environment

4.6.1 The fire resistant container shall be designed and its materials selected assuming it will be operated outdoors throughout temperature ranges of −40 °C (−40 °F) to 60 °C (140 °F) with relative humidity between 20 % and 85 %, including ice, snow, and soaking in water.

4.6.2 The fire resistant container's materials shall be assessed for potential deterioration of their fire and puncture resistances 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. The manufacturer shall inform the purchaser about expected performance degradation and any identified chemical incompatibility.

4.6.3 The above shall be substantiated, for any non-metallic materials used in the fire resistant container's construction, by, as appropriate, the puncture, U.V. and humidity, abrasion and fungus resistance tests specified in ISO 14186:2013, 6.1, to be performed on material samples prior to material

flammability and flame penetration testing (see 6.1.2). Where the results show that performance cannot be indefinitely guaranteed, an expiry date shall be defined (see 4.6.5).

4.6.4 Where applicable, testing should take into account the requirements of ISO 7137 (EUROCAE ED-14G standard), and be accordingly subject to an Environment Qualification Form identifying the performed tests.

NOTE See EUROCAE ED-14G Appendix A for Environment Qualification Form. Reference [6] is equivalent to EUROCAE ED-14G and may alternately be used.

4.6.5 Where textile or limited life composite materials are used, an expiry date after which the rated performance may not be expected to be maintained shall be provided to the purchaser at or before the time of delivery of each production batch, and shall be marked on each container (see 7.2). The expiry date for spares may take into account the expected storage duration, provided that storage conditions which might affect performance degradation are identified and catered for.

4.6.6 If the fire resistant container's construction includes elements made of woven textile material or thread, the available data concerning degradation of woven textile fibre performance when exposed to environment factors should be taken into account for material and thread selection and treatment, commensurate with the expected service life of the fire resistant container. See ISO/TR 8647.

NOTE Reference [8] is equivalent to ISO/TR 8647, and may alternately or additionally be used.

4.6.7 In addition, the fire resistant container's components and materials should be selected in order to allow identified recycling methods when the unit is out of use or after its expiry date, if applicable. Instructions for recycling shall be provided by the manufacturer (see 8.1).

4.7 Maintenance

4.7.1 The manufacturer should provide approved procedures, parts, and repair kits meeting the fire resistance (flammability and flame penetration) requirements specified in 5.1 to durably repair punctures or other damage in excess of the allowable damage limits (see 5.3) in the fire resistant containers.

4.7.2 The approved repair method(s) shall be defined in the Component Maintenance Manual (CMM) (see 8.2). Any approved repairs shall re-establish the container's fire containment and air-tightness performance. This shall be substantiated by a repaired container being subjected to a full scale FRC test (see 6.3). For this test, the repaired part should be located adjacent to and over the ignition box (see 6.3.2 and Annex B).

4.7.3 Any curing time for bonding or equivalent shall be specified. The allowable minimum and maximum ambient conditions together with the associated curing time shall be specified in the Component Maintenance Manual (CMM).

5 Performance

5.1 Components

5.1.1 Container body

All fire resistant container's material(s), including such parts as per 4.3.2, shall meet the flammability requirements of CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraphs (a)(1)(ii) and (a)(2)(ii), i.e. shall be self-extinguishing when tested vertically in accordance with Part I paragraph

(b)(4), and there shall be no flame penetration during application of the specified flame source when subjected to the 45° angle test defined in Part I, paragraph (b)(6).

NOTE The 45° test may be replaced by the Appendix F Part III flame penetration test hereafter deemed more critical.

In addition, the sidewalls, roof, and door materials shall meet the flame penetration requirements of CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part III, paragraph (a)(3), i.e. there shall be no flame penetration within 5 min after application of the specified flame source, and the peak temperature measured at 100 mm (4,0 inches) above the upper surface of the horizontal test sample must not exceed 204 °C (400 °F). See 6.1.1.1 to 6.1.1.5, materials flammability testing.

5.1.2 Base

The material(s) of the fire resistant container's base shall meet the requirements of CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraphs (a)(1)(ii) and (a)(2)(ii), i.e. shall be self-extinguishing when tested vertically in accordance with Part I paragraph (b)(4), and there shall be no flame penetration during application of the specified flame source when subjected to the 45° angle test defined in Part I, paragraph (b)(6). See 6.1.1.6, materials flammability testing.

NOTE Plate aluminium bases were previously tested and demonstrated to meet these flammability requirements.

5.1.3 Door

The door materials, whether rigid or flexible and including any seals, shall meet the flammability requirements of 5.1.1.

In the event of a net or straps being used for restraint as part of a fire resistant container's door, they shall be located outside. The material of the net or straps shall, in addition to TSO/ETSO C90, meet the requirements of CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraph (a)(1)(ii), i.e. shall be self-extinguishing when tested vertically in accordance with Part I paragraph (b)(4). See 6.1.1.7, materials flammability testing.

5.1.4 Accessories

Accessories, the failure of which would affect the capability of the container to safely contain a fire, e.g. seals or structural parts, shall meet the requirements of 5.1.1.

Accessories, the failure of which would not affect this capability, e.g. placard holders, labels, etc., shall, in accordance with TSO C90, meet the flammability requirements of CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraph (a)(2)(iv), i.e. may not have a burn rate greater than 100 mm/min (4,0 in/min) when tested horizontally in accordance with Appendix F Part I (b)(5).

5.2 FRC assembly

5.2.1 The fire resistant container, fitted as intended and closed according to instructions, shall effectively contain and control (see 3.1) a fire within it.

5.2.2 The fire resistant container, fitted as intended and closed according to instructions, shall minimize heat generated outside it, to ensure that the adjacent aircraft systems and structure are not adversely affected.

Compliance with this requirement shall be demonstrated by successfully completing both 6.1.1, materials flammability tests and 6.2 full scale FRC test, showing that the temperature measured at any point 100 mm (4,0 in) outside of container contour or below the base at no time exceeds 204 °C (400 °F), in accordance with CS-25, CCAR-25, JAS Part 3 or 14CFR Part 25 Appendix F, Part III, paragraph (a)(3) (Amendment 25-72), and no flame penetration occurs. See 6.2.

5.2.3 The temperatures recorded and heat loads calculated at locations above, around and below the FRC shall be used to establish the length of protection time afforded by the system. Where the FRC is intended and approved for one aircraft type only, the so determined protection time shall not be less than the approved extended range operations (EROPS) or long range operations (LROPS) maximum diversion time for the intended aircraft type. For unlimited aircraft type use, the protection time should not be less than 360 min (6 h).

5.2.4 The fire resistant container, fitted as intended and closed according to instructions, should minimize the amount of contaminants such as noxious or flammable gases coming out of a container containing a fire.

5.3 Allowable damage

5.3.1 Performance of the fire resistant container shall be maintained in the presence of maximum allowable damage, to be determined and substantiated by the manufacturer. The maximum allowable damage shall be defined in the Component Maintenance Manual (CMM) (see 8.2).

5.3.2 Manufacturers are encouraged to demonstrate the highest sustainable degree of in-service damage that maintains the highest degree of fire containment performance.

5.3.3 Maximum damage allowance shall be determined by the manufacturer by assessment of the maximum air leakage rate compatible with maintaining the required fire resistance performance.

5.3.4 Damage allowances shall consider instances of air-tightness/sealing reduction, e.g. at doors (inaccurate positioning, door seals damage) and panels junctions between themselves and with the base.

5.3.5 Where fire containment performance depends or partly depends on an inner container coating or protective material (see 4.2.2), the manufacturer shall also define and substantiate allowable inner damage to this coating or inner material resulting from repeated container build-up and break-down. Attention shall be paid to providing reliable and easily applicable damage assessment/measurement methods at container internal inspection.

5.3.6 Intended maximum allowable damage stated in the CMM shall be substantiated by a container presenting that damage being successfully submitted to the full scale FRC test (see 6.2).

5.3.7 The CMM published maximum damage should be a single set of values, based on the lowest allowed by either TSO C90 certification or fire resistance performance assessment confirmed by testing. However, where maximum damage for fire resistance performance is less than for general container airworthiness, the two sets of values may be provided in order to allow use as an ordinary container when the fire performance limits are exceeded.

In such a case, the container concerned shall be clearly identified as not anymore approved for fire protection, see 7.1. The two sets of maximum damage limits can be reflected on two separate and clearly identified Operational Damage Limits Notices (see Reference [3]).

6 Testing

6.1 Materials testing

6.1.1 Flammability and flame penetration tests

6.1.1.1 For fire resistant container's materials qualification, at least three 406 mm ± 3 mm × 610 mm ± 3 mm (16 in ± 1/8 in × 24 in ± 1/8 in) specimens of each fire resistant container's material shall be tested in accordance with CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25

Appendix F, Part III, using the test apparatus (mounting stand, kerosene test burner, thermocouples) specified in its paragraph (d) and the test procedure specified in its paragraph (g).

6.1.1.2 Each specimen shall be pre-conditioned prior to testing as follows.

a) Soak for 24 h in water, then dry at room temperature in a well-ventilated place (weighing is recommended before and after pre-conditioning to confirm the specimen was fully dried).

b) Apply the sample conditioning procedure of CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraph (b) (1), i.e. bring the specimens to 21 °C ± 3 °C (70 °F ± 5 °F) and at 50 % ± 5 % relative humidity until moisture equilibrium is reached or for 24 h. Each specimen shall remain in the conditioning environment until it is subjected to the flame.

6.1.1.3 Each specimen shall be tested in the horizontal position. Where the material is unsymmetrical, it shall be installed on the apparatus with the inner side of the FRC material down (exposed to the flame).

6.1.1.4 The tested specimens shall include any other elements part of the FRC's construction, e.g. joints, closure devices, seals, etc., the failure of which would affect the capability of the container to safely contain a fire. See 5.1.4 for accessories the failure of which would not affect performance.

6.1.1.5 On completion of the tests, there shall be no flame penetration of any specimen within 5 min after application of the flame source, and the peak temperature measured at 100 mm (4,0 in) above the upper surface of the horizontal test sample shall not exceed 204 °C (400 °F).

6.1.1.6 Base

Unless previously tested and demonstrated to meet flammability requirements (e.g. plate aluminium bases), at least three specimens of the fire resistant container's base material shall be tested in accordance with CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I paragraphs (a)(1)(ii) and (a)(2)(iii) as follows.

a) Vertical test

- Each specimen shall be tested in accordance with CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraph (a)(1)(ii), using specimen configuration specified in its paragraph (b)(2), a Bunsen burner, the test apparatus (draft-free cabinet) specified in its paragraph (b)(3) and the test procedure specified in its paragraph (b)(4).
- Minimum flame temperature measured by a thermocouple in its centre shall be 840 °C (1 550 °F). The flame shall be applied for 12 s and then removed. Subsequent flame time, burn length, and flaming time of drippings, if any, are to be recorded.
- Upon completion of the tests, the average burn length may not exceed 203 mm (8 in), the average flame time after removal of the flame source may not exceed 15 s, and drippings from the test specimens, if any, may not continue to flame for more than an average of 5 s after falling.

b) 45° angle test

- Each specimen shall be tested in accordance with CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraph (a)(2)(iii), using specimen configuration specified in its paragraph (b)(2), a Bunsen burner, the test apparatus (draft-free cabinet) specified in its paragraph (b)(3) and the test procedure specified in its paragraph (b)(6).
- Minimum flame temperature measured by a thermocouple in its centre shall be 840 °C (1 550 °F). The flame shall be applied for 30 s with one third contacting the material at the centre of the specimen, and then removed. Subsequent flame time, glow time, and whether the flame passes through the specimen are to be recorded.

— Upon completion of the tests, the flame may not have passed through the material during application of the flame or subsequent to its removal, the average flame time after removal of the flame source may not exceed 15 s, and the average glow time may not exceed 10 s.

6.1.1.7 Door

Container door panel materials, whether rigid or flexible, shall be qualified in accordance with 6.1.1.1 to 6.1.1.5 above.

For material qualification of door nets or straps (see 5.1.3), at least three specimens of the net's or straps' material shall be tested vertically in accordance with CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I paragraphs (a)(1)(ii) and (b)(iv) as follows:

— each specimen shall be tested in accordance with CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part I, paragraph (a)(1)(ii), using specimen configuration specified in its paragraph (b)(2), the test apparatus (draft-free cabinet) specified in its paragraph (b)(3) and test procedure specified in its paragraph (b)(4);

— minimum flame temperature measured by a thermocouple in its centre shall be 840 °C (1 550 °F). The flame shall be applied for 12 s and then removed. Subsequent flame time, burn length, and flaming time of drippings, if any, are to be recorded;

— upon completion of the tests, the average burn length may not exceed 203 mm (8 in), the average flame time after removal of the flame source may not exceed 15 s, and drippings from the test specimens, if any, may not continue to flame for more than an average of 5 s after falling.

6.1.2 Environmental tests

Any non-metallic materials used, e.g. for fire resistant container panels or doors, shall be submitted, as appropriate, to the tests specified in ISO 14186:

— puncture test per ISO 14186:2013, 6.1.2, in accordance with ISO 12236, for any door textile material;

— U.V. and humidity test per ISO 14186:2013, 6.1.3, in accordance with ISO 877-1, ISO 4892-1, and ISO 4892-3;

— abrasion test per ISO 14186:2013 6.1.4, in accordance with a recognized test method;

— fungus resistance test per ISO 14186:2013, 6.1.5, in accordance with EUROCAE ED-14G, Section 13.

The test results shall be used to determine if the container can be guaranteed to indefinitely maintain its original performance, or if it, or certain of its components, shall be life-limited to guarantee it.

6.2 FRC air-tightness test (conditional)

6.2.1 Container air-tightness can be a significant element of its fire containment performance, in both the normal and maximum allowable damage conditions. Where its determination is necessary for performance assessment, a test shall be conducted to determine its air leakage rate, as follows.

6.2.2 The temperature inside and outside the container shall be stabilized within 3 K (5 °F) of each other and shall both be within the range of 288 K to 298 K (58 °F to 76 °F). The container shall be empty, in its normal operational condition, and the door normally closed.

6.2.3 Air shall be introduced through an accurate metering device, and a suitable manometer shall be connected to the container by a leak-proof connection. The manometer shall not be part of the air supply system. The flow-measuring device shall be accurate to ±3 % of the measured flow rate, and the manometer on the container shall be accurate to ±5 %.

6.2.4 The container, once closed according to instructions, shall be submitted to air introduction at various rates as necessary. If the venting area is not permanent but operates under a pressure differential (e.g. door seals deformation), the relative pressure shall be at least 3,5 kPa (0,5 lbf/in^2) in accordance with ISO 11242 and 4.5.5.

6.2.5 The actual container venting area shall be computed from the flow and pressure measurements. In order to account for the possible effects of slightly different positioning of the door, this shall be repeated at least five times after reopening and closing the door. The average calculated venting area shall be recorded.

Measurements varying more than 20 % from the average should not be retained, insofar as they likely indicate incorrect positioning of the door. Design efforts should aim at preventing or minimizing the possibility of such incorrect positioning.

6.2.6 Where air flow suppression or limitation is essential to fire containment performance, it shall be taken into account that the effective venting area and leakage rate measured on a newly built unit can become significantly higher on an in-service container, due to warping, wear, and deformations. In-service inspection methods and maximum allowable damage criteria, such as structure warping, etc., shall be accordingly defined as part of the Instructions for Continuing Airworthiness (ICA) in the Component Maintenance Manual (CMM).

6.3 FRC full scale test

6.3.1 In order to substantiate the fire resistant container model's approval, full scale tests of the container shall be performed: the container shall be built-up with the load specified in 6.3.2 then closed, and a class A fire as defined in 3.7 lit within the cargo. The amount of fire materials shall be determined in order to sustain the fire for the minimum protection time defined in 5.2.3, and in accordance with the U.S. DOT/FAA/TC-TN12/11 technical report (see Reference [6]). Test recordings shall start on fire ignition.

6.3.2 Materials for the Class A fire shall be built-up inside the container. The following arrangement is to be used for test repeatability purposes:

— fill up corrugated cardboard boxes measuring approximately 450 mm × 450 mm × 450 mm (18 in × 18 in × 18 in) and weighing approximately 1 kg (2 lb) with approximately 1,2 kg (2,5 lb) of shredded paper (not confetti) each. Each box shall be filled at least 75 % in volume;

— stack together, immediately adjacent to each other, as many of them as necessary to fill the container, then position, calibrate and adjust any monitoring equipment;

— fire ignition shall be obtained by remote control in one of the boxes at the lowest stacking level, immediately adjacent to one corner of the fire resistant container between the door and a side panel (worst case), and adjacent to an inner sealing or bonding line if any is part of the design.

6.3.3 Thermocouple readings at locations above and around the fire resistant container and below the base shall be performed throughout the duration of the test to measure the temperature, at a distance of 100 mm (4,0 in) outside of the container, using test apparatus (thermocouples) specified in CS-25, CCAR-25, JAS Part 3 or 14 CFR Part 25 Appendix F, Part III, paragraph (d)(4) i.e. 1,6 mm (1/16 in) ceramic sheathed type K grounded thermocouples with a nominal 0,25 mm/30 American wire gauge (AWG) diameter connector, or equivalent. There shall be no flame penetration (burn-through) at any time, and the peak measured temperatures shall at no time exceed 204 °C (400 °F).

NOTE 1 Reference [19] includes an allowance for a brief ignition of the test specimen as long as the 204 °C (400 °F) requirement is not exceeded.

NOTE 2 Flame penetration is not to be mistaken with off gassing of certain non-metallic materials (see 6.3.7).

6.3.4 The container shall be supported at least 200 mm (8 in) over a non-heat reflecting, e.g. concrete, floor. A minimum of eight recording thermocouples shall be located 100 mm ±10 mm (4 in ± ½ in) away from the container contour and under it, at the fixed locations defined in Annex B, not to be readjusted if the container deforms either inside or outside its initial contour during the test. When testing maximum allowable damage containers (see 6.3.6), additional thermocouples shall be located 100 mm ± 10 mm (4 in ± ½ in) away from any container panel puncture.

NOTE 1 Other additional thermocouples may be used, if deemed necessary according to previous testing results. It is to be taken into account that overheat points over the top part of the container can be very localized, as a result of temporary inside flame bursts.

Where the distance from a thermocouple significantly increases over 100 mm (4 in) during the test as a result of deformations, the concerned thermocouple's reading should not be taken into account from that moment.

6.3.5 These measurements shall be continuously recorded at appropriate time intervals for the duration required by aircraft extended range operations maximum diversion time (see 5.2.3), after fire ignition, and the time history data shall be used to determine the length of protection time afforded by the system. This will become part of the fire resistant container's approval, to be in turn used to determine an approved aircraft cargo compartment protection time.

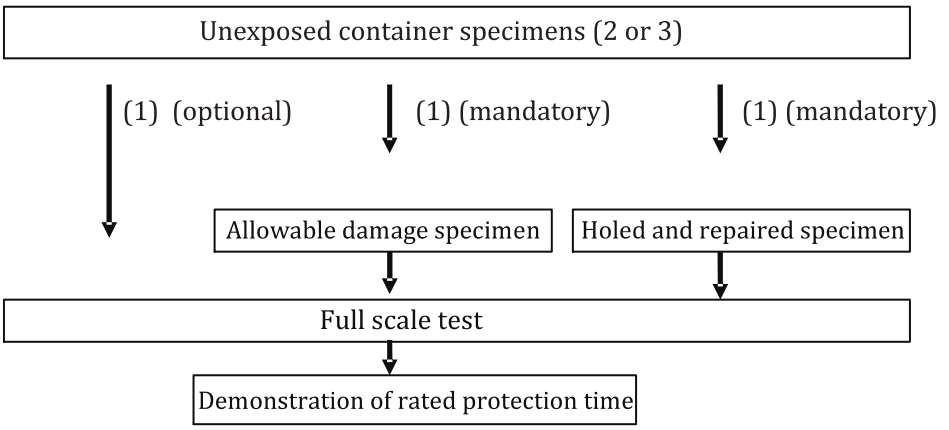
6.3.6 The test in 6.3.1 shall either be performed or repeated with a fire resistant container presenting maximum damage, such as defined punctures, intended to be allowed in operation (see 5.3), then with a repaired unit in order to substantiate the retained repair method. For punctured container tests, particular attention shall be paid to the possibility of flame outbursts through any punctures. Such flames shall not exceed the duration limits in 6.3.7, and temperature measured 100 mm (4,0 in) outside of the container by the additional thermocouple located next to the puncture shall not exceed 204 °C (400 °F). The test record files shall be used to substantiate the defined degree of damage as allowable operational serviceability limits, and repair method approval.

6.3.7 During each test, continuous attention shall be paid to behaviour of the materials, and any partial or complete melting, off gassing, combustion, or drippings if any, shall be recorded together with the relative location and duration of each event. The duration of any outer flame resulting from off gassing in the container panels may not exceed 15 s, and drippings, if any, may not continue to flame for more than an average of 5 s after falling.

6.3.8 FRC full scale testing record files, including the thermocouple readings continuous recording, shall be maintained for all tests in 6.3.1 and 6.3.7, and made available to the purchaser on request, and where applicable to the approval authority.

It is recommended that the files also include continuous video recording all around the unit during each test. Additional test measurement devices can include infrared cameras for overall temperature distribution assessment, and aircraft type smoke detectors to record the first detectable smoke outbreak.

6.3.9 A typical schedule to perform the minimum required series of FRC full scale tests should be as illustrated below.



However, the number and sequence of tests may be altered in order to best fit testing arrangements, under condition that the requirements of each testing clause are complied with, and the actual numbers, sequence and results be recorded in the testing file.

7 Markings

7.1 Each fire resistant container conforming to this International Standard shall bear at least the following markings:

a) identification graphic symbol shown in Annex B, at mid height on two opposite sides;

NOTE Where maximum damage for fire resistance performance is less than for general container airworthiness, the graphic symbol may be crossed-out in operation in order to allow use as an ordinary container while the fire performance limits are exceeded, see 5.3.7 NOTE and Annex B.

b) markings required on a standard container (see ISO 10327 and TSO/ETSO C90):

- manufacturer or supplier's name and address or identifiable logo;
- type, part number, or model designation;
- ISO 21100/AS 36100 configuration code (e.g. "AS 36100*A – 2A7C*");
- authority approval (e.g. "*TSO-C-90d* ", authorization number and date);
- individual serial number, with the option to add the date of manufacture;
- tare weight in the format ____ kg (____ lb);
- any limitations or aircraft type restrictions;

c) additional FRC specific markings at mid height on two opposite sides:

- "FIRE RESISTANT CONTAINER", in bold characters at least 50 mm (2 in) high;
- approved protection duration (e.g. "*Minimum protection time 6 hours*");
- "ISO 19281".

The indication "ISO 19281" shall be deemed to mean, under the manufacturer's or supplier's responsibility, that the unit complies with the mandatory requirements of this International Standard, and meets at least in an equivalent manner its recommended criteria.

7.2 If applicable for the materials, the container or parts of it are constructed from (see 4.6.5), a traceability code shall be marked to enable the unit's manufacturing and (if recorded by the user) in-service history to be retraced, and include, in accordance with TSO/ETSO C90.

— Year (four numerics) – month (two numerics) of manufacture

— Expiration date year (four numerics) – month (two numerics), preceded by “EXP”, as defined with the purchaser as a result of environmental degradation evaluation testing (see 4.6.3), if applicable. Characters shall be bold and at least 25 mm (1 in) high.

— Code of production batch, assigned by the manufacturer (optional). A new production batch code should be assigned any time a change occurs in either materials nature, or procurement source, or fabrication process.

Example of a traceability code:

2015 -10 / **EXP 2020- 09** / A17

Manufacture date Expiry date Production batch (optional)

If applicable, the traceability code including expiration date shall be marked on either the whole container, or the part (e.g. flexible door) specifically concerned.

7.3 The markings in 7.1 (b) and (c) and 7.2 shall be engraved or otherwise printed in an indelible manner, in characters at least 12,5 mm (½ in) high except the “FIRE RESISTANT CONTAINER” and “EXPIRY DATE” ones, onto the data plate affixed to the outer surface of the container (ensuring the printing process or plate fixing means do not deteriorate material’s fire containment performance) or a manufacturer’s tag permanently affixed to it. They should preferably remain legible after the container’s full scale fire test.

7.4 In addition, where a removable item’s material is such that one side shall be the inner one to withstand fire, the outer side shall bear at mid height the words ” THIS SIDE OUT ” and, conversely, the words “THIS SIDE IN” at mid height on each inner side, in contrasting colour bold characters at least 150 mm (6,0 in) high.

8 Manufacturer’s instructions

8.1 The manufacturer shall deliver together with the first batch of fire resistant containers a set of written instructions including at least the following:

a) Certificate of Conformity with the requirements of the present International Standard;

b) guaranteed protection time (see 5.2.3) to be used for flight operations;

c) authority approval, as applicable;

d) appropriate instructions to the operators (see 8.2);

e) materials Environment Qualification Forms required (see 4.6.4);

f) recycling instructions (see 4.3.4).

The tests record file defined in 6.3.8 should be made available to the purchaser on request, and shall be provided to the approval authority where applicable.

Document (a) shall be renewed at each subsequent delivery.

8.2 Instructions to the operators under 8.1 (d) should include at least the following:

a) storage conditions and inventory control requirements appropriate to ensure that the FRC’s performance is maintained and any applicable expiry dates are complied with;

b) intended conditions of use and any exclusions there from if applicable;

c) environmental assessment, health precautions, known chemical incompatibilities;

d) appropriate installation and removal instructions;

e) inspection requirements and serviceability limits (maximum allowable damage);

f) instructions for continuing airworthiness (ICA) and approved repair instructions with parts and materials procurement information (CMM), including expiry dates and storage requirements for spares, where applicable, and the maximum damage allowances.

9 Operator requirements

9.1 General

Flight safety depends on effectiveness and dependability of fire resistant containers build-up and control prior to their being loaded aboard aircraft. Accordingly, it is essential that air carriers, as required by their operating certification, fully meet their responsibilities as follows.

9.2 Operating instructions

9.2.1 The air carrier shall ensure that the fire resistant containers used meet the performance and testing requirements of this International Standard and, if applicable, were approved by an appropriate authority for use on the aircraft type(s) concerned.

9.2.2 The air carrier shall establish and distribute to all concerned, including sub-contractors, fire resistant containers operating instructions specifying the aircraft cargo compartments where FRC use is either allowable or required and taking into account the requirements of the approved Weight and Balance Manual(s) for the aircraft type(s) concerned, as well as the recommendations of the present International Standard and any specific requirement from authority approval, if applicable.

9.2.3 The air carrier shall take all necessary steps to ensure that these operating instructions are fully understood and applied at each airport by at least one suitably trained and available competent person (see 9.3) or under its direct supervision, including the establishment and implementation of such procedure as can guarantee an aircraft will not be dispatched with fire resistant containers in use on board unless each container was inspected after build-up and found satisfactory by such a competent person prior to release for loading aboard the aircraft.

9.2.4 Operating instructions should consider operating procedures for either fully or partly loaded containers, including the following:

— cargo stacking, door installation, handling and storage instructions;

— limitations or restrictions on carriage of oxygen generating devices or oxygen storage devices, since oxygen starvation is a parameter of safe use of FRCs. The operating instructions should consider the prohibition of loading into the container packages containing ICAO TI/IATA DGR items:

  — UN 1072, Oxygen, Compressed;

  — UN 3356, Oxygen generator, Chemical;

  — UN 3090, Lithium metal batteries;

— any other pertinent procedure or precaution.

9.2.5 Operating instructions shall include procedures for duly inspecting the condition of the fire resistant container after build-up, checking for air-tightness and possible punctures or other damage against approved serviceability limits.

9.2.6 The air carrier shall ensure that the Aircraft Flight Manual (AFM) for the relevant aircraft type(s) includes the maximum guaranteed protection time determined for each fire resistant container type used, and flight planning takes it into account for determination of routes, see 4.1.3.

9.3 Training and qualification

9.3.1 The air carrier shall establish and implement recurrent training programs to ensure their fire resistant containers installation instructions are fully understood and practiced by a sufficient number of duly trained competent persons as defined, for example in ISO 9001:2008, 6.2.2, throughout their organization and subcontractors responsible for preparing containers for loading aboard aircraft.

9.3.2 The basic contents of such training programs should be taught using field training and practical demonstrations with actual fire resistant containers. They should also include information on any limitations applicable to the specific aircraft type(s) intended.

9.3.3 It is recommended that such training be individually recorded after a proficiency check was performed, both theoretical and practical (actual containers build-up). Such individuals may be deemed qualified to perform fire resistant containers inspection and release for loading aboard an aircraft.

NOTE A recommended practice consists in having the qualified individual who performed the inspection sign the container tag accordingly.

9.4 Quality control

9.4.1 As any activity with a potential impact on flight safety, fire resistant containers build-up and 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 14 CFR Part 121 and FAA AC 120-59, EU-OPS 1.035 and its AMC and IEM).

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

9.4.3 It is also recommended airport cargo handling agencies facilities performing build-up of fire resistant containers for loading on board an air carrier's aircraft maintain their own continuous quality control program meeting the requirements of (for example, ISO 9001) or an equivalent pertinent industry standard.

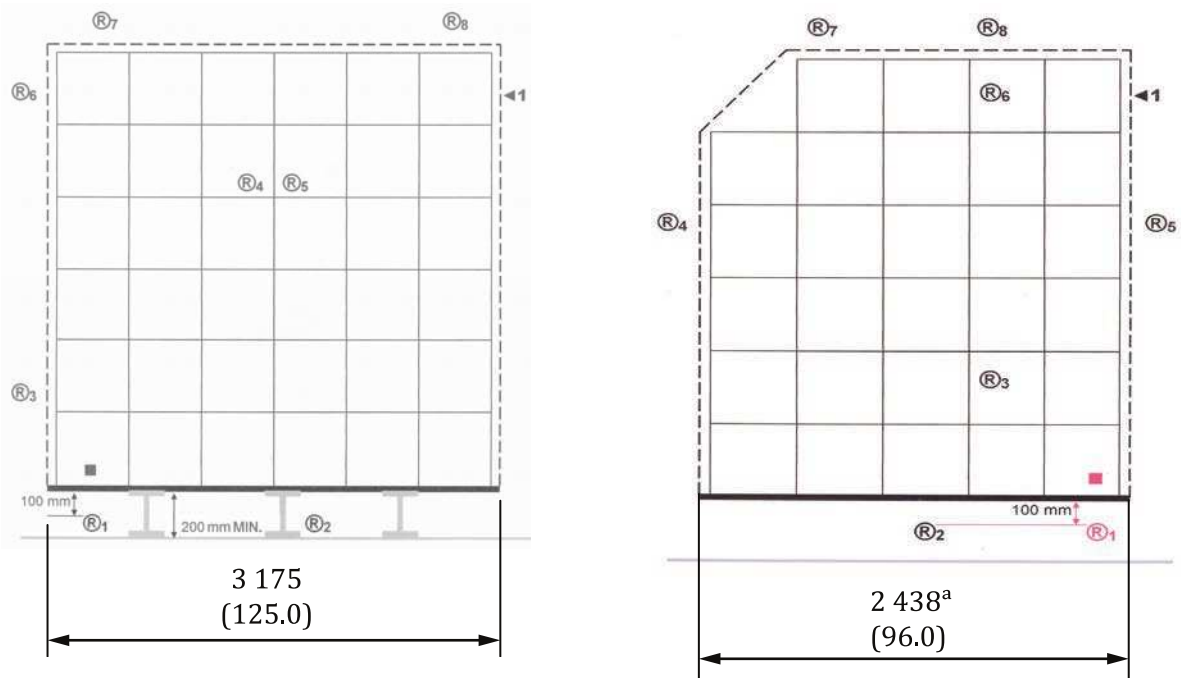
9.4.4 In addition, it is recommended any significant incident, in flight or on the ground at aircraft loading or offloading, resulting from or related to improper performance, installation or inspection of (a) fire resistant container(s) be reported and subject to carrier's quality control department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

9.4.5 Any occurrence or evidence of a fire in a fire resistant container, whether on the ground or in flight, shall be immediately reported to the air carrier's quality control department to be investigated as a flight safety occurrence. The fire resistant container involved and its load shall be kept aside for the investigation, and the container shall not be returned to service after it unless cleared.

Annex A
(normative)

Location of thermocouples for FRC full scale test

See 6.3.2 for test load characteristics. Size **M** contour **D** example. For smaller contours, thermocouples number to be maintained but positions adjusted.



a) Side view **b) End view**

Key

1 maximum ULD contour

■ ignition box

® recording thermocouples

a Or 2 235 mm (88,0 in) for size **A**.

NOTE See 6.3.4 for additional thermocouples to be located 100 mm (4 in) away from any container panel puncture when testing a container presenting maximum allowable damage.

Figure A.1 — Location of thermocouples for FRC full scale test

Annex B
(normative)

FRC graphical symbol

Safety yellow background: see ISO 3864.

Black frame and bold letter F

Minimum dimensions: 200 mm × 200 mm (8 in × 8 in)

Recommended dimensions: 300 mm × 300 mm (12 in × 12 in)

Crossed out symbol to indicate container not meeting anymore fire protection damage limits (see 5.3.7 NOTE and 7.1)

Bibliography

[1] ISO 2685, *Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones*

[2] ISO 9001, *Quality management systems — Requirements*

[3] IATA ULD Regulations Standard Specification 40/3, *Operational Damage Limits Notice*[7)]

[4] IATA ULD Regulations Standard Specification 50/0, *ULD General Technical Requirements*[7)]

[5] IATA ULD Regulations Standard Specification 50/4, *Certified Aircraft Container*[7)]

[6] U.S. DOT/FAA/TC-TN12/11, *Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression System (2012* update*)*, FAA W.J. Hughes Technical Center, http://www.fire.tc.faa.gov

[7] RTCA DO-160G,[8)] *Environmental conditions and test procedures for airborne equipment*, http://www.rtca.org

[8] SAE AIR 1490C, *Environmental Degradation of Textiles Used in Air Cargo Equipment*[9)]

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

[10] NAS 3610 Rev 10,[10)] *Minimum Airworthiness Requirements and Test Conditions for* Air *Cargo ULD*

[11] ASTM G151-10, *Standard Practice for Exposing Non-metallic Materials in Accelerated Test Devices that use Laboratory Light Sources*[11)]

[12] ASTM G154-06, *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Non-metallic Materials*

[13] Advisory Circular FAA (AC) 25.795-5, *Cargo compartment fire suppression*, http://www.faa.gov

[14] Advisory Circular FAA (AC) 120-59, *Air carriers internal evaluation programs*, http://www.faa.gov

[15] Advisory Circular FAA (AC) 120-85A, *Air cargo operations*, http://www.faa.gov

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

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

[18] ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment*

[19] US FAA Aircraft Materials Fire Test Handbook

[20] ISO 3864, *Graphical symbols — Safety colours and safety signs*

7) IATA Technical Standard Specifications are part of the Unit Load Devices Regulations, which can be obtained from : International Air Transport Association, Publications Assistant, 800 Place Victoria, PO Box 113, Montréal, Québec, Canada H4Z 1M1.

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

9) Equivalent to ISO/TR 8467, can be obtained from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale PA 15096-001, USA, or through its web site at www.sae.org.

10) Equivalent to ISO 8097, can be obtained from Aerospace Industries Association, 1250 Eye Street NW, Washington, DC 20005, USA.

11) ASTM G151-10 and ASTM G154-06 are equivalent to ISO 4892-1 and ISO 4892-3. ASTM standards can be obtained from American National Standards Institute (ANSI), 1819 L Street NW, Washington DC 20036, U.S.A.

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