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# International Standard



# 1496/2

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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## Series 1 freight containers — Specification and testing — Part 2 : Thermal containers

*Conteneurs de la série 1 — Spécifications et essais — Partie 2 : Conteneurs à caractéristiques thermiques*

Second edition — 1979-11-01

**iTeh STANDARD PREVIEW**  
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## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1496/2 was developed by Technical Committee ISO/TC 104, *Freight containers*.

This second edition was submitted directly to the ISO Council, in accordance with clause 6.13.1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 1496/2-1977), which had been approved by the member bodies of the following countries:

Australia	Hungary	Poland
Belgium	India	Romania
Brazil	Iran	South Africa, Rep. of
Bulgaria	Ireland	Spain
Canada	Israel	Sweden
Cuba	Japan	Switzerland
Czechoslovakia	Malaysia	Turkey
Denmark	Mexico	United Kingdom
Finland	Netherlands	USA
France	New Zealand	USSR
Germany, F. R.	Norway	Yugoslavia

The member body of the following country had expressed disapproval of the document on technical grounds :

Austria

# Series 1 freight containers — Specification and testing — Part 2 : Thermal containers

## iTeh STANDARD PREVIEW (standards.iteh.ai)

### 0 INTRODUCTION

Part 6

Grouping of container types for specification purposes		Platform based	54 and 55, 61 to 69
Part 1		Air mode	90 to 99
General cargo	00 to 09, 50 to 53, 56 to 59		
Part 2			
Thermal	20 to 49		
Part 3			
Tank	70 to 79		
Part 4 <sup>1)</sup>			
Bulk	80 to 84		
Part 5			
Platform (container)	60		

#### NOTES

1 Container groupings for Part 1 and Parts 3 to 7 will be set forth in detail in the relevant documents.

2 The 1E and 1F containers have been deleted from Series 1 freight containers. The text of Part 2 : Thermal containers, has been changed to reflect this deletion.

#### 1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard sets out basic requirements for the specification and testing of ISO series 1 Part 2 freight containers which are suitable for international exchange and for conveyance by road, rail and sea, including interchange between these forms of transport.

1) Currently under study.

1.2 The container types covered by this International Standard are as follows :

Code	Type	K max. W/(m <sup>2</sup> ·°C)	Temperatures			
			°C		°F	
			inside	outside	inside	outside
20	Insulated	0,4*	—	—	—	—
21	Insulated	0,7*	—	—	—	—
22	Heated	0,4	16	- 20	60	- 4
23 to 29	Spare numbers for insulated or heated containers					
30	Refrigerated expandable refrigerant.	0,4	- 18	38	0	100
31	Mechanically refrigerated.	0,4	- 18	38	0	100
32	Refrigerated and heated.	0,4	- 18/16	38/ - 20	0/60	100/ - 4
33 to 39	Spare numbers for refrigerated, mechanically refrigerated and refrigerated and heated containers.					
40	Refrigerated and/or heated, with removable equipment, appliance located externally.	0,4	**	**	**	**
41	Refrigerated and/or heated with removable equipment, appliance located internally.	0,4	**	**	**	**
42	Refrigerated and/or heated, with removable equipment, appliance located externally.	0,7	**	**	**	**
43 to 49	Spare numbers for refrigerated and/or heated containers with removable equipment.					

\* 0,4 W/m<sup>2</sup>·°C = 0,0704 Btu/h·ft<sup>2</sup>·°F  
 0,7 W/m<sup>2</sup>·°C = 0,1232 Btu/h·ft<sup>2</sup>·°F

\*\* This category does not have specified temperature limits. The actual performance is dependent on the capability of the equipment attached in any transport mode.

**1.3** The marking requirements for these containers are to be in accordance with the principles embodied in ISO 790 and ISO 2716 for the marking and identification of series 1 containers.<sup>1)</sup>

If containers are fitted for the carriage of hanging cargo, the load bearing capability of the handling equipment shall be clearly marked on the inside of the container.

## 2 REFERENCES

ISO 668, *Freight containers — External dimensions and ratings.*

ISO 790, *Marking of series 1 freight containers.*<sup>1)</sup>

ISO 1161, *Series 1 freight containers — Corner fittings — Specification.*

ISO 2716, *Identification marking code for freight containers.*<sup>1)</sup>

## 3 DEFINITIONS

The following definitions apply to thermal freight containers:

**3.1 thermal container:** Freight container built with insulating walls, doors, floor and roof which retard the rate of heat transmission between the inside and the outside of the container.

**3.2 insulated container:** Thermal container without the use of devices for cooling and/or heating.

**3.3 refrigerated container (expendable refrigerant):** Thermal container using a means of cooling such as:

- ice, or
- dry ice, with or without sublimation control, or
- liquefied gases, with or without evaporation control.

It is implicit in this definition that such a container requires no external power supply or fuel supply.

**3.4 mechanically refrigerated container:** Thermal container served by refrigerating appliance (mechanical) compressor unit, absorption unit, etc.).

**3.5 heated container:** Thermal container served by heat-producing appliance.

**3.6 refrigerated and heated container:** Thermal container served by refrigerating appliance (mechanical or expendable refrigerant) and heat-producing appliance.

**3.7 removable equipment:** Refrigerating and/or heating appliance which is designed primarily for attaching to or detaching from the container when transferring between different modes of transportation.

**3.8 located internally:** Totally within the external dimensional envelope of the container as defined in ISO 668.

**3.9 located externally:** Partially or totally outside the external dimensional envelope of the container as defined in ISO 668.

It is implicit in this definition that an appliance located externally must be removable or retractable to facilitate transport in certain modes.

**3.10 battens:** Members protruding from the inside walls of the container to hold the freight away from the walls to provide an air passage. They may be integral with the walls, or added during cargo loading.

**3.11 bulkhead:** A partition providing a plenum chamber and/or air passage for either return or supply air. It may be an integral part of the appliance or a separate member.

**3.12 ceiling air duct:** A passage or passages located in proximity to the ceiling to direct air flow.

**3.13 floor air duct:** A passage or passages located beneath the freight support surface to direct air flow.

## 4 DIMENSIONS AND RATINGS

### 4.1 External dimensions

The overall external dimensions and tolerances of the freight containers covered by this International Standard are those established in ISO 668. No part of the container shall project beyond these overall external dimensions.

### 4.2 Internal dimensions

Internal dimensions of containers shall be as large as possible. They shall be measured from inner faces of battens, bulkheads, ceiling air ducts, floor air ducts, etc., where fitted. The minimum internal width shall be 2 200 mm (86 5/8 in) for container types 20, 21, 22, 30, 31, 32, 40, 41 and 42.

### 4.3 Ratings

The value of the rating  $R$ , being the maximum operating gross weight of the container, are those given in ISO 668.

$$R = P + T$$

where  $P$  is the maximum operating payload and  $T$  is the tare weight.

1) For containers having particular characteristics which prevent the application of the general specification for marking, reference should be made to ISO 790. A combination and revision of ISO 790 and ISO 2716 is under study by TC 104/WG 3.

## 5 DESIGN REQUIREMENTS

### 5.1 General

All containers shall be capable of fulfilling the following requirements.

The strength requirements for containers are given in diagrammatic form in annex A (these requirements are applicable to all containers except where otherwise stated). They apply to containers as complete units, except as envisaged in 6.1.

The strength requirements for corner fittings (see also 5.2) are given in ISO 1161.

The containers shall be capable of withstanding all the test requirements detailed in clause 6.

As the effects of loads encountered under any dynamic operating condition should only approach, but not exceed, the effects of the corresponding test loads, it is implicit that the capabilities of containers indicated in annex A and demonstrated by the structural tests described in clause 6 shall not be exceeded in any mode of operation.

### 5.2 Corner fittings

Series 1 containers 1AA, 1A, 1BB, 1B, 1CC, 1C and 1D shall be equipped with top and bottom corner fittings. The requirements and positioning of the corner fittings are given in ISO 1161. The upper faces of the top corner fittings shall protrude above all other parts of the top of the container by a minimum of 6 mm (1/4 in) (see 5.3.3).

### 5.3 Base structure

**5.3.1** All containers equipped with bottom corner fittings shall be capable of being supported by their bottom corner fittings only.

Containers 1AA, 1A, 1BB, 1B, 1CC and 1C shall also be capable of being supported on load transferring areas in their base structures only.

Consequently, these containers shall have end transverse members and sufficient intermediate load transferring areas (or a flat underside) of sufficient strength to permit vertical load transfer. These requirements are specified in annex B.

The maximum load to be transferred at the load transfer zones (shown in figure 23) shall not exceed the value  $R$  multiplied by a dynamic factor of 2,0.

For containers 1AA, 1A, 1BB, 1B, 1CC and 1C the lower faces of the load transferring areas in their bases, including their end transverse members, shall lie in a plane located :

$$12,5 \begin{matrix} + 5 \\ - 1,5 \end{matrix} \text{ mm} \left( 1/2 \begin{matrix} + 3/16 \\ - 1/16 \end{matrix} \text{ in} \right)$$

above the base plane of the containers (bottom faces of lower corner fittings).

**5.3.2** For the 1D container, the level of the underside of the base structure is not specified, except insofar as it is implied in 5.3.3.

**5.3.3** For series 1 containers under dynamic conditions, or the static equivalent thereof, with the container having a load uniformly distributed over the floor in such a way that the combined weight of the container and test load is equal to  $1,8 R$ , no part of the base of the container shall deflect more than 6 mm (1/4 in) below the base plane (bottom faces of the lower corner fittings).

**5.3.4** The base structure shall be designed to withstand all forces, particularly lateral forces, induced by the cargo in service. This is particularly important where provisions are made for securement of cargo to the base structure of the container.

### 5.4 End structure

For containers 1AA, 1A, 1BB, 1B, 1CC and 1C, the sideways deflection of the top of the container with respect to the bottom of the container at the time it is under full transverse rigidity test conditions shall not cause the sum of the changes in length of the two diagonals to exceed 60 mm (2 3/8 in).

### 5.5 Side structure

For containers 1AA, 1A, 1BB, 1B, 1CC and 1C, the longitudinal deflection of the top of the container with respect to the bottom of the container at the time it is under full longitudinal rigidity test conditions shall not exceed 25 mm (1 in).

### 5.6 Walls

Where openings are provided in end or side walls, the ability of these walls to withstand tests Nos. 5 and 6 shall not be impaired.

### 5.7 Door opening

Each container shall be provided with a door opening at least at one end.

Containers designated 1AA, 1A, 1BB, 1B, 1CC, 1C and 1D shall have a door opening as large as possible, preferably having dimensions equal to those of the internal cross-section of the containers.

### 5.8 Sanitary requirements

Attention is drawn to the need for the proper choice of materials for the container and refrigeration/heating appliances to prevent adverse effects on cargoes. Any relevant national or international requirements should also be considered.

The interior surface and the container structure shall be so constructed as to facilitate cleaning and the surface and the

insulation shall not be functionally affected by cleaning methods, such as wet steam cleaning and detergents normally used.

No pockets shall exist inside the container that cannot be reached by conventional cleaning methods.

Adequate provision should be made to ensure that cleaning water can drain satisfactorily from the inside of the container.

## OPTIONAL REQUIREMENTS

### 5.9 Fork lift pockets

Fork lift pockets may be provided as optional features for handling 1CC, 1C and 1D containers in the loaded or unloaded condition. The dimensional requirements for such pockets are specified in annex C.

Fork pockets, when provided, shall pass completely through the base structure of the container, so that lifting devices may be inserted from either side.

It is not necessary for the base of the fork lift pockets to be the full width of the container, but it should be provided in the vicinity of each end.

### 5.10 Provision for handling at the base by means of grapple arms or similar devices

Provision for handling 1AA, 1A, 1BB, 1B, 1CC, 1C and 1D containers by means of grapple arms or similar devices may be provided as optional features. The dimensional requirements for such provisions are specified in annex D.

### 5.11 Gooseneck tunnels

Gooseneck tunnels may be provided as optional features in containers 1AA and 1A. The dimensional requirements are specified in annex E and, in addition, all other parts of the base structure shall be as specified in 5.3.

NOTES — The requirements of 5.2, 5.9 and 5.10 do not preclude the provision of additional facilities for lifting, either from the top or at the bottom of the containers.

### 5.12 Drains

Cargo space drains, if required to operate when carrying cargo, should be protected by fittings which open automatically above normal internal operating pressure. If required for cleaning of the interior of the container, they shall be provided with manual closures.

Consideration should be given to Customs and health requirements.

### 5.13 Water connections

For appliances requiring water connections the inlet and outlet interfaces shall conform to annex F.

Water-cooled appliances should incorporate the possibility to drain the unit in order to prevent freezing of the water.

The water inlet and outlet connections shall be so located at the machinery end of the container that, to an observer facing that end, they appear in the lower right-hand quarter.

### 5.14 Air inlets and outlets

Where series 1AA, 1CC and 1C containers are designed for ducted air systems and for use with externally located removable equipment, the air inlet and outlet openings shall conform to G.1, G.2 and G.3, respectively, of annex G.

NOTE — The requirements of 5.2, 5.9 and 5.10 do not preclude the provision of additional facilities for lifting, either from the top or at the bottom of the container.

## 6 TESTING

### 6.1 General

Unless otherwise stated, containers complying with the design requirements specified in clause 5 shall, in addition, be capable of withstanding the tests specified in 6.2 to 6.17 inclusive, as applicable.

The refrigeration and/or heating equipment (for example components, framework, panelling, battens, ductwork, bulkheads) need not necessarily be in place when the container is tested except where specified for a particular test. But where any of the main parts or frameworks of the refrigeration and/or heating equipment is not in position for any test, the ability of that part or framework to withstand the appropriate proportion of any relevant cargo loading and/or the forces or accelerations to which the container and equipment may be subjected in the service for which it was designed shall be established independently. Where parts of the refrigeration and/or heating equipment which contribute to the strength or integrity of the container in service are not in position for testing, substitute framework and/or panelling may be employed during testing provided such substitute components are secured in the same manner as the equipment itself and do not provide greater strength than the equipment would have provided.

The test for weatherproofness (test No. 13) shall be made after tests Nos. 1 to 12, with the tests No. 14 (airtightness) and No. 15 (thermal) being made last.

6.1.1 The symbol  $R$  denotes the maximum operating gross weight of the container and the symbol  $P$  denotes the maximum operating payload of the container to be tested, that is, the tare weight  $T$  subtracted from the maximum operating gross weight  $R$  :

$$P = R - T$$

6.1.2 The test load within the container shall be uniformly distributed.

6.1.3 The test loads specified in all of the following tests are the minimum requirements.



**6.1.4** The dimensional requirements to which reference is made in the requirements sub-clause after each test are those specified in :

- a) the dimensional and design requirement clauses of this International Standard;
- b) ISO 668;
- c) ISO 1161.

**6.2 Test No. 1 – Stacking**

**6.2.1 General**

This test shall be carried out to prove the ability of a container to support five other fully loaded containers of the same length and rating under the acceleration conditions encountered in ships' cell structures, taking into account relative eccentricities between containers due to clearance.

**6.2.2 Procedure**

The container under test shall be placed on four level pads, one under each bottom corner fitting or equivalent corner structure. The pads shall be centralized under the fittings and be substantially of the same plan dimensions as the fittings. The container shall have had a load uniformly distributed over the floor in such a way that the combined weight of the container and the test load is equal to  $1,8 R$ .

The container under test shall be subjected to a vertical force equivalent to a load of  $2,25 R$  on each of the top corner fittings simultaneously or  $4,5 R$  on each pair of end fittings in such a manner that the planes of application of the forces and the supports of the container remain horizontal and unchanged during the test. The forces shall be applied through a corner fitting or a pad of the same plan area as a corner fitting. Each pad shall be offset in the same direction by 25,4 mm (1 in) laterally and 38 mm (1 1/2 in) longitudinally.

**6.2.3 Requirements**

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

**6.3 Test No. 2 – Lifting from the top corner fittings**

**6.3.1 General**

The test shall be carried out to prove the ability of 1AA, 1A, 1BB, 1B, 1CC and 1C containers to withstand being lifted from the top corner fittings with the lifting forces applied vertically, and the ability of the 1D container to withstand being lifted from the top corner fittings with the lifting forces applied at any angle between the vertical and  $30^\circ$  to the vertical, these being the only recognized methods of lifting these containers by the top corner fittings.

This test shall also be regarded as proving the ability of the floor and base structure to withstand the forces arising from acceleration of the payload in lifting operations.

**6.3.2 Procedure**

The container under test shall have a load uniformly distributed over the floor in such a way that the combined weight of the container and test load is equal to  $2 R$ , and it shall be carefully lifted from all four top corners in such a way that no significant acceleration or deceleration forces are applied.

For 1AA, 1A, 1BB, 1B, 1CC and 1C containers the lifting forces shall be applied vertically.

For the 1D container, lifting shall be by means of slings, the angle of each leg being at  $30^\circ$  from the vertical.

After lifting, the container shall be suspended for 5 min and then lowered to the ground.

**6.3.3 Requirements**

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

**6.4 Test No. 3 – Lifting from the bottom corner fittings**

**6.4.1 General**

This test shall be carried out to prove the ability of containers to withstand being lifted from bottom corner fittings by means of lifting devices bearing on the bottom corner fittings only and attached to a single transverse central spreader beam, above the container.

This test shall be carried out on 1AA, 1A, 1BB, 1B, 1CC, 1C and 1D containers.

**6.4.2 Procedure**

The container under test shall have a load uniformly distributed over the floor in such a way that the combined weight of container and test load is equal to  $2 R$ , and it shall be carefully lifted from the side apertures of all four bottom corner fittings in such a way that no significant acceleration or deceleration forces are applied.

Lifting forces shall be applied at :

- $30^\circ$  to the horizontal for 1AA and 1A containers;
- $37^\circ$  to the horizontal for 1BB and 1B containers;
- $45^\circ$  to the horizontal for 1CC and 1C containers;
- $60^\circ$  to the horizontal for the 1D container.

In each case the line of action of the lifting force and the outer face of the corner fitting shall be no farther apart



than 38 mm (1 1/2 in). The lifting shall be carried out in such a manner that the lifting devices bear on the bottom corner fittings only.

The container shall be suspended for 5 min and then lowered to the ground.

### 6.4.3 Requirements

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

## 6.5 Test No. 4 – Restraint (longitudinal)

### 6.5.1 General

This test shall be carried out to prove the ability of containers to withstand longitudinal external restraint under dynamic conditions of railway operations, which implies accelerations of 2 *g*.

### 6.5.2 Procedure

The container under test shall have a load uniformly distributed over the floor in such a way that the combined weight of container and test load is equal to *R*, and it shall be secured to rigid anchor points through the bottom apertures of the bottom corner fittings at one end of the container.

1AA, 1A, 1BB, 1B, 1CC, 1C and 1D containers shall be restrained longitudinally.

A force equivalent to a load of 2 *R* shall be applied horizontally to the container through the bottom apertures of the other corner fittings, first towards and then away from the anchor points.

### 6.5.3 Requirements

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

## 6.6 Test No. 5 – Strength of end walls

### 6.6.1 General

This test shall be carried out to prove the ability of containers to withstand forces under the dynamic conditions referred to in 6.5.1.

### 6.6.2 Procedure

The container shall have each end tested when one end is blind and the other equipped with doors. In case of symmetrical construction, one end only need be tested. 1AA,

1A, 1BB, 1B, 1CC, 1C and 1D containers shall be subjected to an internal load of 0,4 *P*. The internal load shall be uniformly distributed over the wall under test and arranged to allow free deflection of the wall.

### 6.6.3 Requirements

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

## 6.7 Test No. 6 – Strength of side walls

### 6.7.1 General

This test shall be carried out to prove the ability of containers to withstand the forces resulting from ship motions.

### 6.7.2 Procedure

Each side wall of 1AA, 1A, 1BB, 1B, 1CC, 1C and 1D containers (or one only in the case of symmetrical construction) shall be subjected to an internal uniformly-distributed force of 0,6 *P*, applied separately and arranged to allow free deflection of the side wall and its longitudinal members.

### 6.7.3 Requirements

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

## 6.8 Test No. 7 – Strength of the roof

### 6.8.1 General

- a) This test shall be carried out to prove the ability of the roof of a container to withstand the loads imposed by persons working on it.
- b) If the roof is intended to carry a hanging cargo a test shall be carried out to prove the ability of the container to carry a minimum total hanging load of 1 490 kg/m (1 000 lb/ft) of usable inside container length. A vertical acceleration of 2 *g* shall be taken into account.

### 6.8.2 Procedure

- a) A load of 300 kg (660 lb) shall be uniformly distributed over an area of 600 mm × 300 mm (24 in × 12 in) located at the weakest area of the roof of the container.

b) A load of twice the service load or twice 1 490 kg/m (1 000 lb/ft), whichever is greater, shall be attached to the roof in a manner simulating normal service loadings, while the container is supported by its four corner fittings only.

### 6.8.3 Requirements

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

## 6.9 Test No. 8 – Floor strength

### 6.9.1 General

This test shall be carried out to prove the ability of a container floor to withstand the concentrated dynamic loads imposed during loading operations by trucks or similar devices.

The test applies to 1AA, 1A, 1BB, 1B, 1CC, 1C and 1D containers.

### 6.9.2 Procedure

The test shall be performed using a test vehicle equipped with tyres, and loaded to 5 460 kg (12 000 lb) per axle [i.e. 2 730 kg (6 000 lb) on each of two wheels]. It is to be so arranged that all points of contact between each wheel and a flat continuous surface lie within a rectangular envelope measuring 185 mm (7 1/4 in) in a direction parallel to the axle of the wheel, by 100 mm (4 in), and that each wheel makes physical contact over an area within this envelope of not more than 142 cm<sup>2</sup> (22 in<sup>2</sup>). The wheel width is to be nominally 180 mm (7 in) and the wheel centres are to be nominally 760 mm (30 in). The test vehicle shall be manoeuvred over the entire floor area of the container. The test shall be made with the container resting on four level supports under its four bottom corner fittings with its base structure free to deflect.

### 6.9.3 Requirements

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

## 6.10 Test No. 9 – Rigidity (transverse)

### 6.10.1 General

This test shall be carried out to prove the ability of 1AA, 1A, 1BB, 1B, 1CC and 1C containers to withstand the racking forces resulting from ship motions.

### 6.10.2 Procedure

The container under test, in tare condition (7), shall be placed on four level supports, one under each corner fitting, and shall be restrained against lateral and vertical movement by means of anchor devices acting through the bottom apertures of the bottom corner fittings. Lateral restraint shall be provided only at a bottom corner fitting diagonally opposite to and in the same end frame as a top corner fitting to which force is applied. When testing the two end frames separately, vertical restraint shall only be applied at the end frame under test.

Forces of 150 kN (15 000 kgf) (15 tf) shall be applied either separately or simultaneously to each of the top corner fittings on one side of the container in lines parallel both to the base and to the planes of the ends of the container. The forces shall be applied first towards and then away from the top corner fittings.

In the case of a container with identical ends, only one end need be tested. Where an end is not essentially symmetrical about its own vertical centre line, both sides of that end shall be tested.

### 6.10.3 Requirements

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

## 6.11 Test No. 10 – Rigidity (longitudinal)

### 6.11.1 General

This test shall be carried out to prove the ability of 1AA, 1A, 1BB, 1B, 1CC and 1C containers to withstand the longitudinal racking forces resulting from ship motions.

### 6.11.2 Procedure

The container under test, in tare condition (7), shall be placed on four level supports, one under each corner fitting, and shall be restrained against longitudinally and vertical movement by means of anchor devices acting through the bottom apertures of the bottom corner fittings. Longitudinal restraint shall be provided only at a bottom corner fitting diagonally opposite to and in the same side frame as a top corner fitting to which force is applied.

Forces of 75 kN (7 500 kgf) (7,5 tf) shall be applied either separately or simultaneously to each of the top corner fittings on one end of the container in lines parallel both to the base of the container and to the planes of the sides of the container. The forces shall be applied first towards and then away from the top corner fitting. In the case of a container with identical sides, only one side need be tested. Where a side is not essentially symmetrical about its own vertical centre line, both ends of that side shall be tested.

### 6.11.3 Requirements

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

## 6.12 Test No. 11 – Lifting from fork lift pockets (where fitted)

### 6.12.1 General

The test applies to containers 1CC, 1C and 1D where fitted with fork lift pockets.

### 6.12.2 Procedure

The container under test shall have a load uniformly distributed over the floor in such a way that the combined weight of the container and test load is equal to 1,25 *R*, and it shall be supported on two horizontal bars, each 200 mm (8 in) wide projecting  $1\,828 \pm 3$  mm ( $72 \pm 1/8$  in) into the fork pocket, measured from the outside face of the side of the container. The bars shall be centred within the pockets.

The container shall be supported for 5 min and then lowered to the ground.

### 6.12.3 Requirements

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

## 6.13 Test No. 12 – Lifting from the base at grapple arm positions (where fitted)

### 6.13.1 General

This test shall be carried out on all containers with provisions for being lifted by grapple arms or similar devices with lifting positions as detailed in annex D.

### 6.13.2 Procedure

The container under test shall have a load uniformly distributed over the floor in such a way that the combined weight of the container and test load is equal to 1,25 *R*, and it shall be supported at the four positions where provision has been made for the equipment in 6.13.1, over an area of 32 mm × 254 mm (1.25 × 10 in), centrally located at each of the four positions, clear of the safety lips.

The container shall be supported for 5 min and then lowered to the ground.

### 6.13.3 Requirements

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

## 6.14 Test No. 13 – Weatherproofness

### 6.14.1 General

This test shall be carried out on door seals, exterior gasketed joints and other openings which are fitted with closing devices.

### 6.14.2 Procedure

A stream of water shall be applied to the area being tested from a nozzle of 12,5 mm (0.51 in) inside diameter, at a pressure of about 1 bar [corresponding to a head of about 10 m (33 ft) of water], on the upstream side of the nozzle. The nozzle shall be held at a distance of 1,5 m (5 ft) from the container under test, and the stream shall be traversed at a speed of 100 mm/s (4 in/s).

Procedures involving the use of several nozzles are acceptable provided that each area being tested is subjected to a water loading not less than that which would be given by a single nozzle.

### 6.14.3 Requirements

Upon completion of the test, the container shall be free from penetration of water.

## 6.15 Test No. 14 – Airtightness test

### 6.15.1 General

This test shall be carried out after all structural tests have been completed and prior to the thermal test (test No. 15). The temperatures inside and outside the container shall be stabilized within 3 °C (5,4 °F) of each other and shall both be within the range of 15 °C to 25 °C (59 °F to 77 °F).

### 6.15.2 Procedure

The container shall be in its normal operating condition and shall be closed in the normal manner. The refrigeration and/or heating equipment shall be in place, except that, where the container is designed for use with removable equipment and the container has closures at the interface(s), the equipment shall not be in position and the closures shall be shut. All drain openings shall be closed. An air supply through a 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 %.

Air shall be admitted to the container to raise the internal pressure to  $250 \pm 10$  Pa ( $25 \pm 1$  mm H<sub>2</sub>O) ( $1 \pm 3/64$  in H<sub>2</sub>O) and the air supply regulated to maintain this pressure. Once steady test conditions have been established, the air flow required to maintain this pressure shall be recorded.

**6.15.3 Requirements**

The air leakage rate, expressed in standard atmospheric conditions, should be no more than the values given in table 1<sup>1)</sup>. If the measured air leakage is equal to or less than the values given in table 1, the heat transfer results determined under test No. 15 shall be reported without correction for air leakage.

TABLE 1

Size of container	1AA 1A (40 ft)	1BB 1B (30 ft)	1CC 1C (20 ft)	1D (10 ft)	
Air leakage rate					
	m <sup>3</sup> /h	30	23	16	9
	ft <sup>3</sup> /h	1 059	812	565	318

If the measured air leakage exceeds these values but is no more than the values given in table 2, then the measured  $U$  values of test No. 15 shall be increased by the amounts given in table 3<sup>1)</sup>.

TABLE 2

Size of container	1AA 1A (40 ft)	1BB 1B (30 ft)	1CC 1C (20 ft)	1D (10 ft)	
Air leakage rate					
	m <sup>3</sup> /h	60	46	32	18
	ft <sup>3</sup> /h	2 119	1 624	1 130	636

TABLE 3

Size of container	1AA 1A (40 ft)	1BB 1B (30 ft)	1CC 1C (20 ft)	1D (10 ft)	
Correction value					
	W/°C	2,40	1,85	1,29	0,72
	Btu/(h·°F)	4.58	3.51	2.44	1.37

1) **Rationale.** The air leakage values given in the first table are those amounts which, when related to actual operating conditions of one millimetre water gauge air pressure in the container, will result in additional heat gain due to air leakage of less than 5 % of the maximum heat gain allowed for that type of container and based on an outside condition of 38 °C (100 °F), 50 % relative humidity and an inside condition of -18 °C (0 °F). When the air leakage exceeds the amounts given in table 1, the correction value given in table 3 compensates for the heat gain due to air leakage in excess of that quoted in table 1, assuming that the total air leakage does not exceed that quoted in table 2.

2)  $1 \text{ W}/^\circ\text{C} = 0,556 \text{ W}/^\circ\text{F} = 0,860 \text{ kcal}/(\text{h}\cdot^\circ\text{C}) = 1,895 \text{ Btu}/(\text{h}\cdot^\circ\text{F})$

Containers that have air leakage rates greater than those shown in table 2 shall not be rated under this International Standard.

For those series 1CC and 1C containers covered by the exclusion clause in 6.15.2 which, in addition, have air inlet and outlet openings as envisaged in 5.14, the maximum permitted air leakage rate expressed in standard atmospheric conditions shall be less than 8 m<sup>3</sup>/h (283 ft<sup>3</sup>/h).

**6.16 Test No. 15 – Thermal test**

**6.16.1 General**

**6.16.1.1** This test shall be carried out to establish the coefficient of heat transfer for the container. It shall be carried out after successful completion of the airtightness test. It shall be performed with the refrigeration and/or heating equipment in place, except that, where the container is designed for use with removable equipment and the container has closures at the interface(s), the equipment shall not be in position but the closures shall be shut.

**6.16.1.2** The test shall be performed under steady state conditions using either the internal heating or internal cooling method. All instruments and devices shall be selected and calibrated as follows :

- Temperature-measuring devices  $\pm 0,5$  °C ( $\pm 0,9$  °F)
- Power-measuring system  $\pm 2$  % of the quantity measured
- Flow meter system  $\pm 3$  %

**6.16.1.3** The heat leakage shall be expressed by the total heat transfer rate ( $U_\theta$ ), which is defined by the formula

$$U_\theta = \left| \frac{Q}{\theta_e - \theta_i} \right|$$

The coefficient of heat transfer ( $K$ ) is such that

$K = U_\theta/S$ , expressed in watts per square metre per degree Celsius;

where

$U_\theta$  is the total heat transfer rate, expressed in watts per degree Celsius<sup>2)</sup>;

$Q$  is the power dissipated or absorbed by the operation of internal heaters and fans or internal cooling units, in watts;

$\theta_e$  is the average outside temperature, which shall be the arithmetic mean of the temperatures recorded at the end of each test interval (see 6.16.2 g)) and measured 100 mm (4 in) from the walls, at least at the following twelve points, as shown in annex H :

- a) the eight outside corners of the container;
- b) the centres of the side walls, underside and roof;

$\theta_i$  is the average inside temperature, which shall be the arithmetic mean of the temperatures recorded at the end of each test interval (see 6.16.2 g)) and measured 100 mm (4 in) from the walls at least at the following twelve points as shown in annex H :

- a) the eight outside corners of the container;
- b) the centres of the side walls, floor and ceiling;

$\theta$  is the mean wall temperature; by convention,  

$$\theta = \frac{\theta_e + \theta_i}{2};$$

$S$  is the mean surface area of the container in square metres, which is the geometric mean of the inside surface area  $S_i$  and the outside surface area  $S_e$ ; by convention,

$$S = \sqrt{S_i \times S_e}.$$

If areas are corrugated, the projected area shall be used.

No air temperature used shall cause damage to any material.

No test method used shall result in frost build-up which could affect the test results in any way.

### 6.16.3 Requirements

The overall coefficient of heat transfer  $K$  calculated from the average of the 17 or more sets of readings – see formula below – taken during the continuous period of not less than 8 h, where  $U_\theta$  includes the correction factor from test No. 14 where applicable, shall not exceed the value for the class of container under test.

$$K = \frac{\sum U_\theta}{n} \times \frac{1}{S} \text{ where } n \geq 17$$

NOTE – Because the above test may be carried out under conditions different from those at which the unit may operate and because the refrigeration and/or heating equipment will not be running during the test, care should be taken when using the value of  $K$  obtained from this test for calculation of performance under service conditions.

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6.17 Test No. 16 – Performance test of thermal appliances

### 6.16.2 Procedure

Test data for determining the heat leakage of the container must be taken for a continuous period of not less than 8 h during which the following conditions must be satisfied :

- a) The test shall be performed with a mean wall temperature chosen between 20 °C and 32 °C (68 °F and 90 °F) and a temperature difference between inside and outside of not less than 20 °C (36 °F).
- b) Maximum difference between the warmest and the coldest inside points at any one time, 3 °C (5.4 °F).
- c) Maximum difference between the warmest and coldest outside points at any one time, 3 °C (5.4 °F).
- d) Maximum difference between any two average inside air temperatures,  $\theta_i$  at different times, 1,5 °C (2.7 °F).
- e) Maximum difference between any two average outside air temperatures,  $\theta_e$  at different times, 1,5 °C (2.7 °F).
- f) Maximum percentage difference between the lowest and the highest power dissipation  $\left(\frac{\text{watt}\cdot\text{h}}{\text{h}}\right)$  values is not to exceed 3 % of the lowest figure.
- g) Sets of readings shall be recorded at intervals of not more than 30 min.
- h) All temperature-measuring instruments placed inside and outside the container shall be protected against radiation.

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### 6.17.1 General

Where temperature limits are given in 1.2 a test shall be performed on the container in its normal operating condition in accordance with 6.17.2.

Where no temperature limits are given in 1.2 for the type of container under test, the ability of the test container and its refrigeration unit to meet stated operating conditions shall be demonstrated by test in a manner as close as practicable to 6.17.2.

### 6.17.2 Procedure for refrigerated unit

The container shall be placed in a room or chamber where the temperature is held constant at the outside temperature for the type of container under test.

The refrigeration unit shall be capable of reducing the temperature of the container to the inside temperature for that type and then maintaining this temperature for a period of 8 h. After this time, a heater placed inside the container shall be turned on, having a capacity of at least 25 % of the total heat transfer rate (determined from test No. 15), which is :

$$\text{Heating capacity} = 0,25 (K \times S) (\theta \text{ outside} - \theta \text{ inside});$$

$\theta$  outside = outside temperature for the type of container from 1.2;

$\theta$  inside = inside temperature for the type of container from 1.2.