INTERNATIONAL STANDARD

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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

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 1496-2 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Subcommittee SC 2, *Specific purpose containers*.

This fifth edition cancels and replaces the fourth edition (1996) which has been technically revised. It also incorporates the Amendment ISO 1496-2:1996/Amd. 1:2006 and the Technical Corrigendum ISO 1496-2:1996/Cor. 1:1997. The main changes are:

— ISO 1496-2:1996/Amd. 1:2006 has been incorporated;

— 1EE and 1EEE containers have been added to Table 1;

— ventilation control and humidity control have been added as 7.9.9 and 7.9.10;

— a new test, 8.17 Test No. 15 b) Functional test of a thermal container at high ambient temperatures while being cooled by a mechanical refrigeration unit (MRU), has been added and the following tests have been renumbered;

— in 8.14.3, the air leakage rate requirement has been revised to not exceed 5 m^3/h;

— clarification has been given in 8.16.1.1, 8.16.2.1, 8.12.1 and in a note to 9.4;

— the requirements given in Table 4 have been corrected.

The opportunity was also taken for an editorial revision to update the style.

ISO 1496 consists of the following parts, under the general title *Series 1 freight containers — Specification and testing*:

— *Part 1: General cargo containers for general purposes*

— *Part 2: Thermal containers*

— *Part 3: Tank containers for liquids, gases and pressurized dry bulk*

— *Part 4: Non-pressurized containers for dry bulk*

— *Part 5: Platform and platform-based containers*

Introduction

The following grouping of container types is used for specification purposes in ISO 1496:

Part 1	
General purpose	00 to 09
Specific purpose	
closed, vented/ventilated	10 to 19
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Part 2	
Thermal	30 to 49
Part 3	
Tank	70 to 79
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Bulk, non-pressurized (box type)	20 to 24
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Part 5	
Platform (container)	60
Platform-based, with incomplete superstructure and fixed ends	61 and 62
Platform-based, with incomplete superstructure and folding ends	63 and 64
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NOTE Container groupings for parts 1 and 3 to 5 inclusive are described in detail in the relevant parts of ISO 1496.

Series 1 freight containers — Specification and testing —

Part 2: Thermal containers

1 Scope

This part of ISO 1496 gives the basic specifications and testing requirements for ISO series 1 thermal containers for international exchange and for conveyance of goods by road, rail and sea, including interchange between these forms of transport.

NOTE For the convenience of users of this part of ISO 1496, the conversion of values expressed in SI units to values expressed in non-SI units is given in Annex N.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 668:1995, *Series 1 freight containers — Classification, dimensions and ratings*

ISO 830:1981, *Freight containers — Vocabulary*

ISO 1161:1984, *Series 1 freight containers — Corner fittings — Specification*

ISO 6346:1995, *Freight containers — Coding, identification and marking*

ISO 10368:2006, *Freight thermal containers — Remote condition monitoring*

IEC 60947-1, *Low-voltage switchgear and controlgear — Part 1: General rules*

3 Terms and definitions

For the purposes of this document, the general terms and definitions given in ISO 830 and the following apply.

3.1
thermal container
freight container having insulating walls, doors, floor and roof designed to retard the rate of heat transmission between the inside and the outside of the container

3.2
insulated container
thermal container having no devices for cooling and/or heating, either permanently installed or attached

3.3
refrigerated container (expendable refrigerant)
thermal container using a means of cooling such as liquefied gases, with or without evaporation control

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

3.4
mechanically refrigerated container
thermal container served by a refrigerating appliance (mechanical compressor unit, absorption unit, etc.)

3.5
heated container
thermal container served by a heat-producing appliance

3.6
refrigerated and heated container
thermal container served by a refrigerating appliance (mechanical or using expendable refrigerant) and a heat-producing appliance

3.7
refrigerated and heated container with controlled or modified atmosphere
thermal container served by a refrigerating and heat-producing appliance, initially loaded with a modified atmosphere and/or capable of generating and/or maintaining a modified atmosphere

3.8
removable equipment
refrigerating and/or heating appliance, power-generating unit or other equipment designed to be attached or detached from a freight container

3.9
located internally
totally within the external dimensional envelope of the freight container as defined in ISO 668

3.10
located externally
partially or totally outside the external dimensional envelope of the container as defined in ISO 668

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

3.11
batten
member protruding from the inside walls of the container to hold the cargo away from the wall to provide an air passage

NOTE The member may be integral with the wall, fastened to the wall or added during cargo loading.

3.12
bulkhead
partition providing a plenum chamber and/or air passage for either return or supply air

NOTE The partition may be an integral part of the appliance or a separate member.

3.13
ceiling air duct
passage or passages located in proximity to the ceiling to direct air flow

3.14
floor air duct
passage or passages located beneath the cargo support surface to direct air flow

3.15
pin mounting
mounting system using two vertical pins engaging mating sockets built into the top end transverse member such that the entire mass of the removable equipment is supported by the top end transverse member

3.16
lower mounting points
threaded receptacles to which the lower two corners of the removable equipment are fastened

4 Classification

The container types covered by this part of ISO 1496 are classified as shown in Table 1, in which the maximum allowable heat-leakage rates are specified.

A conversion table for kelvins to degrees Celsius is given for convenience in Table 2.

5 Marking

The marking of thermal containers shall be in accordance with ISO 6346.

In addition, thermal containers intended to carry hanging cargo and thermal containers given a modified atmosphere shall be marked in accordance with 7.9.7 and 7.9.8.

6 Dimensions and ratings

6.1 External dimensions

The overall external dimensions and tolerances of the freight containers covered by this part of ISO 1496 shall be in accordance with ISO 668. No part of the container shall project beyond these specified overall external dimensions.

6.2 Internal dimensions

Internal dimensions of thermal containers shall be measured from inner faces of battens, bulkheads, ceiling air ducts, floor air ducts, etc., where fitted.

The minimum internal dimensions for ISO series 1 thermal freight containers are specified in Table 3.

Internal dimensions of thermal containers should be as large as possible.

6.3 Ratings

The values of the rating R, where R is the maximum gross mass of the container, are those given in ISO 668.

Table 1 — Classification of thermal containers

Type, code designation	Description	Maximum heat-leakage rate 1), U_{max}, for freight containers W/K								Design temperatures 2)			
										Inside		Outside	
		1D	1C, 1CC	1B, 1BB	1BBB	1A, 1AA	1AAA	1EE	1EEE	K	°C	K	°C
30	Refrigerated (expendable refrigerant)	13	22	31	33	40	42	44	46	255	−18	318	+45
31	Mechanically refrigerated	13	22	31	33	40	42	44	46	255	−18	318	+45
32	Refrigerated and heated	13	22	31	33	40	42	44	46	289 255	+16 −18	253 318	−20 +45
33	Heated	13	22	31	33	40	42	44	46	289	+16	253	−20
34, 35	Unassigned												
36	Mechanically refrigerated, self-powered	13	22	31	33	40	42	44	46	255	−18	318	+45
37	Refrigerated and heated, self-powered	13	22	31	33	40	42	44	46	289 255	+16 −18	253 318	−20 +45
38	Heated, self-powered	13	22	31	33	40	42	44	46	289	+16	253	−20
39	Unassigned												
40	Refrigerated and/or heated, with removable equipment, appliance located externally	13	22	31	33	40	42	44	46				
41	Refrigerated and/or heated, with removable equipment, appliance located internally	13	22	31	33	40	42	44	46				
42	Refrigerated and/or heated, with removable equipment, appliance located externally	26	46	66	71	86	92						
43, 44	Unassigned												
45	Insulated 3) 4)	13	22	31	33	40	42	44	46				
46	Insulated 3) 4)	26	46	66	71	86	92						
47, 48, 49	Unassigned												

1) The values of U_{max} for heavily insulated containers (types 30, 31, 32, 33, 36, 37, 40, 41 and 45) are better than a coefficient of heat transfer, K, of 0,4 W/($m^2 \cdot K$). The values of U_{max} for lightly insulated containers (types 42 and 46) are related to an approximate coefficient of heat transfer, K, of 0,7 W/($m^2 \cdot K$).

2) See Table 2.

3) This category does not have design temperatures; the actual performance is dependent on the capability of the equipment attached in any transport mode.

4) Types 42, 45 and 46 are included for information but are no longer produced.

Table 2 — Kelvins to degrees Celsius conversion table

Kelvin K	**Degree Celsius** °C
0 273,15	−273,15 0
253	−20
255	−18
285	+12
288	+15
289	+16
293	+20
298	+25
305	+32
311	+38
318	+45
323	+50
NOTE For the purposes of temperature differences, 1 K = 1 °C.	

Table 3 — Minimum internal dimensions

Dimensions in millimetres

Type code designation	**Minimum length** [a] = Nominal container external length minus	**Minimum width** = Nominal container external width minus	**Minimum height** [a] (no gooseneck tunnel) = Nominal container external height minus	**Minimum height** [a] (with gooseneck tunnel) = Nominal container external height minus
30, 31, 32, 33	690	220	345	385
36, 37, 38, 41	990			
40	440			
42	390	180	310	350
45	340	220	285	340
46	290	180	250	290
NOTE Some thermal containers built to conform with earlier editions of this part of ISO 1496 are significantly smaller, particularly if a diesel generator is fitted.				
[a] Some of the length and height dimensions specified will necessarily be used for air circulation.				

7 Design requirements

7.1 General

All thermal containers shall comply with the following requirements.

The strength requirements for containers are given in diagrammatic form in Annex A (these requirements are applicable to all thermal containers except where otherwise stated). They apply to containers as complete units, except as envisaged in 8.1.

The strength requirements for corner fittings (see also 7.2) are specified in ISO 1161.

The thermal container shall be capable of withstanding the loads and loadings specified in Clause 8.

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 thermal containers as indicated in Annex A and demonstrated by the tests described in Clause 8 shall not be exceeded in any mode of operation.

Any closure in a container, which if unsecured could lead to a hazardous situation, shall be provided with an adequate securing system having external indication of the positive securement of that closure in the appropriate operation position. In particular, doors should be capable of being securely fastened in the open or closed position.

The walls, doors, floors and roof of the thermal container shall be insulated in such a manner as to balance, as far as is practicable, the heat transfer through each of them, although the roof insulation may be increased to compensate for solar radiation.

7.2 Corner fittings

All containers shall be equipped with top and bottom corner fittings. The requirements and positioning of the corner fittings shall be in accordance with ISO 1161. The upper faces of the top corner fittings shall protrude above the top of the container by a minimum of 6 mm (see 7.3.4). The “top of the container” means the highest level of the cover of the container.

However, if reinforced zones or doubler plates are provided to afford protection to the roof in the vicinity of the top corner fittings, such plates and their securements shall not protrude above the upper faces of the top corner fittings. These plates shall not extend more than 750 mm from either end of the container but may extend the full width.

7.3 Base structure

7.3.1 All containers shall be capable of being supported by their bottom corner fittings only.

7.3.2 All containers, other than 1D, shall also be capable of being supported only by load-transfer areas in their base structure.

Consequently, these containers shall have end transverse members and sufficient intermediate load-transfer areas (or a flat underside) of sufficient strength to enable vertical load transfer to or from the longitudinal members of a carrying vehicle. Such longitudinal members are assumed to lie within the two 250 mm wide zones defined by the dashed lines in Figure B.1.

The lower faces of the load-transfer areas, including those of the end transverse members, shall be in one plane located 12,5 mm $^{+5,0}_{-1,5}$ mm above the plane of the lower faces of the bottom corner fittings and bottom side rail. Apart from the bottom corner fittings and bottom side rails, no part of the container shall project below this plane. However, doubler plates may be provided in the vicinity of the bottom corner fittings to afford protection to the understructure.

Such plates shall not extend more than 550 mm from the outer end and not more than 470 mm from the side faces of the bottom corner fittings, and their lower faces shall be at least 5 mm above the lower faces of the bottom corner fittings of the container.

Containers having all their intermediate transverse members spaced 1 000 mm apart or less (or having a flat underside) shall be deemed to comply with the requirements given in the second paragraph of this sub-clause.

Requirements for containers not having transverse members spaced 1 000 mm apart or less (and not having a flat underside) are given in Annex B.

7.3.3 For 1D containers, the level of the underside of the base structure is not specified, except as implied in 7.3.4.

7.3.4 For all 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 mass of the container and test load is equal to 1,8R, no part of the base of the container shall deflect more than 6 mm below the base plane (lower faces of the bottom corner fittings).

7.3.5 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 securing the cargo to the base structure of the container.

7.4 End structure

For all thermal containers other than 1D, 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.

NOTE It should be noted that the rigidity of the end structure of a container fitted with an internally located refrigeration unit is not necessarily equal to the sum of rigidities of container and unit, but is also dependent on the way in which the unit is fitted.

7.5 Side wall structure

For all thermal containers other than 1D, the longitudinal deflection of the top of the container with respect to the bottom of the container when under full longitudinal-rigidity test conditions shall not exceed 25 mm.

7.6 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.

7.7 Door opening

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

All door openings and end openings shall be as large as possible.

The usable width shall correspond with the appropriate minimum internal dimension given in Table 3.

The usable height shall be as close as practicable to the appropriate minimum internal dimension given in Table 3.

7.8 Sanitary and taint-free requirements

Attention is drawn to the need for the proper choice of materials for the thermal container and any refrigerator/heating appliances to prevent adverse effects in cargo, especially foodstuffs. Any relevant national or international requirements should also be considered.

The interior surface and container structure shall be so constructed as to facilitate cleaning, and the structure and the insulation shall not be functionally affected by cleaning methods, for example steam cleaning and detergents normally used.

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

If drains are fitted, provision shall be made to ensure that cleaning water can drain from the inside of the container.

7.9 Requirements for optional features

7.9.1 Fork-lift pockets

7.9.1.1 Fork-lift pockets used for handling 1CC, 1C and 1D thermal containers in the loaded or unloaded condition may be provided as optional features.

Fork-lift pockets shall not be provided on 1AAA, 1AA, 1A, 1BBB, 1BB and 1B thermal containers.

7.9.1.2 Where a set of fork-lift pockets has been fitted as in 7.9.1.1, a second set of fork-lift pockets may, in addition, be provided on 1CC and 1C containers for empty handling only.

The(se) additional pocket(s) which may in fact be one pocket paired with an existing pocket, provided in accordance with 7.9.1.1, should be centred as closely as possible about the centre of gravity of the empty container.

7.9.1.3 The fork-lift pockets, where provided, shall meet the dimensional requirements specified in Annex C and 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 shall be located in the vicinity of each end of the fork pockets.

7.9.2 Gooseneck tunnels

Gooseneck tunnels shall be provided as mandatory features in 1AAA thermal containers and may be provided as optional features in thermal containers 1AA, 1A, 1BB and 1B. The dimensional requirements are specified in Annex D and, in addition, all other parts of the base structure shall be as specified in 7.3.

7.9.3 Drains

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

Local customs and health requirements may place additional requirements on drains, which should be adhered to.

7.9.4 Water connections

For appliances requiring water connections, the inlet and outlet interfaces shall be in accordance with Annex E.

Water-cooled appliances shall either be self-draining or incorporate the facility to drain the unit to prevent the water from freezing.

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.

7.9.5 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 the requirements given in Annex F.

7.9.6 Intermediate sockets for clip-on units

Where intermediate sockets are provided for use of clip-on units, they shall be located and designed in accordance with Annex G.

7.9.7 Hanging cargo facilities

The roof of containers may be designed to carry hanging cargo. Such containers shall meet the test requirements specified in 8.8. Specific marking shall be placed on the inside of the container to indicate the maximum hanging load.

7.9.8 Modified atmospheres

Thermal containers that are manufactured to operate with a modified atmosphere, which could be injurious to health until appropriately vented, shall be so marked alongside each point of access.

7.9.9 Ventilation control

Where automated ventilation control is provided, this fact shall be clearly marked near the ventilation inlet(s).

7.9.10 Humidity control

Where humidity control to provide reduced humidity is provided by means of reheating only, there are no additional requirements. Where humidity control incorporates addition of water as liquid or vapour, instructions shall be provided for cleaning and disinfecting all water reservoirs.

8 Testing

8.1 General

8.1.1 Unless otherwise stated, thermal containers conforming to the design requirements specified in Clause 7 shall, in addition, be capable of withstanding the tests specified in 8.2 to 8.19 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 so specified for a particular test. But if any of the main parts or frameworks of the refrigeration and/or heating equipment is not in position for any structural 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.

If 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 structural testing, substitute framework and/or panelling may be used, provided that it is secured in the same manner as the equipment and does not provide greater strength than the original parts.

The test for heat leakage (Test No. 14) shall be used to measure the heat leakage rate from the container, which determines its class. The tests described in 8.16. 8.17 and 8.18 [Tests Nos. 15 a), 15b) and 15 c)] establish a standard method for testing the performance of mechanical and expendable liquid refrigeration units respectively, when used in conjunction with a container of known class.

The tests for weatherproofness (Test No. 12), for airtightness (Test No. 13), for heat leakage (Test No. 14) and for performance under refrigeration (Test No. 15) shall be carried out in sequence after completion of Tests Nos. 1 to 11.

NOTE Annex A gives examples of forces applied in the tests described in 8.2 to 8.12.

8.1.2 The maximum payload, P, of the container to be tested is given by:

$$P = R - T$$

where

R is the rating;

T is the tare.

NOTE R and T are expressed in units of mass. Where test requirements are based on the gravitational forces derived from these values, those forces, which are inertial forces, are indicated thus:

Pg, Rg, Tg

the units of which are Newtons or multiples thereof.

The word “load”, when used to describe a physical quantity to which units may be ascribed, implies mass. The word “loading”, for example as in “internal loading”, implies force.

8.1.3 The test loads or loadings within the thermal container shall be uniformly distributed.

8.1.4 The test loads or loadings specified in all of the following tests are minimum requirements.

8.1.5 The dimensional requirements to which reference is made in the requirements subclause after each test are those specified in

a) the dimensional and design requirement clauses of this part of ISO 1496,

b) ISO 668,

c) ISO 1161.

8.2 Test No. 1 — Stacking

8.2.1 General

This test shall be carried out to prove the ability of a fully loaded thermal container to support a superimposed mass of containers, taking into account conditions aboard ships at sea and the relative eccentricities between superimposed containers.

Table 4 specifies the test force to be applied to each pair of corner fittings and the superimposed mass that the test force represents.

Table 4 —Forces to be applied in the stacking test

Container designation	Test force per container (all four corners simultaneously)		Test force per pair of end fittings		Superimposed mass represented by test force	
	kN	lbf	kN	lbf	kg	lb
1A, 1AA and 1AAA	3 767	847 575	1 883	423 675	213 360	470 380
1B, 1BB and 1BBB	3 767	847 575	1 883	423 675	213 360	470 380
1C and 1CC	3 767	847 575	1 883	423 675	213 360	470 380
1D	896	201 600	448	100 800	50 800	112 000

8.2.2 Procedure

The thermal container shall be placed on four level pads, one under each bottom corner fitting. The pads shall be centralized under the fittings and shall be essentially of the same plan dimensions as the fittings.

The container shall have a load uniformly distributed over the floor in such a way that the combined mass of the container and the test load is equal to 1,8R.

The thermal container shall be subjected to vertical forces, applied either to all four corner fittings simultaneously or to each pair of end fittings, at the appropriate level specified in Table 4. The forces shall be applied through a test fixture equipped with corner fittings as specified in ISO 1161, or equivalent fittings which have imprints of the same geometry (i.e. with the same external dimensions, chamfered aperture and rounded edges) as the lower face of the bottom corner fittings specified in ISO 1161. If equivalent fittings are used, they shall be designed to produce the same effect on the container under the test loads as when corner fittings are used.

In all cases, the forces shall be applied in such a manner that rotation of the planes through which the forces are applied and on which the container is supported is minimized.

Each corner fitting or equivalent test fitting shall be offset in the same direction by 25,4 mm laterally and 38 mm longitudinally.

8.2.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

8.3 Test No. 2 — Lifting from the four top corner fittings

8.3.1 General

This test shall be carried out to prove the ability of a thermal container, other than a 1D thermal container, to withstand being lifted from the four top corner fittings with the lifting forces applied vertically, and the ability of a 1D thermal container to withstand being lifted from the top corner fittings with the lifting forces applied at any angle between the vertical and 60° to the horizontal. These are the only recognized methods of lifting these containers by the four top corner fittings.

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

8.3.2 Procedure

The thermal container shall have a load uniformly distributed over the floor in such a way that the combined mass of the container and test load is equal to $2R$, 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 a thermal container other than a 1D thermal container, the lifting forces shall be applied vertically.

For a 1D thermal container, lifting shall be carried out by means of slings, the angle of each leg being at 60° from the horizontal.

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

8.3.3 Requirements

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

8.4 Test No. 3 — Lifting from the four bottom corner fittings

8.4.1 General

This test shall be carried out to prove the ability of a thermal container to withstand being lifted from its four 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.

8.4.2 Procedure

The thermal container shall have a load uniformly distributed over the floor in such a way that the combined mass of container and test load is equal to $2R$, 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° to the horizontal for 1AAA, 1AA and 1A thermal containers;

— 37° to the horizontal for 1BBB, 1BB and 1B thermal containers;

— 45° to the horizontal for 1CC and 1C thermal containers;

— 60° to the horizontal for 1D thermal containers.

In each case, the line of action of the lifting force and the outer face of the corner fitting shall be no further apart than 38 mm. The lifting shall be carried out in such a manner that the lifting devices bear on the four bottom corner fittings only.

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

8.4.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

8.5 Test No. 4 — External restraint (longitudinal)

8.5.1 General

This test shall be carried out to prove the ability of a thermal container to withstand longitudinal external restraint under dynamic conditions of railway operation, which implies accelerations of $2g$.

8.5.2 Procedure

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

A force of $2Rg$ 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.

8.5.3 Requirements

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

8.6 Test No. 5 — Strength of end walls

8.6.1 General

This test shall be carried out to prove the ability of a thermal container to withstand forces under the dynamic conditions referred to in 8.5.1.

8.6.2 Procedure

The thermal container shall have each end tested when one end is blind and the other equipped with doors. In the case of symmetrical construction, one end only need be tested. The container shall be subjected to an internal loading of $0{,}4Pg$. The internal loading shall be uniformly distributed over the wall under test and arranged to allow free deflection of the wall.

8.6.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

8.7 Test No. 6 — Strength of side walls

8.7.1 General

This test shall be carried out to prove the ability of a thermal container to withstand the forces resulting from ship movement.

8.7.2 Procedure

The thermal container shall have each side wall tested. In the case of symmetrical construction, one side only need be tested.

Each side wall of the thermal container shall be subjected to an internal loading of $0{,}6Pg$. The internal loading shall be uniformly distributed, applied to each wall separately and arranged to allow free deflection of the side wall and its longitudinal members.

8.7.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use, nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

8.8 Test No. 7 — Strength of the roof

8.8.1 General

This test shall be carried out to prove the ability of the roof of a thermal container to withstand the loads imposed by persons working on it and, if the roof is intended to carry hanging cargo, the ability to carry a maximum hanging load of 1 490 kg per metre of usable inside container length, taking into account a vertical acceleration of $2g$.

8.8.2 Procedure

A load of 300 kg shall be uniformly distributed over an area of 600 mm × 300 mm located at the weakest area of the roof of the thermal container.

If the roof is intended to carry hanging cargo, a load equal to twice the service load or twice 1 490 kg per metre of usable container length, whichever is greater, shall be attached to the roof in a manner simulating normal service loading, while the container is supported by its four bottom corner fittings only.

8.8.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

8.9 Test No. 8 — Floor strength

8.9.1 General

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

8.9.2 Procedure

The test shall be performed using a test vehicle equipped with tyres, with an axle load of 5 460 kg (i.e. 2 730 kg on each of two wheels). All points of contact between each wheel and a flat continuous surface shall lie within a rectangular envelope measuring 185 mm (in a direction parallel to the axle of the wheel) by 100 mm and each wheel shall make physical contact over an area within this envelope of not more than 142 cm^2. The wheel width shall be nominally 180 mm and the wheelbase shall be nominally 760 mm. The test vehicle shall be manoeuvred over the entire floor area of the thermal 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.

8.9.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

8.10 Test No. 9 — Rigidity (transverse)

8.10.1 General

This test shall be carried out to prove the ability of a thermal container, other than a 1D thermal container, to withstand the transverse racking forces resulting from ship movement.

8.10.2 Procedure

The thermal container in tare condition (T) shall be placed on four level supports, one under each bottom 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 be applied only at the end frame under test.

Forces of 150 kN shall be applied 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 thermal container with identical ends, only one end need be tested. Where an end is not essentially symmetrical about its own vertical centreline, both sides of that end shall be tested.

For allowable deflections under full test loading, see 7.4.

8.10.3 Requirements

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

8.11 Test No. 10 — Rigidity (longitudinal)

8.11.1 General

This test shall be carried out to prove the ability of a thermal container, other than a 1D thermal container, to withstand the longitudinal racking forces resulting from ship movement.

8.11.2 Procedure

The thermal container in tare condition (T) shall be placed on four level supports, one under each bottom corner fitting, and shall be restrained against longitudinal 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 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 thermal container with identical sides, only one side need be tested. Where a side is not essentially symmetrical about its own vertical centreline, both ends of that side shall be tested.

For allowable deflections under full test loading, see 7.5.

8.11.3 Requirements

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

8.12 Test No. 11 — Lifting from fork-lift pockets (where provided)

8.12.1 General

This test shall be carried out on any 1CC, 1C or 1D thermal container which is fitted with fork-lift pockets.

8.12.2 Procedure

8.12.2.1 1CC, 1C or 1D thermal containers fitted with one set of fork-lift pockets

The thermal container shall have a load uniformly distributed over the floor in such a way that the combined mass of container and test load is equal to 1,6R and it shall be supported on two horizontal bars, each 200 mm wide, projecting 1 828 mm ± 3 mm into the fork-lift pockets, measured from the outside face of the side of the container. The bars shall be centred within the pockets.

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

8.12.2.2 1CC or 1C thermal containers fitted with two sets of fork-lift pockets

The test described in 8.12.2.1 shall be applied to the outer pockets.

A second test shall be applied to the (additional) inner pockets. The procedure for this second test shall be as required in 8.12.2.1, except that in this case the combined mass of the container and test load shall be equal to 0,625R, and the bars shall be placed in the inner pockets.

8.12.3 Requirements

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

8.13 Test No. 12 — Weatherproofness

8.13.1 General

This test shall be carried out on door seals, exterior gasketed joints and other openings which are fitted with closing devices. This test also applies to refrigerating and/or heating appliance(s), if fitted.

8.13.2 Procedure

A stream of water shall be applied to the area being tested from a nozzle with an inside diameter of 12,5 mm, at a pressure of about 100 kPa (corresponding to a head of about 10 m of water). The nozzle shall be held at a distance of 1,5 m from the container under test, and the stream shall be traversed at a speed of 100 mm/s.

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

8.13.3 Requirements

On completion of the test, no water shall have leaked into the thermal container, and the refrigeration or heating unit shall function properly.

8.14 Test No. 13 — Airtightness test

8.14.1 General

This test shall be carried out after all structural tests have been completed and prior to the heat leakage test (Test No. 14). The temperatures inside and outside the thermal container shall be stabilized within 3 K of each other and shall both be within the range 288 K to 298 K (see Table 2 for conversion to degrees Celsius).

8.14.2 Procedure

The thermal 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 thermal container by a leakproof connection. The manometer shall not be part of the air supply system. The flow-measuring device shall be accurate to ± 3 % of the measured flowrate, 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 Pa ± 10 Pa and the air supply regulated to maintain this pressure.

Once steady test conditions have been established, the airflow required to maintain this pressure shall be recorded.

8.14.3 Requirements

For all thermal containers other than those with additional door openings, the air leakage rate, expressed in standard atmospheric conditions, shall not exceed 5 m^3/h. For each additional door opening (e.g. side doors) provided, an extra allowance of 5 m^3/h shall be granted.

NOTE The pressure-decay method may be used as an alternative, but in this case a correlation should be established between the constant pressure method and the pressure-decay method during prototype testing.

8.15 Test No. 14 — Heat leakage test

8.15.1 General

This test shall be carried out to establish the heat leakage for the thermal container. It shall be carried out after successful completion of the airtightness test (Test No. 13). It shall be performed with the refrigeration and/or heating equipment in place, with all openings closed. Where the thermal 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.

The inner heating method only shall be used. This test requires the establishment of a heat balance. A heating device shall be placed inside the (insulated) body of the container and thermal equilibrium shall be established between the power of the heating device(s) and associated fan(s), and the heat flowing out through the insulation. All instruments and devices shall be selected and calibrated for the following accuracy:

— temperature-measuring devices: ± 0,5 K;

— power-measuring device: ± 2 % of quantity measured;

— flowmeter system: ± 3 %.

The heat leakage shall be expressed by the total heat leakage rate, U_θ, in watts per kelvin, as determined using the formula:

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

where

Q is the power, in watts, dissipated by the internal heater(s) and fan(s);

θ_i is the average inside temperature, in kelvins, which shall be the arithmetic mean of the temperatures recorded at the end of each test interval (see 8.15.2.5) and measured 100 mm from the walls, at least at the twelve points shown in Annex H;

θ_e is the average outside temperature, in kelvins, which shall be the arithmetic mean of the temperatures recorded at the end of each test interval (see 8.15.2.5) and measured 100 mm from the walls, at least at the twelve points shown in Annex H;

θ is the mean wall temperature, in kelvins; by convention:

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

8.15.2 Procedure

8.15.2.1 Test data for determining the heat leakage of the thermal container shall be taken for a continuous period of not less than 8 h, during which the following conditions shall be met.:

a) the test shall be performed with a mean wall temperature chosen between 293 K and 305 K (see Table 2 for conversion to degrees Celsius) and a temperature difference between inside and outside of not less than 20 K;

b) the maximum temperature difference between the warmest and coldest inside points at any one time shall be 3 K;

c) the maximum temperature difference between the warmest and coldest outside points at any one time shall be 3 K;

d) the maximum difference between any two average inside air temperatures, θ_i, at different times shall be 1,5 K;

e) the maximum difference between any two average outside air temperatures, θ_e, at different times shall be 1,5 K;

f) the greatest difference between the highest power, Q_h, and the lowest power, Q_l, shall be not more than 3 % of Q_l, i.e.

$$(Q_h - Q_l)_{max} < 0{,}03\ Q_l$$

NOTE The requirements specified above, which define the steady-state conditions or the degree of equilibrium, are illustrated in Annex I.

8.15.2.2 The electric heating element(s) shall be operated at temperatures sufficiently low to minimize radiation effects. The heat from the element(s) shall be distributed by a fan or fans delivering a quantity of air sufficient, but not exceeding the level necessary, to ensure that the temperature distribution inside the body of the thermal container is within the limits given in 8.15.2.1. The fan(s) should be in the body of the container. If the test is run with a mechanical refrigeration unit (MRU) installed, no action should be taken to prevent the movement of small quantities of air through the MRU. Such fans as the MRU may contain shall not run.

If the test is carried out with the fan(s) of the MRU running, the test report shall draw attention to this fact. The heat leakage, U, measured — which in this case shall include the power consumption of the evaporator fan(s) — should not be expected to conform to the classification given in Table 1.

8.15.2.3 Air should be circulated over the exterior surfaces of the thermal container at a velocity not exceeding 2 m/s at points approximately 100 mm from the mid-length of the side walls and the roof of the container.

8.15.2.4 All of the temperature-measuring instruments placed inside and outside the thermal container shall be protected against radiation.

8.15.2.5 Sets of readings shall be recorded at intervals of not more than 30 min.

8.15.3 The heat leakage, U, in watts per kelvin, shall be calculated from the average of the 17 or more sets of readings taken during the continuous period of not less than 8 h for which steady-state conditions were maintained, using the following formula:

$$U = \frac{1}{n}\sum_{1}^{n} U_\theta$$

where

$n \geqslant 17$.

The value of U obtained from this formula shall be recorded together with the mean of the mean wall temperature(s) which were maintained during the test period. The value of U, corrected to the standard mean wall temperature of 293 K, should also be recorded. The correction should be made using a curve relating U to mean wall temperature.

NOTE Since the test described in this clause can be carried out under conditions different from those at which the unit can operate and since the refrigeration and/or heating equipment will not be running during the test, care should be taken when using the value of U obtained from this test to calculate performance under service conditions.

8.16 Test No. 15 a) — Test of the performance of a thermal container under refrigeration by a mechanical refrigeration unit (MRU)

8.16.1 General

8.16.1.1 This test shall measure the ability of a thermal container when fitted with a particular MRU, either an “integral” or “clip-on” unit, to maintain a given inside temperature, θ_i, at a given outside temperature, θ_e,

— for a period of 8 h without additional heat load above that leaking through the walls of the container, and

— for a further period of 4 h during which electrical heater(s) and fan(s) inside the container provide an additional heat load equal to at least 25 % of the total heat leakage rate for the containers as determined in the heat leakage test (Test No. 14), i.e. additional heat load is equal to

$$0{,}25\, U_\theta\,(\theta_e - \theta_i)$$

8.16.1.2 This test shall be carried out on a thermal container which has already been subjected to the heat leakage test (Test No. 14).

8.16.1.3 The thermal container shall be equipped with instruments for the measurement of:

a) outside and inside air temperatures as envisaged in 8.15.1 and Annex H;

b) the power supplied to heater(s) and fan(s).

The outside air flow at a point adjacent to the midpoint of one of the sides of the container shall be determined.

The thermal container under test shall be equipped with instruments for the measurement of:

a) the energy consumption of heater(s) and fan(s) inside the container;

b) return and supply air temperatures (dry bulb) inside the container, where a minimum of two sensors shall be used for each of these (i.e. four in all);

c) the temperature of the air at the inlet to the condenser, where an air-cooled condenser is used.

8.16.2 Test conditions

8.16.2.1 The outside temperature shall be 45 ºC for the thermal container under test (see Table 1).

8.16.2.2 The inside temperature shall not exceed the specified temperature for the class of thermal container under test (see Table 1); this is understood to be the average of the temperature measured by the 12 sensors inside the container.

8.16.2.3 The outside air velocity shall not exceed 2 m/s at a distance of 100 mm from the side of the thermal container.

8.16.2.4 The inside air velocity shall be as produced by the evaporator fans and fans associated with heaters.

8.16.3 Test procedure

8.16.3.1 The required inside and outside temperatures shall be established. Floor drains, defrost drains (where fitted) and relief valves shall be in their normal operational states, and doors and vent devices shall be closed in the normal manner.

8.16.3.2 At this point, the unit may be defrosted; if this is done, steady-state conditions shall be re-established prior to continuing the test.

8.16.3.3 The unit shall be run (after steady-state conditions have been established) for a period of 8 h with the temperature cycling about a constant level. After this period of operation, the heater(s) and fan(s) described in 8.16.1.1 shall be turned on. After steady-state conditions have been re-established, the test shall continue for a further 4 h.

8.16.3.4 During the periods of 8 h and 4 h of steady-state operation, the inside and outside temperatures and the power consumed by the heater(s) and fan(s) shall be recorded at intervals not exceeding 30 min.

8.16.4 Requirements

The equipment shall be capable of maintaining the average inside temperature of the thermal container at the specified level (see Table 1) for a period of at least 8 h and then for a further period of at least 4 h with additional heat load provided as specified in 8.16.1.1.

NOTE 1 If desired, the energy consumption of the MRU may be measured during this test by means of an electric power-metering device and, if appropriate, a fuel-metering device.

NOTE 2 It may also be advisable to measure temperatures at evaporator outlet and at compressor suction and discharge and pressure at compressor inlet and outlet (especially where a prototype MRU is involved), so that in the event of a shortfall in performance there may be sufficient data to enable the fault to be diagnosed.

8.17 Test No. 15 b) — Functional test of a thermal container at high ambient temperatures while being cooled by a mechanical refrigeration unit (MRU)

8.17.1 General

8.17.1.1 This test shall verify the unrestricted function of a thermal container when fitted with a particular MRU at high ambient air temperature. The test shall be carried out with additional heat load above that leaking through the walls of the container.

8.17.1.2 The thermal container shall be equipped with instruments for the measurement of:

a) inside temperatures: at least 4 measuring points evenly distributed inside the container;

b) outside temperatures: air temperature at the air inlet to the condenser coil, at least 4 measuring points evenly distributed outside the container.

8.17.2 Test condition

8.17.2.1 The average air temperature at condenser inlet shall be at least 50 °C for the duration of the test.

8.17.2.2 The inside temperature set points shall be at two different levels, +12 °C and −18 °C.

8.17.2.3 The inside air velocity shall be as produced by the evaporator fans at the speed designated for the set point temperature.

8.17.3 Test procedure

8.17.3.1 The inside temperature set point shall be +12 °C and the air temperature at condenser inlet shall be maintained at 50 °C at least. These temperatures shall be maintained in steady state condition for a period of not less than 4 h. Floor drains, defrost drains (where fitted) and relief valves shall be in their normal operational states, vent devices shall be closed. The T-gratings shall be covered from the machinery side by at least 2/3 of the T-floor length.

There shall be an additional heat load inside the container equal to the sum of two components. As the ambient temperature is not specified for this test, the first component is the difference (if any) between the actual heat leakage and that at +12 °C internal temperature and 50 °C ambient temperature. This component shall be calculated from the actual heat leakage where this has been measured, otherwise the heat leakage shall be taken from Table 1. The second component is a fixed load of 1kW.

8.17.3.2 The inside temperature set point shall be −18 °C and the air temperature at condenser inlet shall be maintained at 50 °C at least. These temperatures shall be maintained in steady state condition for a period of not less than 4 h. Floor drains, defrost drains (where fitted) and relief valves shall be in their normal operational states, vent devices shall be closed. The T-gratings shall be covered from the machinery side by at least 2/3 of the T-floor length.

There shall be an additional heat load inside the container if the ambient temperature is not at 50 °C. This is equal to the difference (if any) between the actual heat leakage and that at −18 °C internal temperature and 50 °C ambient temperature. This shall be calculated from the actual heat leakage where this has been measured, otherwise the heat leakage shall be taken from Table 1.

8.17.3.3 During the period of steady state condition described in 8.17.3.1 and 8.17.3.2 the temperatures defined in 8.17.1.2 shall be recorded at intervals not exceeding 15 min.

8.17.4 Requirements

During the periods of steady state condition the MRU shall be capable of being operated without functional restrictions or disruptions.

8.18 Test No. 15 c) — Test of the performance of a thermal container with refrigerating equipment which uses a liquid expendable refrigerant (LER)

8.18.1 General

8.18.1.1 This test shall measure the ability of a thermal container when fitted with a particular LER, either an “integral” or “clip-on” unit, to maintain a given inside temperature θ_i, at a given outside temperature, θ_e,

— for a period of 8 h without dimensional heat load above that leaking through the walls of the container, and

— for a further period of 4 h during which electrical heater(s) and fan(s) inside the container provide an additional heat load equal to at least 25 % of the total heat leakage rate for the containers as determined in the heat leakage test (Test No. 14), i.e. additional heat load is equal to

$$0{,}25\,U_\theta(\theta_e - \theta_i)$$

8.18.1.2 This test shall be carried out on a thermal container which has already been subjected to the heat leakage test (Test No. 14).

8.18.1.3 The thermal container shall be equipped with instruments for the measurement of:

a) outside and inside air temperatures as envisaged in 8.15.1 and Annex H; any temperature sensors inside the container directly in the path of the incoming stream of refrigerant shall be moved out of this stream;

b) the power supplied to heater(s) and fan(s).

The outside air flow at a point adjacent to the midpoint of one of the sides of the container shall be determined.

8.18.2 Test conditions

8.18.2.1 The outside temperature shall be as specified for the class of thermal container under test (see Table 1).

8.18.2.2 The inside temperature shall not exceed the specified temperature for the class of thermal container under test (see Table 1); this is the mean of the temperatures measured by the 12 sensors inside the container.

8.18.2.3 The outside air velocity shall not exceed 2 m/s at a distance of 100 mm from the side of the thermal container.

8.18.2.4 The inside air velocity shall be as produced by the refrigerating equipment and fans associated with heaters.

WARNING — All personnel shall be made aware of the likely hazard of the accumulation of concentrations of nitrogen or carbon dioxide within the thermal container, test chamber or adjacent confined spaces, and should be advised not to enter until the spaces are declared safe.

8.18.3 Test procedure

8.18.3.1 The thermal container shall be placed in the environment specified for the relevant level of testing, and the temperature shall be allowed to stabilize. The test shall not commence until the inside, wall and outside temperatures are within 3 K of each other. Floor drains, defrost drains (where fitted) and relief valves shall be in their normal operational states, and doors and vent devices shall be closed in the normal manner.

8.18.3.2 The refrigerant vessels shall be charged to their design capacities, but shall be left in a standby state while the container is brought into temperature equilibrium with its surroundings. The refrigerating system shall then be started to cool the thermal container under test to the operational temperature. The refrigerant vessels shall then be topped up to their design capacity and the container shall be maintained at or below the operational temperature for 8 h using only those temperature control devices fitted as normal equipment.

8.18.3.3 After the temperature has reached the operating level, the heater(s) and fan(s) described in 8.18.1.1 shall be turned on. After steady-state conditions have been re-established, the test shall be continued for a further 4 h.

8.18.3.4 Throughout the test, the inside and outside temperatures shall be recorded at intervals not exceeding 30 min.

8.18.4 Requirements

The equipment shall be capable of maintaining the average inside temperature of the thermal container at the specified level (see Table 1) for a period of at least 8 h and then for a further period of at least 4 h with additional heat load provided as specified in 8.18.1.1.

If desired, the consumption of the LER may be measured; this shall be done at the end of the test.

8.19 Test No. 16 — Strength of mounting devices for removable equipment (where fitted)

8.19.1 General

The tests described in 8.19.2 and 8.19.3 shall be carried out on any thermal container which is fitted with devices for mounting of removable equipment as shown in Annex G.

8.19.2 Test No. 16 a) — Vertical loading

8.19.2.1 General

This test shall be carried out to prove the ability of the thermal container end frame to support loading in the vertical direction due to the installed mass of the removable equipment, taking into account highway and rail modes of transport.

8.19.2.2 Procedure

The thermal container shall be placed on four level pads, one under each bottom corner fitting. The pads shall be centralized under the fittings and shall be essentially of the same plan dimensions as the fittings.

If the thermal container is equipped with provision for pin mounting of power generator sets, the container shall be subjected to vertical forces, applied to each upper pin-mounting socket. The force shall be applied to each socket through a test fixture equipped with a suitable pin surrounded by a rectangular plate no larger than 150 mm $\times$ 150 mm.

Similarly, the container shall be subjected to vertical forces, applied to each upper corner fitting which will carry the load of the installed removable equipment. The force shall be applied first to one corner fitting, and then to the other, through a test fixture equipped with a suitable fitting to engage the front aperture, and impose the load onto the bottom surface of the aperture.

A force of 17,8 kN shall be used for all vertical load tests.

8.19.2.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

8.19.3 Test No. 16 b) — Horizontal loading

8.19.3.1 General

This test shall be carried out to prove the ability of the thermal container end frame to support loading in the horizontal direction due to the installed mass of the removable equipment, taking into account highway and rail modes of transport.

8.19.3.2 Procedure

The thermal container shall be placed as required for Test No. 16 a).

If the thermal container is equipped with provision for pin mounting of generator sets, the container shall be subjected to horizontal forces, applied to each upper pin-mounting socket in a direction perpendicular to the end plane of the container. The force shall be applied first to one socket, and then to the other, through a test fixture equipped with a suitable pin surrounded by a rectangular plate no larger than 150 mm $\times$ 150 mm.

NOTE It is not necessary to carry out a horizontal force test on the upper corner fittings.

The container shall be subjected to horizontal forces applied to each lower mounting point. The force shall be applied first to one lower mounting point, and then to the other, using a fixture equipped with a 3/4-10 UNC Grade 8 bolt threaded into each lower mounting point in turn. The bolt shall be installed such that it engages six, and only six, full threads of the lower mounting point, and the force shall be applied perpendicular to the plane of the end frame in a direction away from the corner post.

A force of 17,8 kN shall be used for all horizontal load tests.

8.19.3.3 Requirements

On completion of the test, the thermal container shall show neither permanent deformation which will render it unsuitable for use nor abnormality which will render it unsuitable for use, and shall meet the dimensional requirements (such as those given in ISO 1496-1) affecting handling, securing and interchange.

9 Electrical aspects of thermal containers

9.1 General

The requirements that follow are only intended to govern those aspects of electrically-powered thermal containers which affect interchange or are the minimum needed to affect safety. They do not constitute a detailed electrical specification. Reference should be made to IEC 60947-1, IEC 60309-1 and IEC 60309-2 and appropriate national and international standards and regulations.

NOTE 1 See Annex M for information concerning electrical power supplies for thermal containers.

NOTE 2 Commonly available electric motors and control gear will not necessarily satisfy the requirements given below, which include wider voltage tolerances than are necessary for stationary equipment.

9.2 General requirements for standard voltage equipment

9.2.1 Equipment shall be designed to operate from three-phase, three-wire a.c. supply sources when the nominal voltage measured between phases at the receptacle is as follows:

a) 50 Hz: 360 V min., 460 V max.;

b) 60 Hz: 400 V min., 500 V max.

The nominal frequencies of 50 Hz and 60 Hz shall have a tolerance of ± 2,5 %.

NOTE Operation at the extremes of the voltage or frequency range specified, particularly both, will greatly shorten motor life.

9.2.2 Equipment shall have a maximum electrical loading, under rated operating conditions, not exceeding 18,75 kVA. The power consumption shall not exceed 15 kW.

9.2.3 Equipment shall operate in the proper direction of rotation when connected to a supply system having standard phase rotation through a plug and socket connector wired as shown in Annex J and as specified in Annex K. Standard phase rotation shall be taken to mean a three-phase a.c. power system in which the line voltages attain their maximum positive values in the sequence A (or R), B (or S), C (or T).

9.2.4 Total starting current shall be as low as possible and shall not exceed 150 A. The total starting current shall be taken to mean the sum of the locked rotor (standstill) currents of all motors starting up at the instant of switch-on plus the current taken by non-rotating elements.

It is permissible for the total starting current of an item of equipment to be limited by sequence controls which allow only one of the motors in the multimotor equipment to start at any one instant.

The starting current shall decay to 125 % of the normal full load operating current in not more than 1 s when tested on a mains supply.

9.2.5 Equipment shall be provided with means for protecting the temperature control apparatus against electrical overloads. Automatic reset devices may be used, provided component temperatures are not allowed to exceed safe levels.

9.2.6 A continuous equipment earthing conductor shall be provided at the plug and through the "powercord" to the equipment. Metallic parts of electrical fittings within the equipment which do not carry electric current shall be connected to this earthing conductor. All parts which are electrically live, at voltages in excess of 42 V, shall be shielded against accidental contact. The insulation resistance of the equipment shall be at least 1 MΩ.

9.2.7 A flexible power cable of adequate electrical capacity shall be permanently attached to the refrigeration and/or heating unit at one end and shall have a male plug at the other end. The cable shall have a minimum length of 18 m.

9.2.8 The equipment shall be provided with a 32 A four-pin (three poles plus earth) male plug with bayonet retaining ring as shown in Annex K.

The plug shall be sealed to the power cable by a suitable means so as to prevent the entry of water under service conditions.

9.2.9 The container or refrigeration equipment shall include a storage space large enough to securely stow the power cable. If a portion of the cable is intended to be stored in the compartment during operation, the storage space shall be ventilated.

9.2.10 Controls shall include an easily accessible and clearly marked ON/OFF switch on the outside of the equipment, which prevents operation of the unit when in the OFF position.

Whenever the unit's ON/OFF switch is in the ON position, the unit shall operate automatically on its own control system and an indicating light shall be illuminated. Indicating lights shall not interfere with on-board navigation lights.

9.2.11 All electrically live metal parts shall be protected from accidental contact.

9.2.12 All exposed non-current carrying metallic components in a plug assembly which are liable to be energized when in the mated position, and all receptacle box assemblies, shall be grounded.

9.2.13 Cable connections to plugs shall be provided with a cable anchorage (strain relief) such that the conductors are relieved from strain, including twisting, and that their covering is protected from abrasion. Cable anchorages shall be designed in such a way that the conductors cannot touch accessible metal parts.

9.2.14 The plug and receptacle shall be designed to conform with IEC 60947-1.

NOTE Safe working procedures should be established for the use of power connectors. In some countries there may be a requirement for the equipment to operate from supplies fitted with a residual current device (rcd).

9.2.15 A wiring diagram shall be mounted on an easily accessible door of the appliance. All wires shall be identified by marking or colour coding to correspond with information on the wiring diagram.

9.2.16 The equipment nameplate details shall include the following data as a minimum requirement:

— volts: three-phase Hz;

— full load current: A;

— total starting current: A.

9.3 220 volt and dual voltage equipment

220 volt and dual voltage equipment, being built to older specifications, are not recommended for installation in new thermal containers.

9.4 Remote condition monitoring

As an option, thermal containers can be equipped to monitor their condition remotely using power line transmission of data. Requirements for implementing this capability are set out in ISO 10368.

NOTE A guidance document on powerline quality requirements for remote condition monitoring is under preparation. Contact the ISO/TC 104/SC 2 Secretariat for further information.

Annex A
(normative)

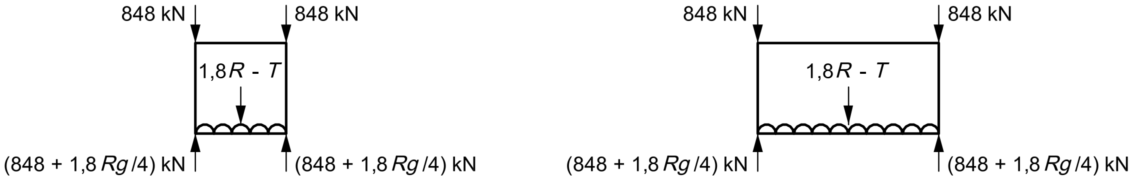
Diagrammatic representation of capabilities appropriate to all types and sizes of thermal containers, except where otherwise stated

Figures A.1 to A.22 show the forces applied in the tests described in 8.2 to 8.12.

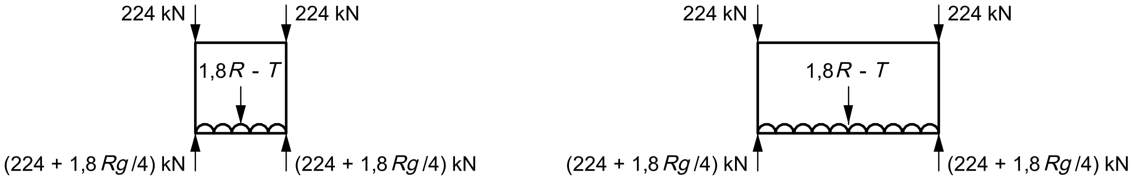
NOTE 1 The externally applied forces shown below are for one end or side only. The loads shown within the containers represent uniformly distributed internal loads only, and such loads are for the whole container.

NOTE 2 For definitions of P, R and T, see 8.1.2.

End elevations	***Side elevations***



a) Not applicable to 1D containers



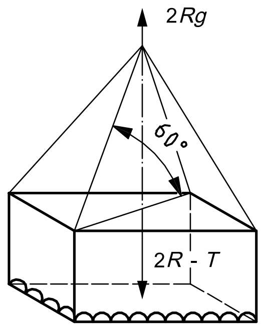
b) Applicable to 1D containers only

Figure A.1 — Stacking Test No. 1

Figure A.2 — Top lift

End elevations	*Side elevations*

a) Not applicable to 1D containers



b) Applicable to 1D containers only

Figure A.3 — Top lift Test No. 2

Figure A.4 — Bottom lift Test No. 3

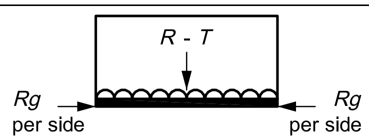


Figure A.5 — Restraint (longitudinal) Test No. 4

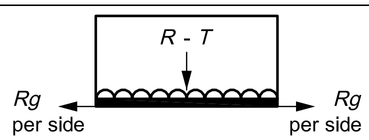


Figure A.6 — Restraint (longitudinal) Test No. 4

End elevations	*Side elevations*

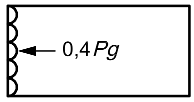


Figure A.7 — End loading Test No. 5

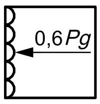
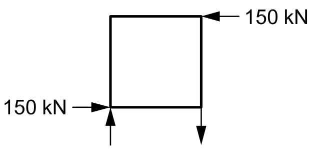


Figure A.8 — Side loading Test No. 6

Figure A.9 — Roof load Test No. 7

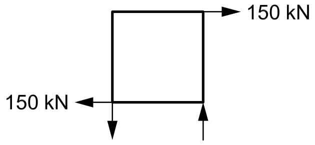
Figure A.10 — Wheel loads Test No. 8



Not applicable to 1D containers

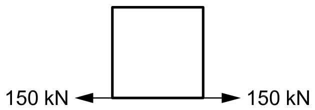
Figure A.11 — Rigidity (transverse) Test No. 9

End elevations	*Side elevations*



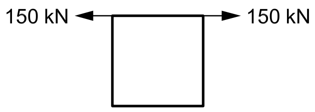
Not applicable to 1D containers

Figure A.12 — Rigidity (transverse) Test No. 9



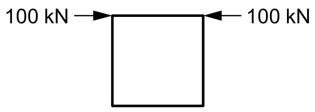
Not applicable to 1D containers

Figure A.13 — Lashing/ securement



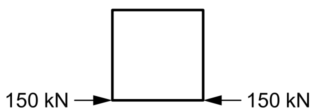
Not applicable to 1D containers

Figure A.14 — Lashing/ securement



Not applicable to 1D containers

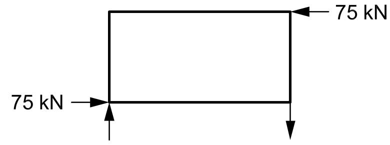
Figure A.15 — Lashing/ securement



Not applicable to 1D containers

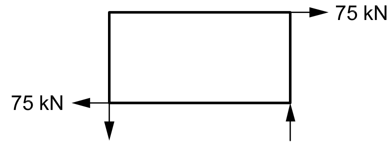
Figure A.16 — Lashing/securement

End elevations	*Side elevations*



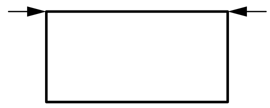
Not applicable to 1D containers

Figure A.17 — Rigidity (longitudinal) Test No. 10



Not applicable to 1D containers

Figure A.18 — Rigidity (longitudinal) Test No. 10

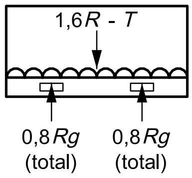


This type of loading is not permissible except as applied in Figure A.3 b).

Figure A.19 — Lashing/securement

Not applicable to 1D containers

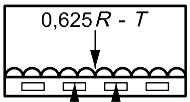
Figure A.20 — Lashing/securement



Applicable to 1CC, 1C and 1D containers when fitted with one set of fork-lift pockets

Figure A.21 — Fork-lift pockets Test No. 11

End elevations	*Side elevations*



Applicable to 1CC and 1C containers when fitted with a second set of fork-lift pockets

Figure A.22 — Fork-lift pockets Test No. 11

Annex B
(normative)

Details of requirements for load-transfer areas in base structures of containers

NOTE For the convenience of users of this part of ISO 1496, the conversion of values expressed in SI units to values in non-SI units is given in Annex N.

B.1 Purpose

The base structures of containers, i.e. the end transverse members and such intermediate members as may be fitted (or such flat underside as may be provided) to constitute load-transfer areas, shall be capable of transferring load to or from the longitudinal members of a carrying vehicle which are assumed to lie within the two 250 mm wide zones defined by the broken lines in Figure B.1.

B.2 Requirements

B.2.1 Containers not having transverse members spaced 1 000 mm apart or less (and not having a flat underside) shall have load-transfer areas as indicated in Figures B.2 to B.6, capable of meeting the requirements in B.2.2 to B.2.5.

B.2.2 Each pair of load-transfer areas associated with an end transverse member shall be capable of transferring loads of not less than $0{,}5R$, i.e. the loads which may occur when a container is placed onto a carrying vehicle of the kind which does not support the container by its corner fittings.

Furthermore, each pair of intermediate load-transfer areas shall be capable of transferring loads of not less than $1{,}5R/n$, where n is the number of pairs of intermediate load-transfer areas, i.e. loads which may occur during transport operations.

B.2.3 The minimum number of pairs of load-transfer areas are:

— for 1CC and 1C containers	4
— for 1BBB, 1BB and 1B containers	5
— for 1AA and 1A containers	5
— for 1AAA, 1AA and 1A containers fitted with a non-continuous gooseneck tunnel	6

Where a greater number of pairs of load-transfer areas are provided, these should be approximately equally spaced along the length of the container.

B.2.4 The spacing between the end transverse member and the nearest intermediate pair of load-transfer areas shall be:

- between 1 700 mm and 2 000 mm for containers having the minimum number of pairs of load-transfer areas for the container concerned;
- between 1 000 mm and 2 000 mm for containers having one more pair of load-transfer areas than the minimum required for the containers concerned.

B.2.5 Each load-transfer area shall have a longitudinal dimension of at least 25 mm.

B.3 Gooseneck tunnel transfer areas

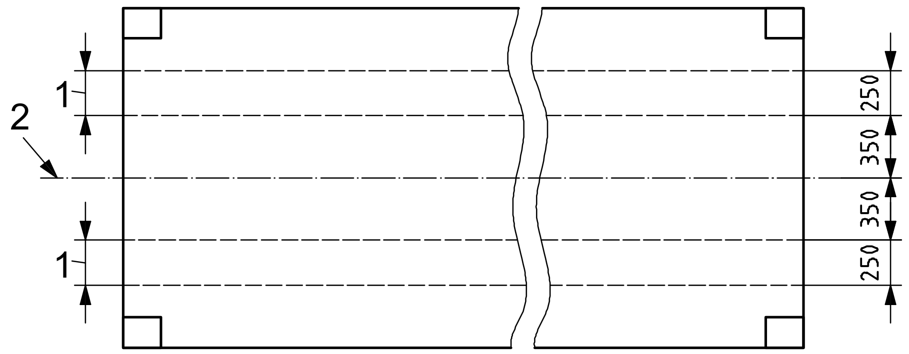
Minimum requirements for load-transfer areas in the vicinity of the gooseneck tunnel are shown in Figure B.6.

Each load transfer area at the tunnel has two components, an upper component (A) and a lower component (B). This paired set, A and B, shall be taken as one load transfer area and the sum of the two components, A + B, shall be equal to or greater than 1 250 mm^2.

(See Annex D for details of tunnel section.)

NOTE In Figures B.2 to B.5 inclusive, the load-transfer areas associated with the container base are shown in black. Gooseneck tunnel transfer areas are shown in black in Figure B.6.

Dimensions in millimetres



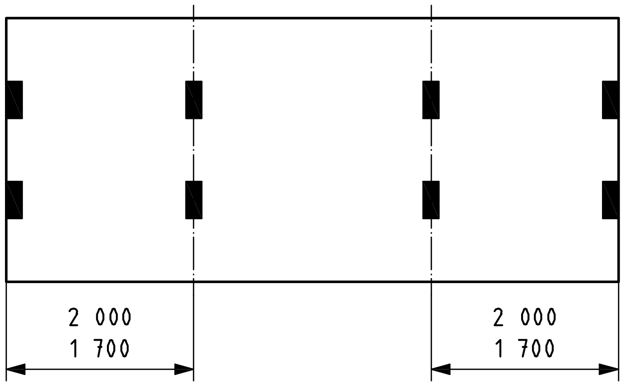
Key

1 zone

2 central axis

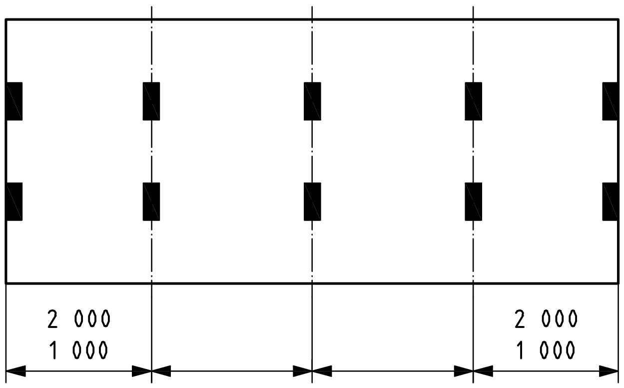
Figure B.1 — Zones for longitudinal members

Dimensions in millimetres



4 pairs of load-transfer areas (1 pair at each end plus 2 intermediate pairs)

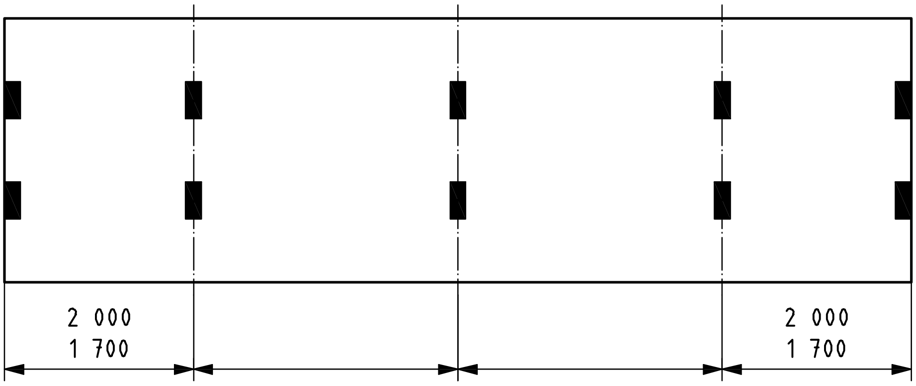
a) Minimum requirements



b) Requirements applicable if 5 pairs of load-transfer areas are to be fitted

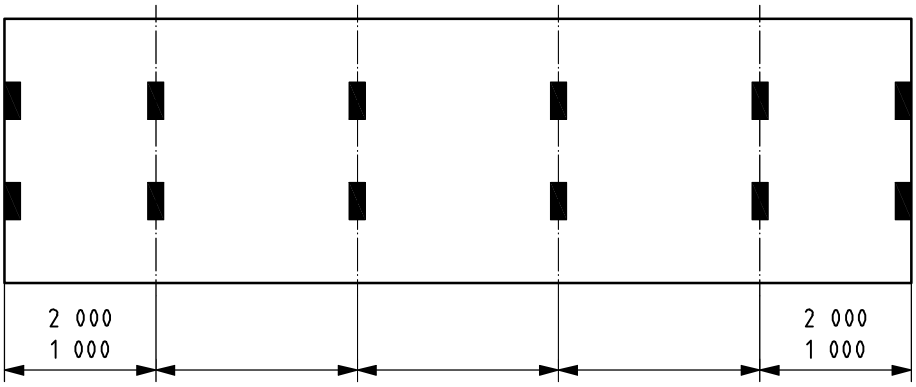
Figure B.2 — 1C and 1CC containers

Dimensions in millimetres



5 pairs of load-transfer areas (1 pair at each end plus 3 intermediate pairs)

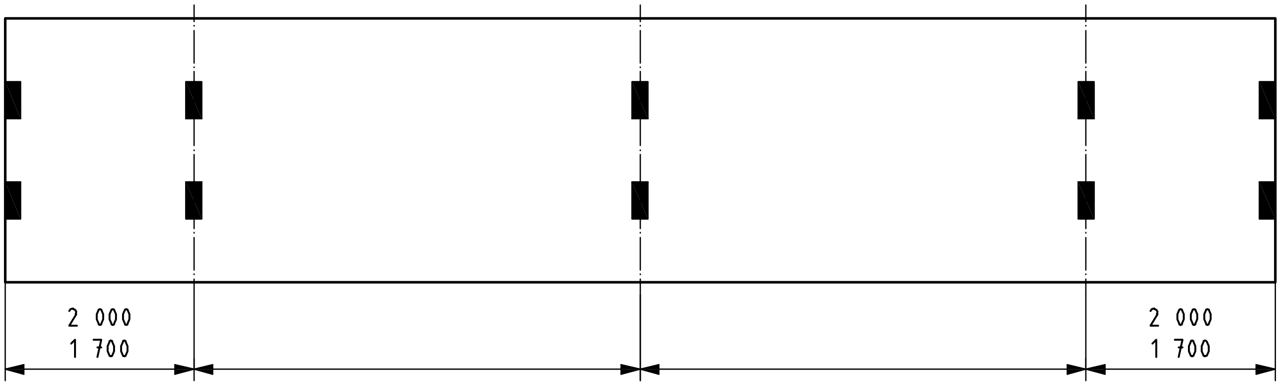
a) Minimum requirements



b) Requirements applicable if 6 pairs of load-transfer areas are to be fitted

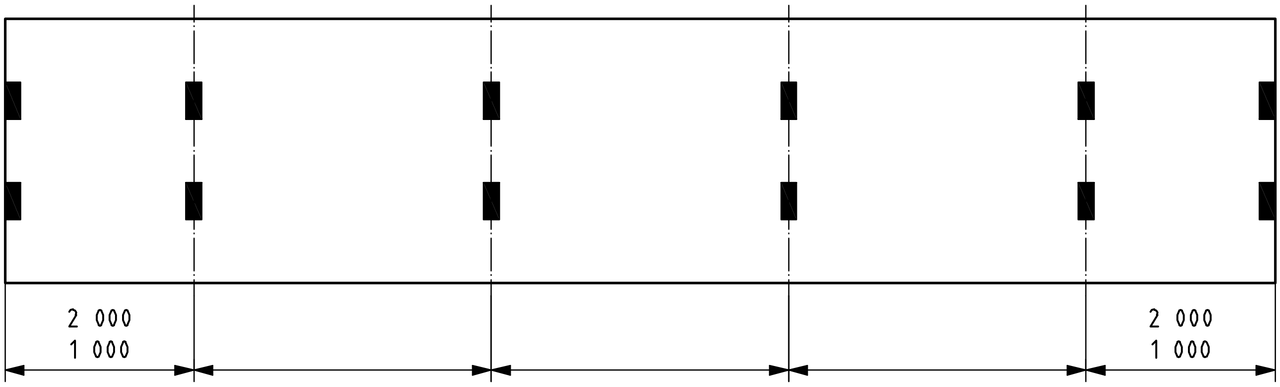
Figure B.3 — 1B, 1BB and 1BBB containers

Dimensions in millimetres



5 pairs of load-transfer areas (1 pair at each end plus 3 intermediate pairs)

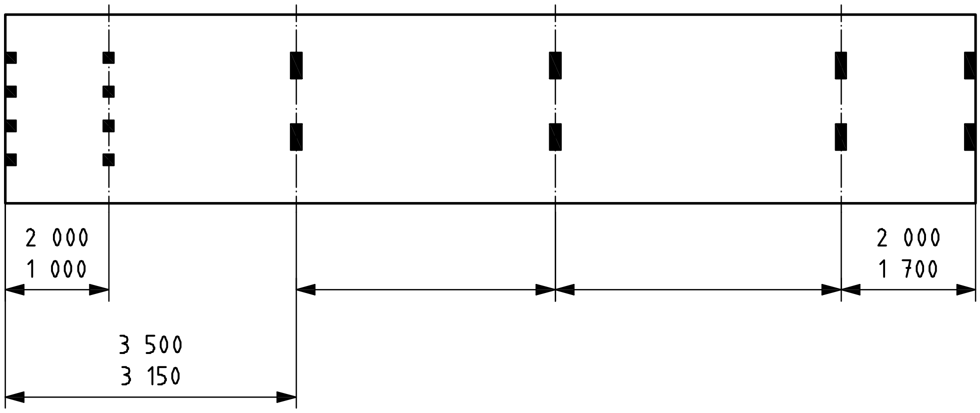
a) Minimum requirements



b) Requirements applicable if 6 pairs of load-transfer areas are to be fitted

Figure B.4 — 1A and 1AA containers without gooseneck tunnel

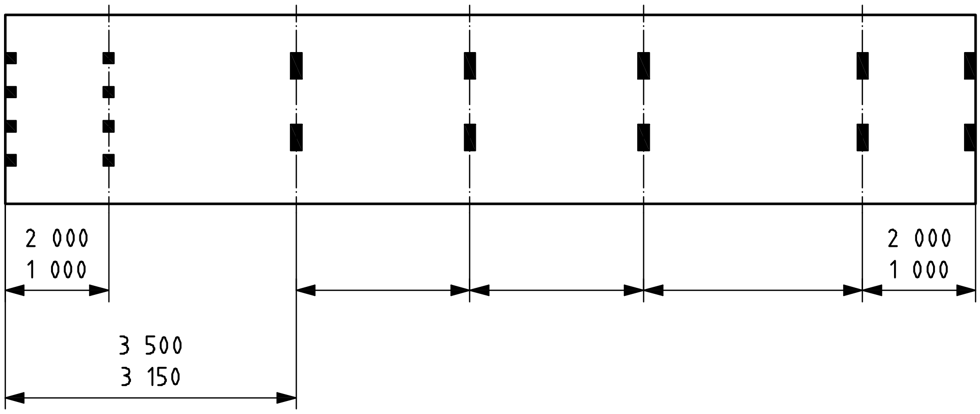
Dimensions in millimetres



See also Figure B.6.

6 pairs of load-transfer areas (1 pair at each end plus 4 intermediate pairs)

a) Minimum requirements

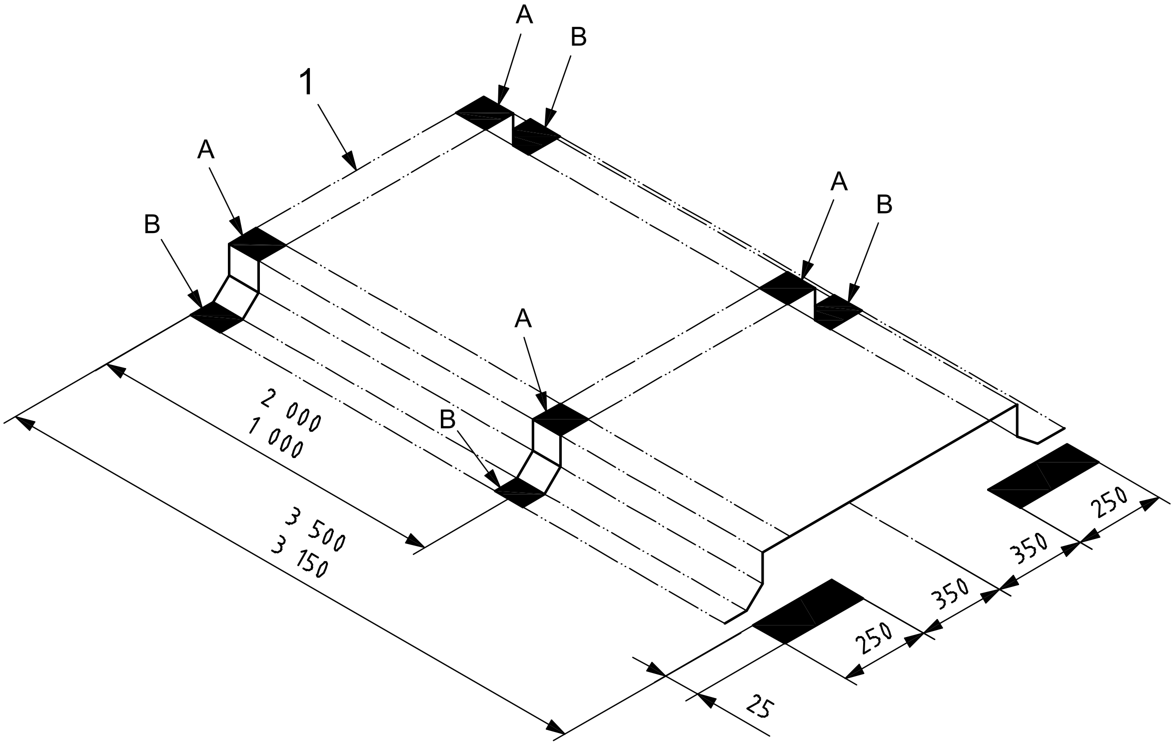


See also Figure B.6.

b) Requirements applicable if 7 pairs of load-transfer areas are to be fitted

Figure B.5 — 1A, 1AA and 1AAA containers with gooseneck tunnel (with minimum localized structure)

Dimensions in millimetres



Key

1 front of container

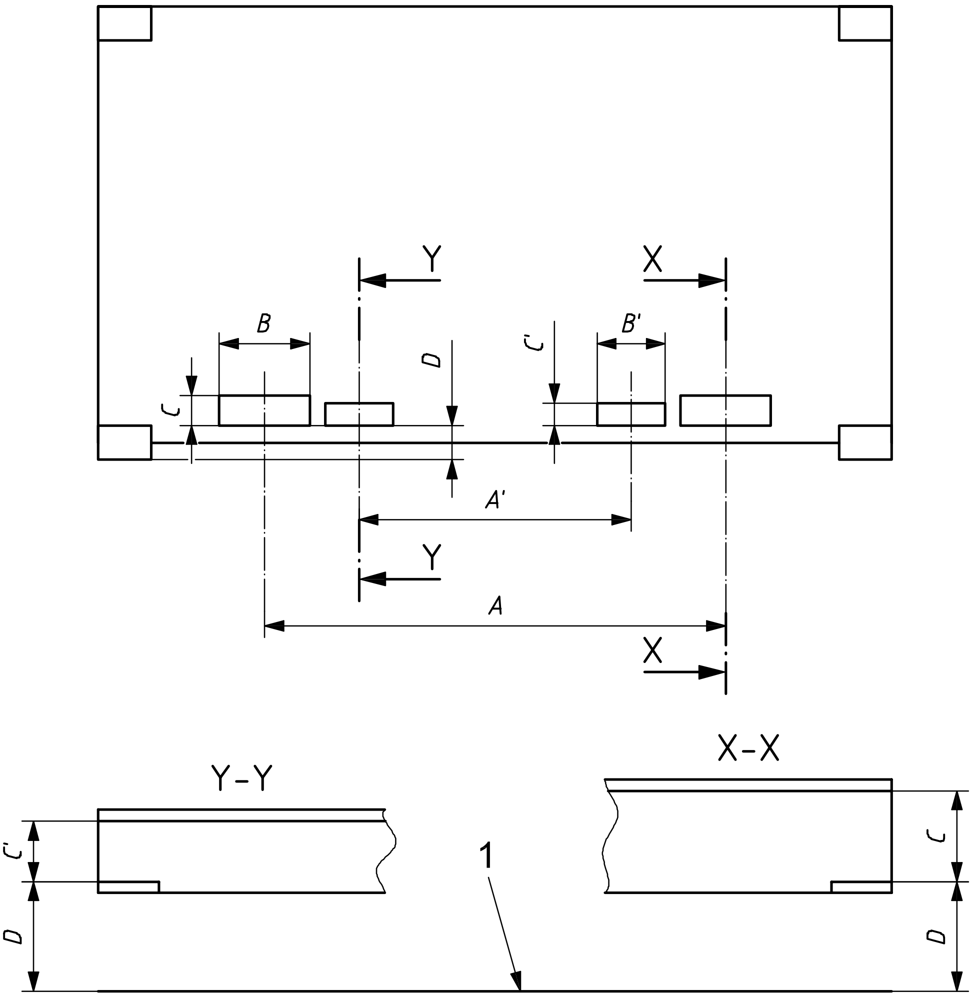
Figure B.6 — Minimum requirements for load-transfer areas near the gooseneck tunnel

NOTE Where continuous tunnel side members are provided, the load transfer areas situated between 3 150 mm and 3 500 mm from the end of the container may be omitted.

Annex C
(normative)

Dimensions of fork-lift pockets (where provided)

Fork-lift pockets are described in 7.9.1 and the dimensions are given in Figure C.1 and Table C.1.



Key

1 base plane

Figure C.1 — Dimensions of fork-lift pockets

Table C.1 — Dimensions of fork-lift pockets

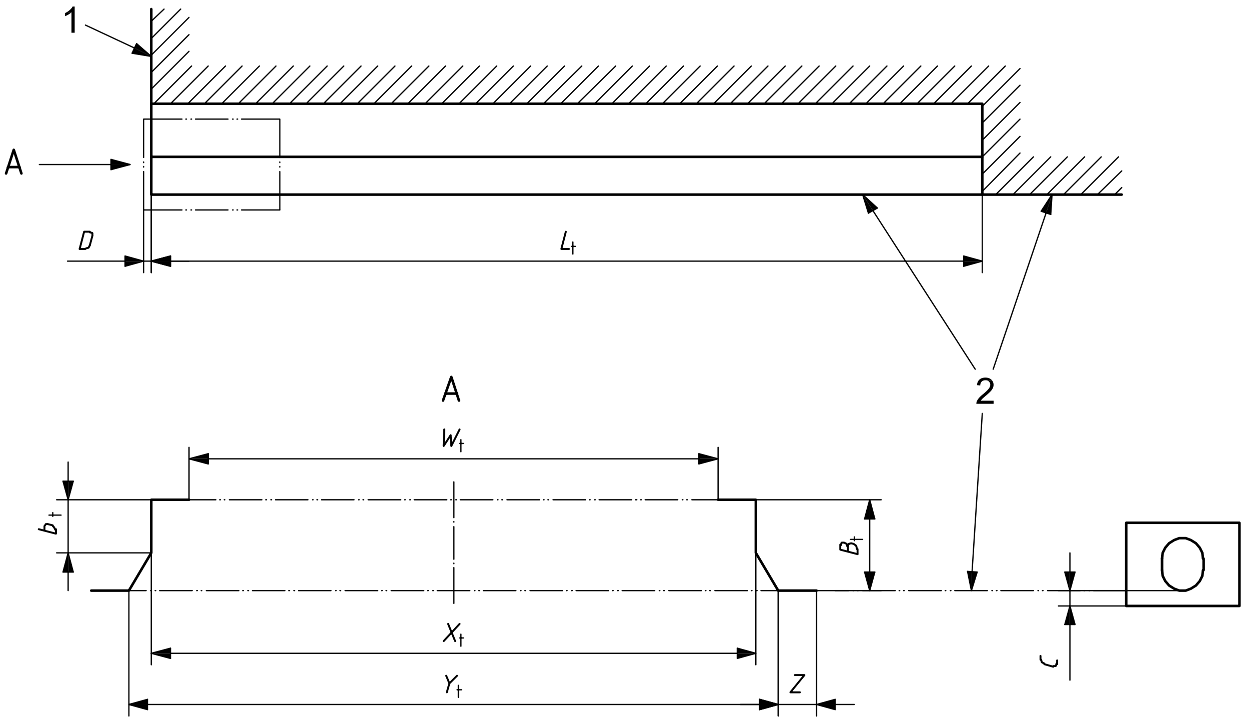
Container designation	Dimensions													
	Fork-lift pockets for loaded and unloaded containers								Fork-lift pockets for unloaded containers only					
	mm				in				mm			in		
	A	*B*	*C*	*D*	*A*	*B*	*C*	*D*	*A*	*B*	*C*	*A*	*B*	*C*
1C, 1CC	2 050 ± 50	355 min.	115 min.	20 min.	81 ± 2	14 min.	4 1/2 min.	0,8 min.	900 ± 50	305 min.	102 min.	35 1/2 ± 2	12 min.	4 min.
1D	900 ± 50	305 min.	102 min.	20 min.	35 1/2 ± 2	12 min.	4 min.	0,8 min.	—					

NOTE *C* = clear opening.

Annex D
(normative)

Dimensions of gooseneck tunnels (where provided)

Gooseneck tunnels are described in 7.9.2. The space required to constitute a tunnel into which the gooseneck of a trailer may fit is shown in Figure D.1 and the dimensions are given in Table D.1.



Key

1 face of front transverse member

2 level of transverse members (tunnel area)

Figure D.1 — Dimensions of gooseneck tunnels

Table D.1 — Dimensions of gooseneck tunnels

Dimensions	Length		Width				Height		
	L_t	D	W_t, max	X_t	Y_t	Z, min	B_t [a]	b_t	C
mm	3 500 3 150	6^{+1}_{-2}	930	$1\,029^{+3}_{0}$	1 130 1 070	25	120^{0}_{-3}	70 35	$12{,}5^{+5{,}0}_{-1{,}5}$
in	137 7/8 124 1/4	$1/4^{+3/64}_{-3/32}$	36 5/8	$40\ 1/2^{+1/8}_{0}$	44 1/2 42 1/8	1	$4\ 23/32^{0}_{-1/8}$	2 3/4 1 3/8	$1/2^{+3/16}_{-1/16}$

NOTE The tunnel structure may be formed by continuous members having the minimum length specified in the table and the internal dimensions given for the thick lines in the figure or, alternatively, localized structures may be provided at the positions shown in black in Figure B.6.

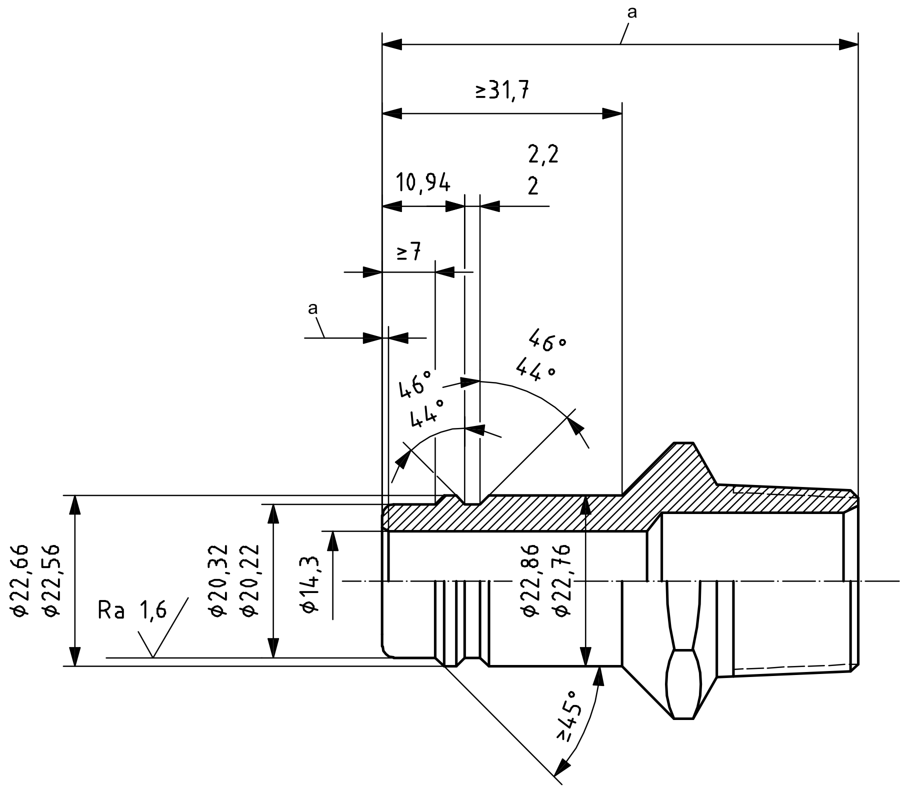
[a] Tolerance B_t shall be measured in the back part of the tunnel, over a length of about 600 mm (23 5/8 in).

Annex E
(normative)

Cooling water connections

Requirements for cooling water connections are given in 7.9.4. Dimensions are given in Figures E.1 and E.2.

Dimensions in millimetres
Surface roughness value in micrometres

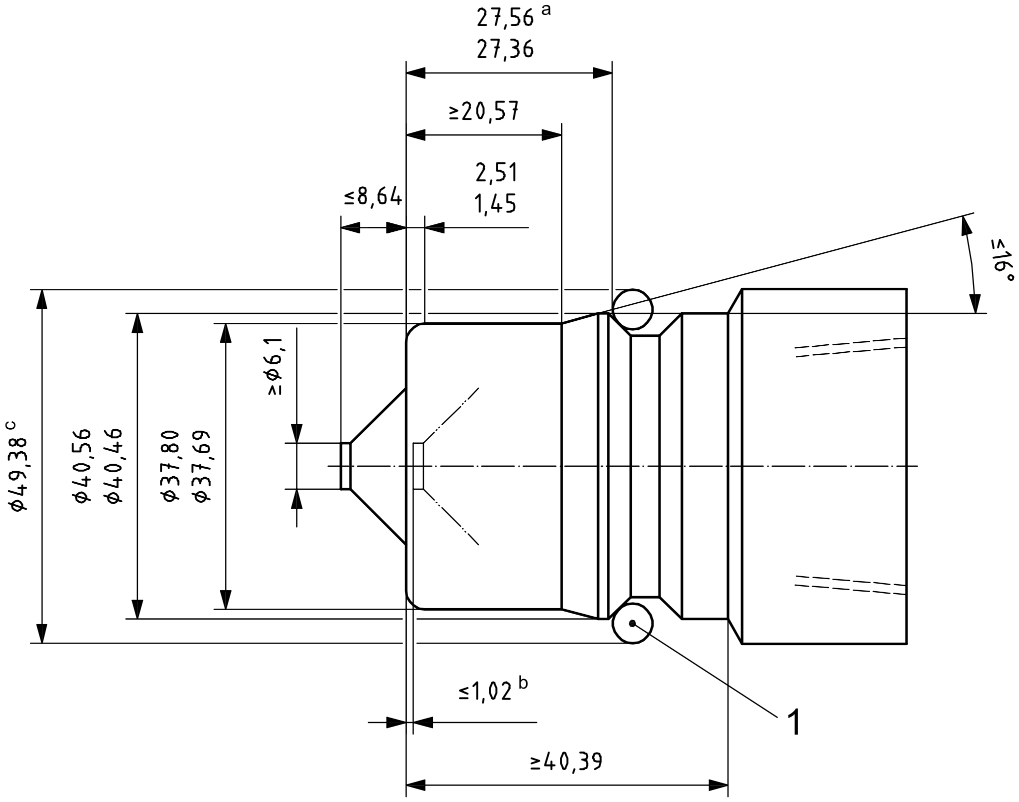


Operating pressure: 1 MPa
Bursting pressure: 4 MPa

[a] Detail not specified in this part of ISO 1496.

Figure E.1 — Cooling water connection — Inlet side

Dimensions in millimetres
Surface roughness value in micrometres



Key

1 locking balls

Operating pressure: 1 MPa
Bursting pressure: 4 MPa

[a] To ball.

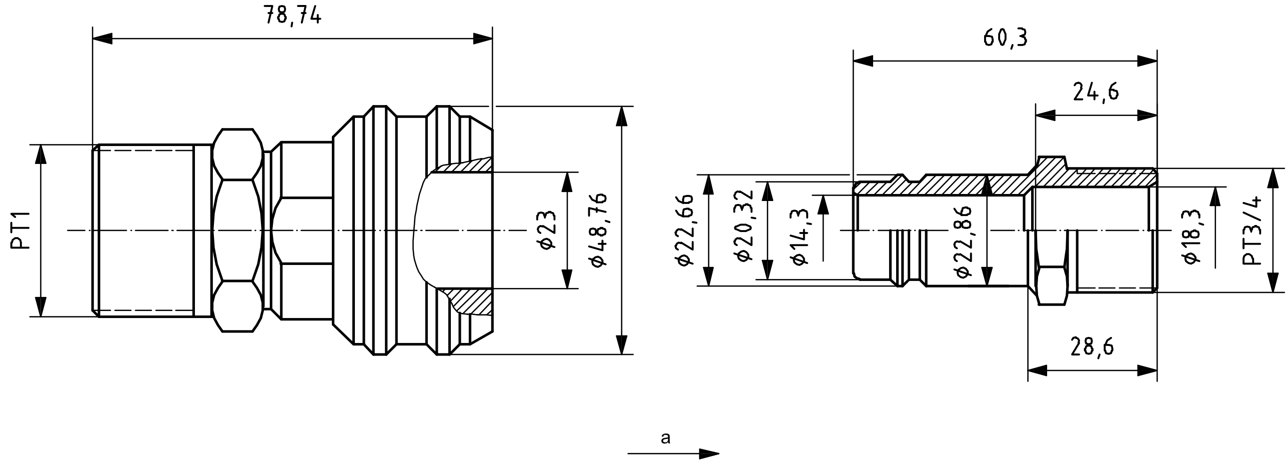
[b] Valve flush to minus from end of coupler when against stop.

[c] Gauge.

Figure E.2 — Cooling water connection — Outlet side

Examples of sectional view and profile of cooling water connections are shown in Figure E.3.

Dimensions in millimetres

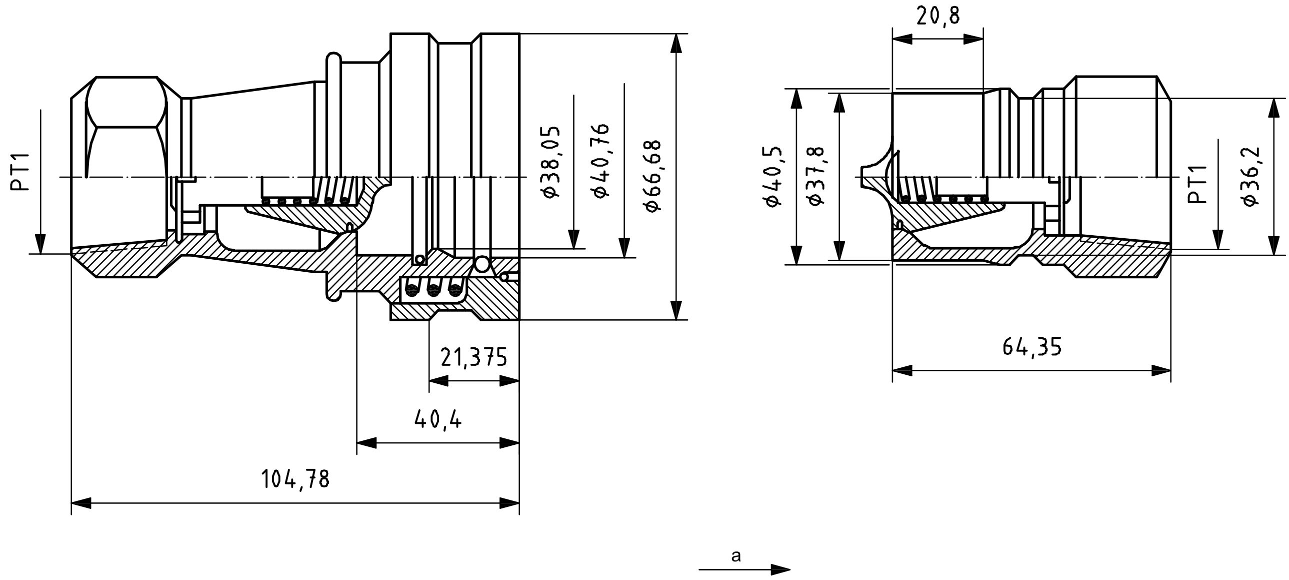


a) Socket with valve (ship side) **b) Plug with valve (container side)**

[a] Flow of water.

Figure E.3 — Cooling water connection — Inlet side (single shut-off)

Dimensions in millimetres



a) Socket with valve (container side) **b) Plug with valve (ship side)**

[a] Flow of water.

Figure E.4 —Cooling water connection — Outlet side (double shut-off)

Annex F
(normative)

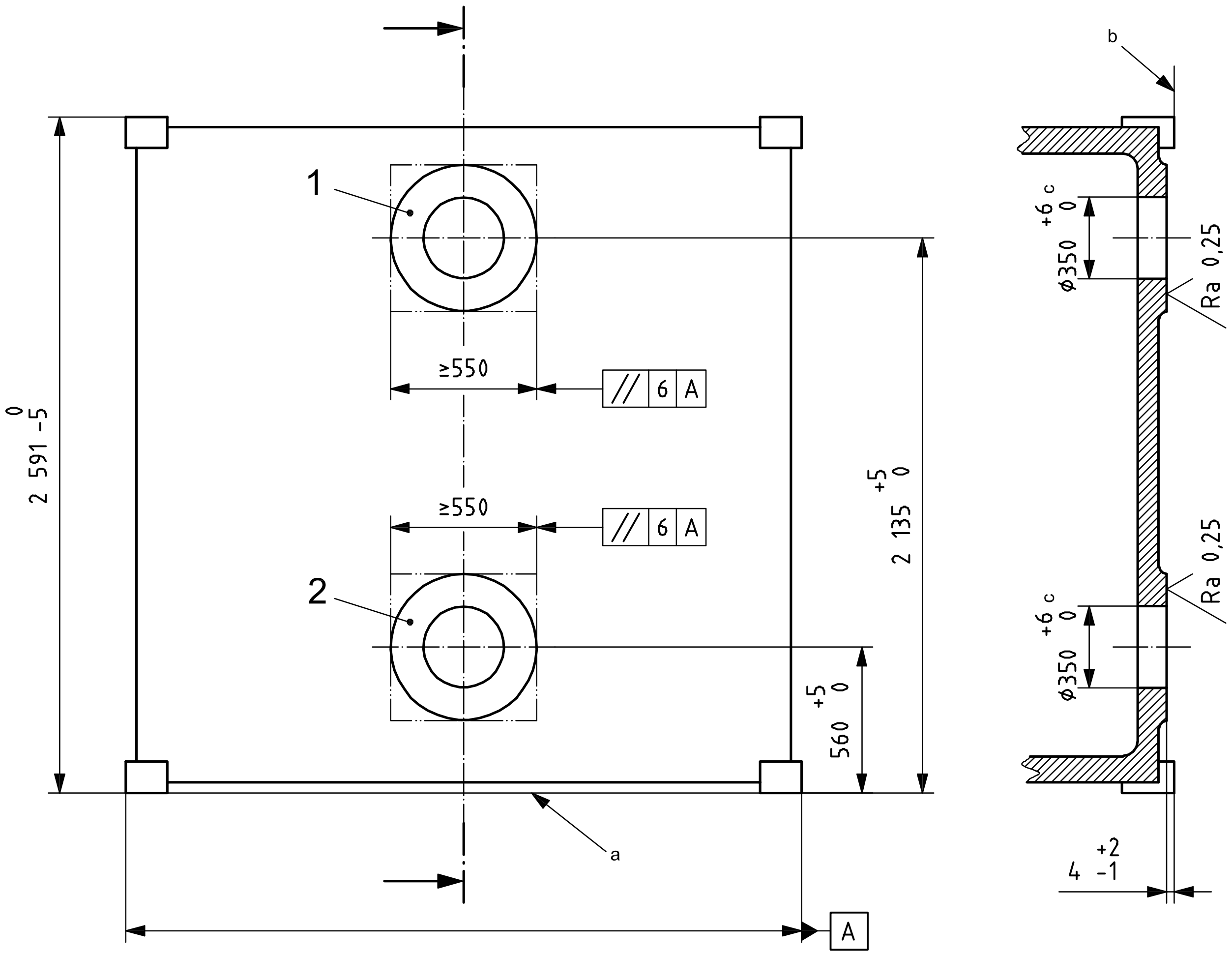
Air inlets and outlets

F.1 Air apertures in end walls of 1AA thermal containers

F.1.1 Dimensions

Dimensions of air apertures (see 7.9.5) in end walls of 1AA thermal containers are given in Figure F.1.

Dimensions in millimetres
Surface roughness values in millimetres



Key

1 air outlet hole

2 air inlet hole

[a] Baseline: bottom face of bottom corner fittings.

[b] Baseline: front face of front corner fittings.

[c] Diameter at outer end of bore of hole.

Figure F.1 — Dimensions of air apertures in end walls of 1AA thermal containers

F.1.2 Area about air circulation openings (see Figure F.1)

F.1.2.1 Bosses shall be 550 mm diameter or on a side (square).

F.1.2.2 Faces of bosses shall be recessed 4^{+2}_{-1} mm from the front faces of the front corner fittings.

F.1.2.3 Faces of bosses shall be parallel to the front face of the front corner fittings and shall be flat to within the limits of the tolerance indicated in F.1.2.2. Their surface roughness shall not exceed 0,25 mm.

F.1.2.4 Holes may have a mould draw taper, but no part of the bore of the hole may have a diameter of less than 350 mm.

F.1.3 Closures for apertures

F.1.3.1 Closure devices that are captive to the container should be provided for closing off the air circulation openings when the container is not connected to a cold air supply.

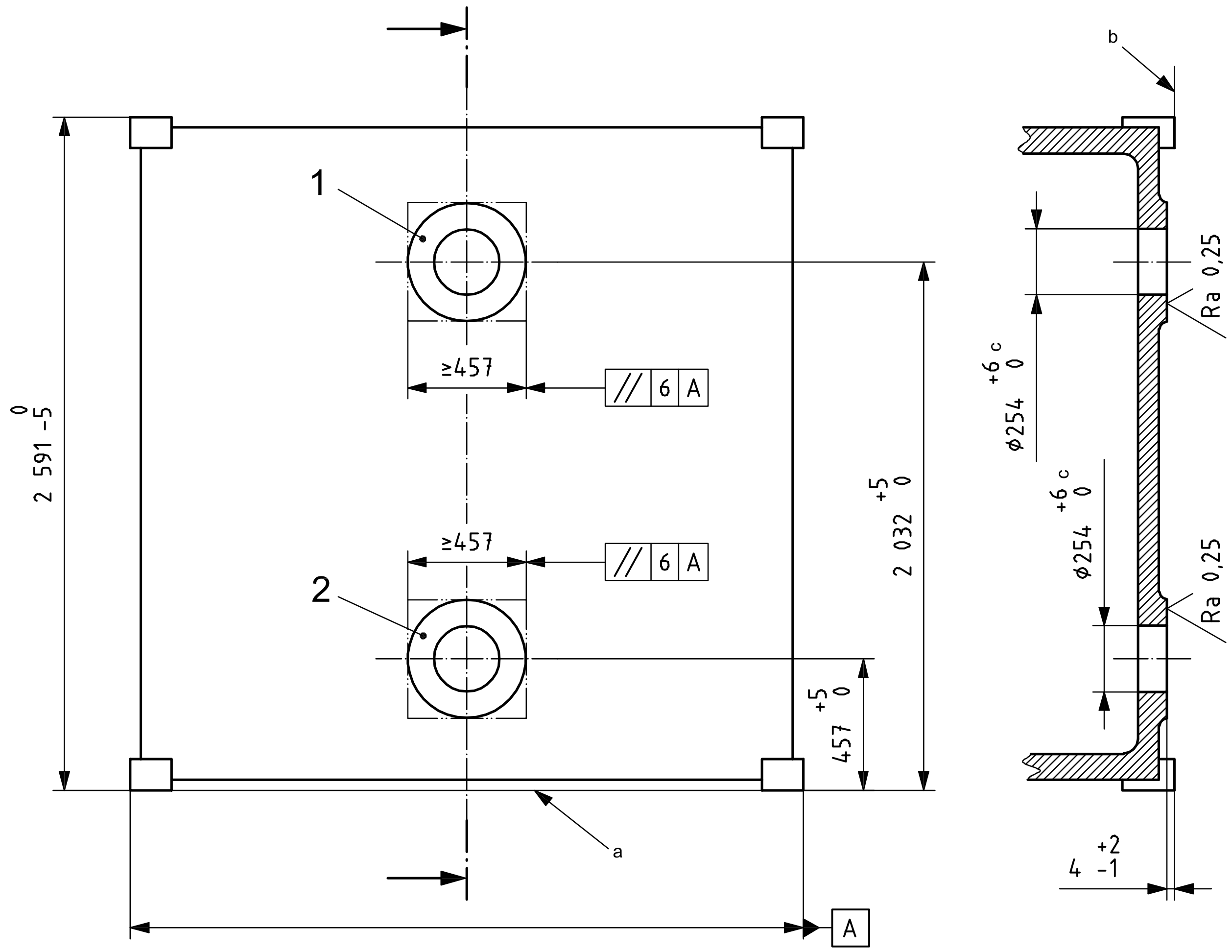
F.1.3.2 Closure devices should be capable of being sealed for customs requirements.

F.2 Air apertures in end walls of 1CC thermal containers

F.2.1 Dimensions

Dimensions of air apertures (see 7.9.5) in end walls of 1CC thermal containers are given in Figure F.2.

Dimensions in millimetres
Surface roughness values in millimetres



Key

1 air outlet hole

2 air inlet hole

[a] Baseline: bottom face of bottom corner fittings.

[b] Baseline: front face of front corner fittings.

[c] Diameter at outer end of bore of hole.

Figure F.2 — Dimensions of air apertures in end walls of 1CC thermal containers

F.2.2 Area about air circulation openings (see Figure F.2)

F.2.2.1 Bosses shall be 457 mm diameter or on a side (square).

F.2.2.2 Faces of bosses shall be recessed 4^{+2}_{-1} mm from the front faces of the front corner fittings.

F.2.2.3 Faces of bosses shall be parallel to the front face of the front corner fittings and shall be flat to within the limits of the tolerance indicated in F.2.2.2. Their surface roughness shall not exceed 0,25 mm.

F.2.2.4 Holes may have a mould draw taper, but no part of the bore of the hole may have a diameter of less than 254 mm.

F.2.3 Closures for apertures

F.2.3.1 Closure devices that are captive to the container should be provided for closing off the air circulation openings when the container is not connected to a cold air supply.

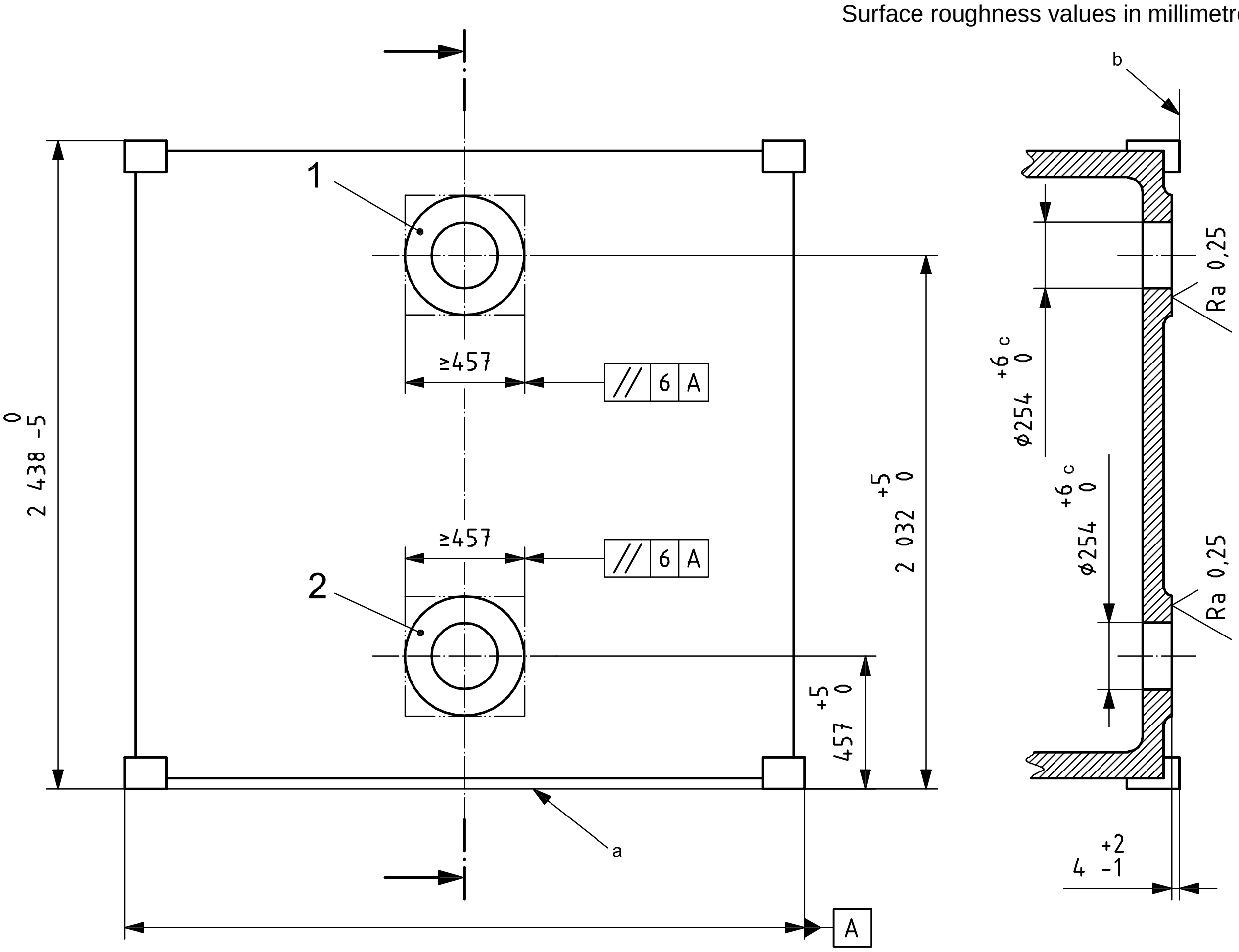
F.2.3.2 Closure devices should be capable of being sealed for customs requirements.

F.3 Air apertures in end walls of 1C thermal containers

F.3.1 Dimensions

Dimensions of air apertures (see 7.9.5) in end walls of 1C thermal containers are given in Figure F.3.

Dimensions in millimetres
Surface roughness values in millimetres



Key

1 air outlet hole

2 air inlet hole

[a] Baseline: bottom face of bottom corner fittings.

[b] Baseline: front face of front corner fittings.

[c] Diameter at outer end of bore of hole.

Figure F.3 — Dimensions of air apertures in end walls of 1C thermal containers

F.3.2 Area about air circulation openings (see Figure F.3)

F.3.2.1 Bosses shall be 457 mm diameter or on a side (square).

F.3.2.2 Faces of bosses shall be recessed 4^{+2}_{-1} mm from the front faces of the front corner fittings.

F.3.2.3 Faces of bosses shall be parallel to the front face of the front corner fittings and shall be flat to within the limits of the tolerance indicated in F.3.2.2. Their surface roughness shall not exceed 0,25 mm.

F.3.2.4 Holes may have a mould draw taper, but no part of the bore of the hole may have a diameter of less than 254 mm.

F.3.3 Closures for apertures

F.3.3.1 Closure devices that are captive to the container should be provided for closing off the air circulation openings when the container is not connected to a cold air supply.

F.3.3.2 Closure devices should be capable of being sealed for customs requirements.

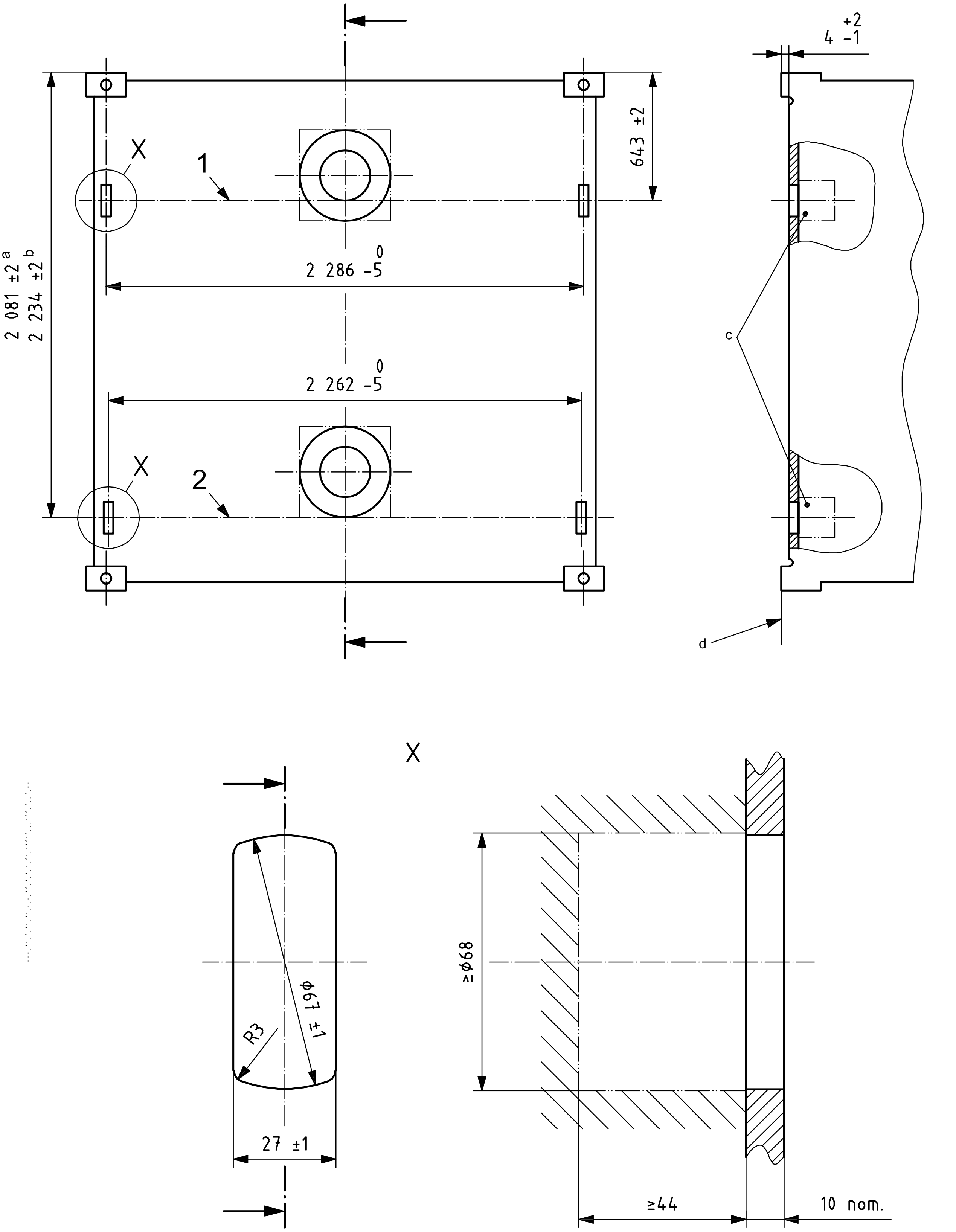
Annex G
(normative)

Mounting of clip-on units

Dimensions of intermediate sockets for clip-on units (where provided) on thermal container types 40 and 42 designed for ducted air systems are shown in Figure G.1.

Top lifting of the container shall not be impaired when a clip-on unit is fitted to the container.

Dimensions in millimetres



Key

1 alternative 1: total-loss refrigerant tanks

2 alternative 2: mechanical refrigeration units

[a] For 1C containers.

[b] For 1AA and 1CC containers.

[c] Clearance required for mounting studs (see detail X).

[d] Front face of front corner fittings.

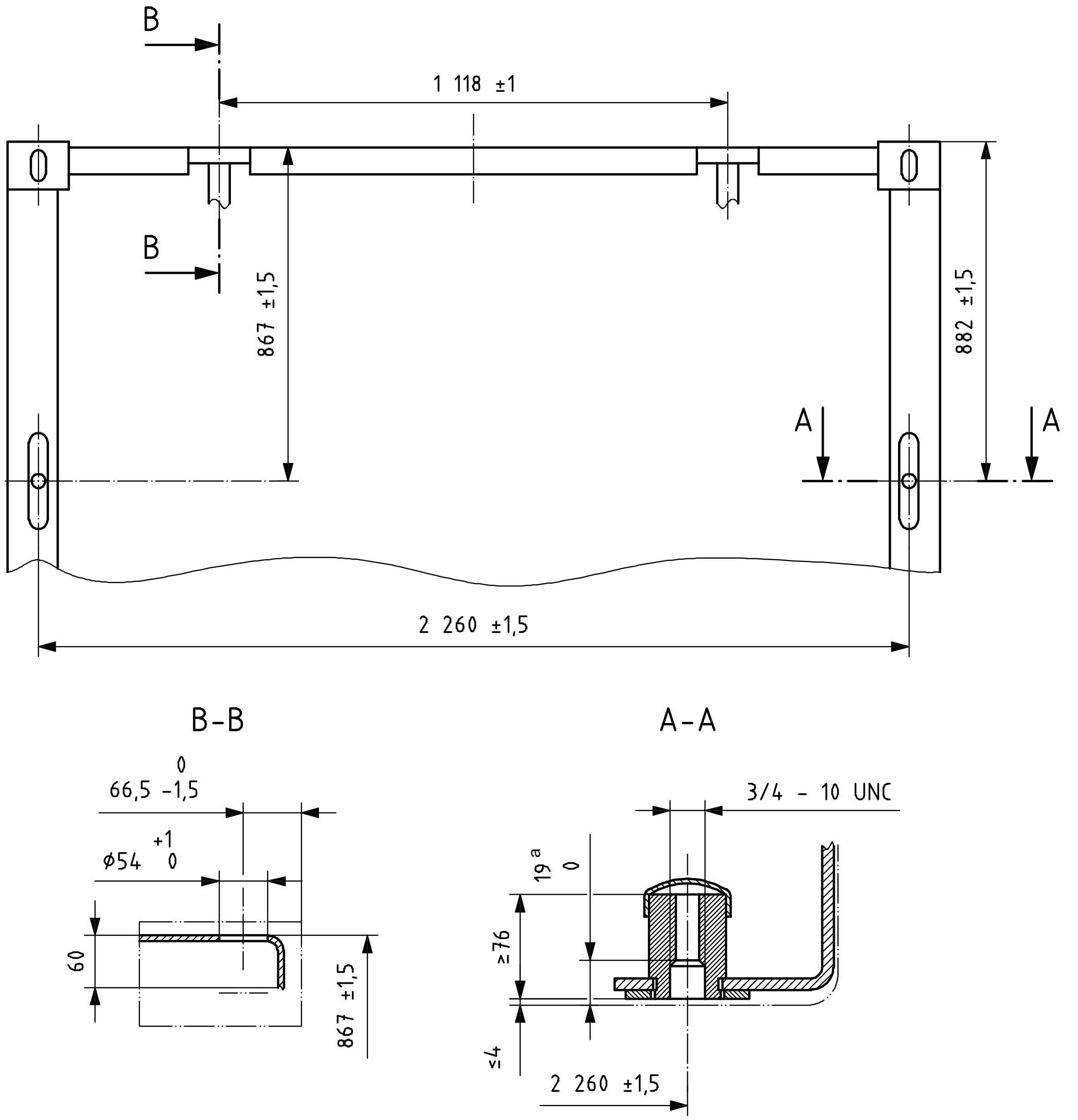
Figure G.1 — Dimensions of intermediate sockets for clip-on units

Dimensions of mounting devices for clip-on power generator sets (where provided) are shown in Figure G.2.

Each mounting device shall be capable of carrying a test load of 2 000 kg (4 400 lbs) in both the horizontal and vertical directions.

Top lifting of the container shall not be impaired when a clip-on unit is fitted to the container.

Dimensions in millimetres unless otherwise specified



Key

a Unthreaded depth.

NOTE Some lower-mounting devices have a horizontal spacing of 2 105 mm ± 1,5 mm.

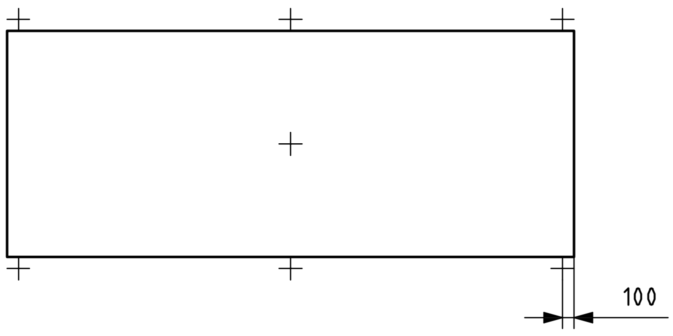
Figure G.2 — Dimensions of Mounting devices for clip-on power generator sets

Annex H
(normative)

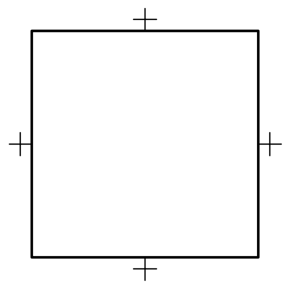
Air temperature measurement points

Requirements for the measurement of air temperature are given in 8.16.1.3. The provision of air temperature measurement points is shown in Figures H.1 and H.2.

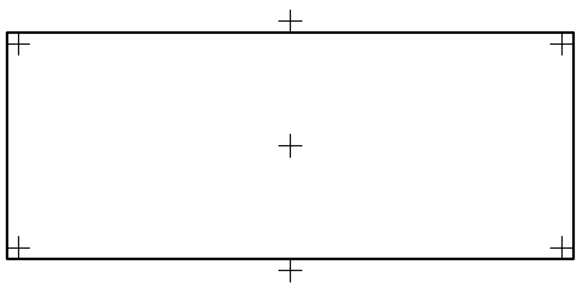
Dimensions in millimetres unless otherwise specified



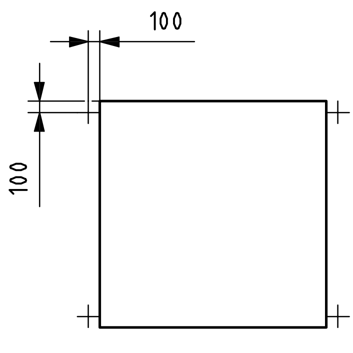
a) Top view



b) Midsection view



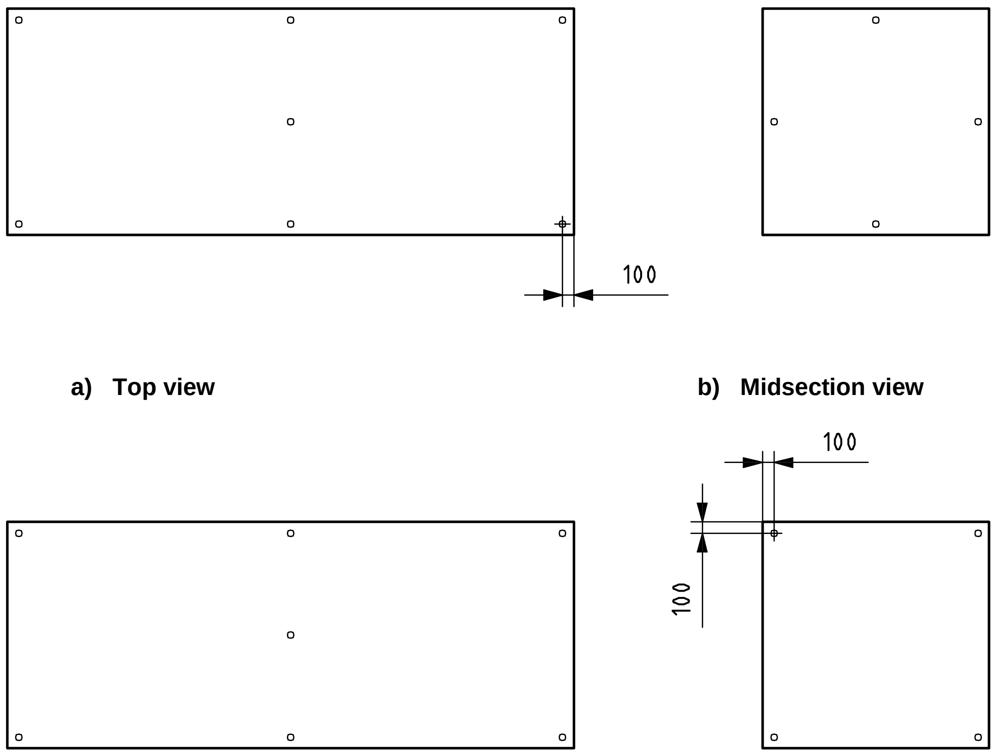
c) Side view



d) End view

Figure H.1 — Outside air temperature measurement points

Dimensions in millimetres unless otherwise specified



a) Top view

b) Midsection view

c) Side view

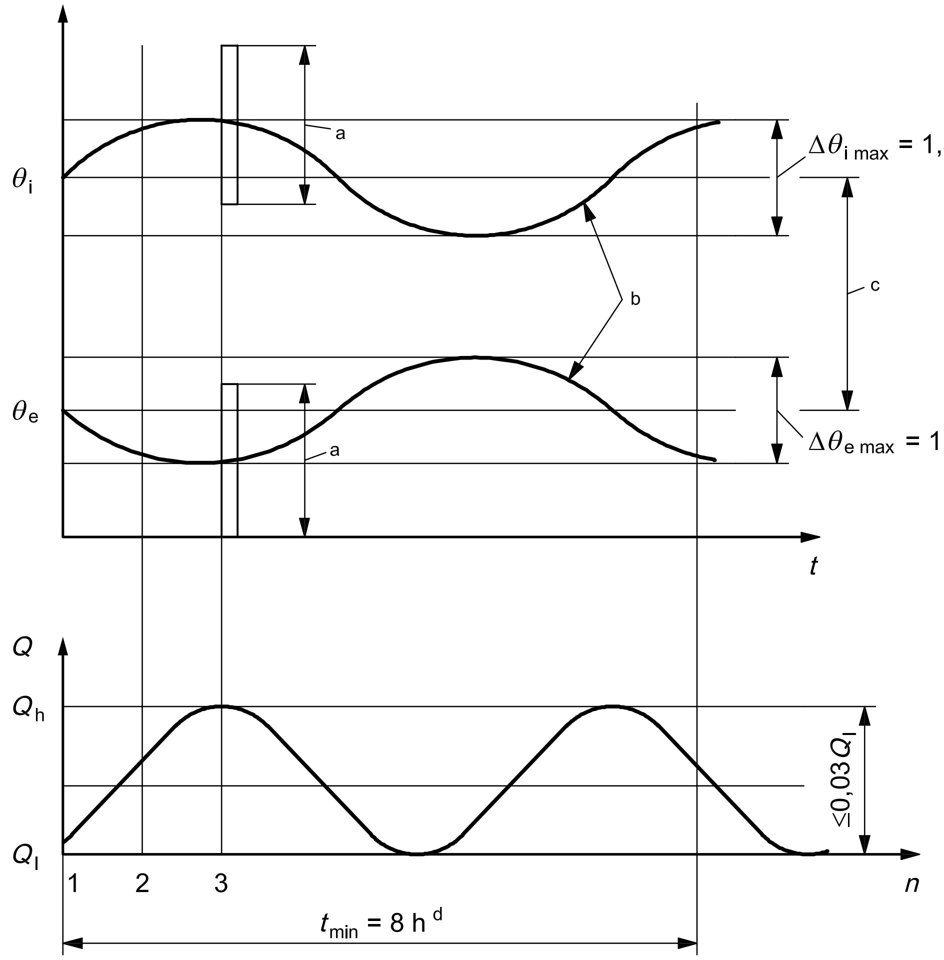
d) End view

Figure H.2 — Inside air temperature measurement points

Annex I
(normative)

Steady-state conditions for heat leakage test (Test No. 14)

An example of the steady-state conditions for heat leakage test (Test No. 14) described in 8.15.2.1 is shown in Figure I.1



Key

θ_i inside temperature
θ_e outside temperature
Q power
t time
n number of readings

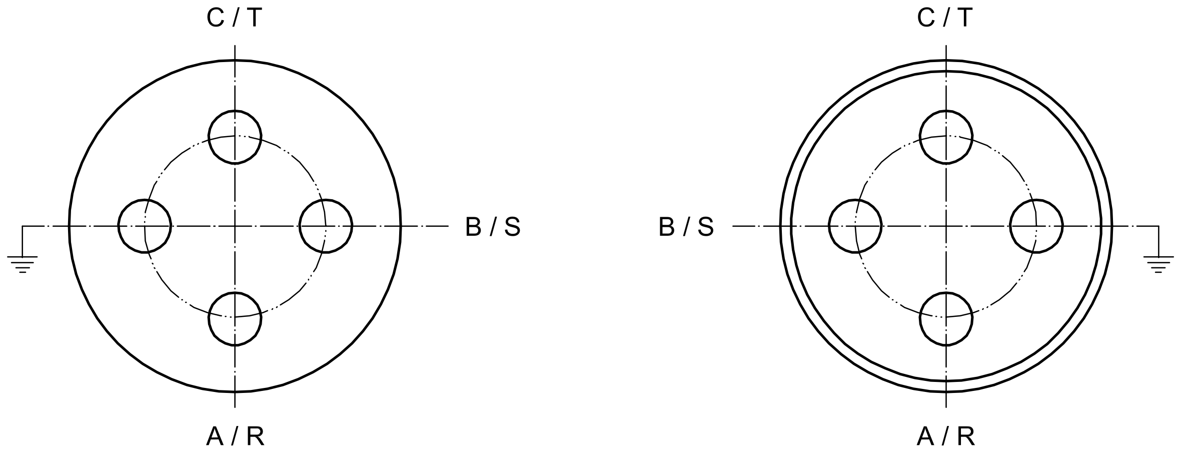
[a] Maximum difference between warmest and coldest temperatures at any one time: 3 K.
[b] Mean temperature.
[c] Minimum difference: 20 K.
[d] Test period.

Figure I.1 — Example of steady-state conditions for heat leakage test (Test No. 14)

Annex J
(normative)

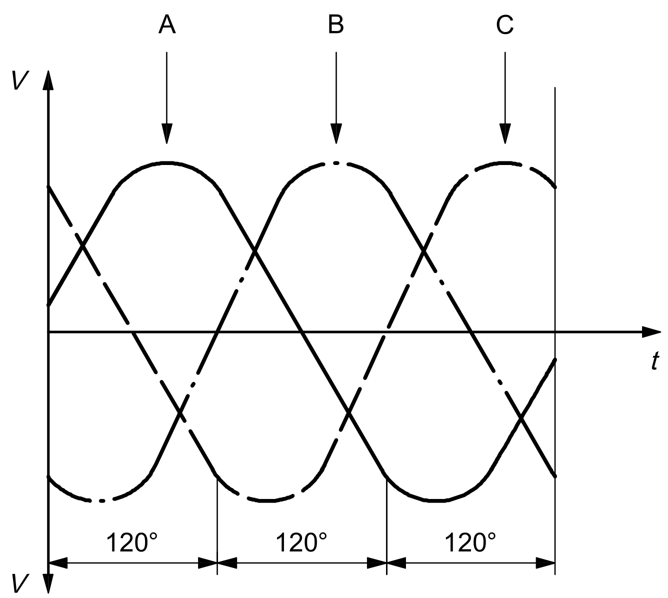
Phase connections to container plugs and sockets

Requirements for wiring plugs and sockets for standard voltage equipment are given in 9.2.3 and shown in Figures J.1 and J.2.



a) Front view of plug **b) Front view of socket**

Figure J.1 — Plug and socket (front view)



Key

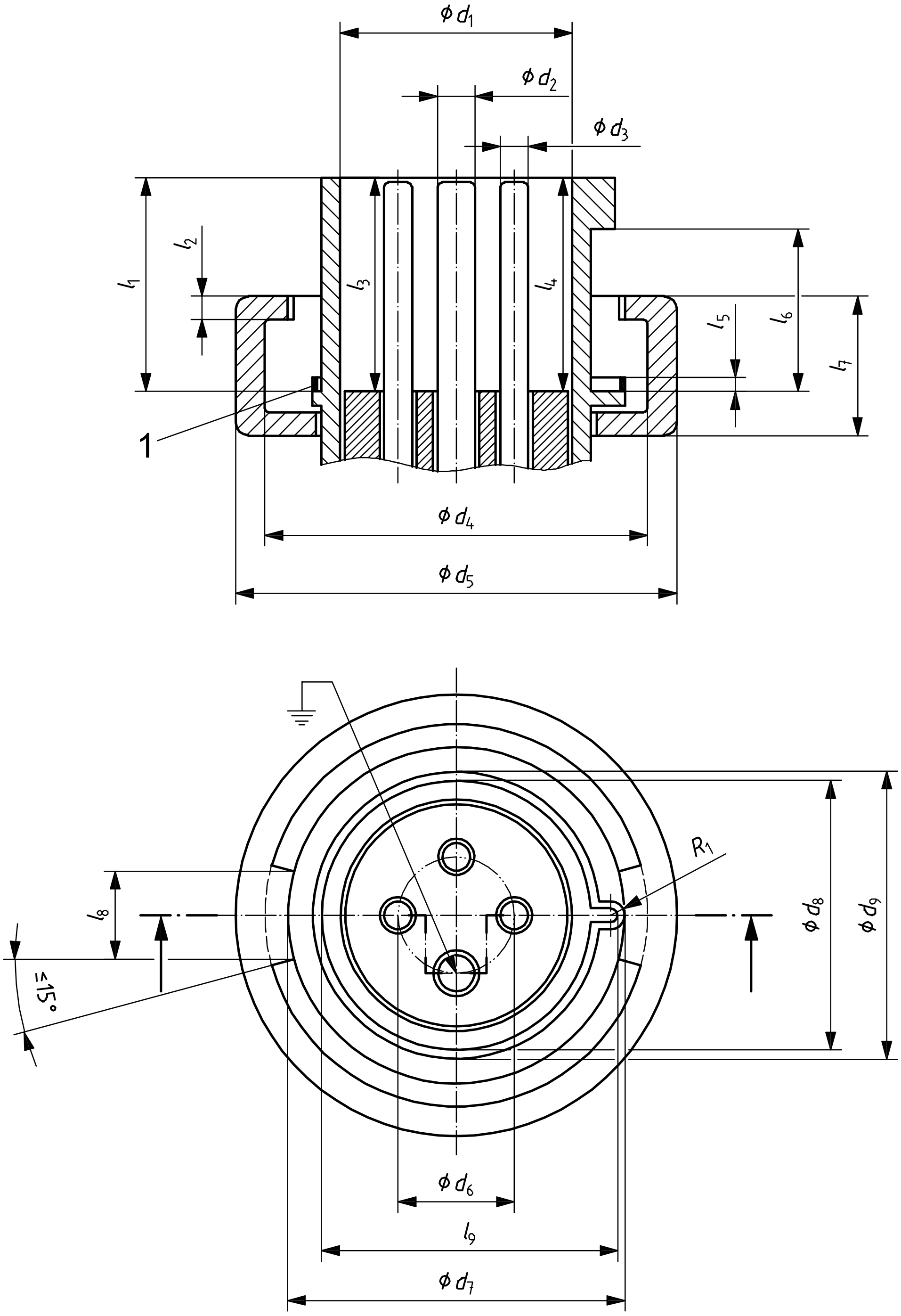
t time
V voltage
A phase A
B phase B
C phase C

Figure J.2 — Phase relationship

Annex K
(normative)

Electric plug and socket, four-pin, 380/440 V, 50/60 Hz, 32 A

Requirements for electric plug and socket, four-pin, 380/440 V, 50/60 Hz, 32 A are given in Figures K.1 and K.2. Dimensions are given in Tables K.1 and K.2.



Key

1 gasket

Figure K.1 — Electric plug, four-pin, 380/440 V, 50/60 Hz, 32 A

Table K.1 — Dimensions for Figure K.1

Dimension	Value	
	mm	in
d_1	49,7 min.	1,956 min.
d_2	$8^{0}_{-0,09}$	$0,315^{0}_{-0,04}$
d_3	$6^{0}_{-0,075}$	$0,236^{0}_{-0,003}$
d_4	82,5 min.	3 1/4 min.
d_5	95 max.	3 3/4 max.
d_6	25 ± 0,5	0,984 ± 0,02
d_7	$72,5^{+0,5}_{0}$	$2,85^{+0,02}_{0}$
d_8	$57,3^{0}_{-0,8}$	$2,25^{0}_{-0,03}$
d_9	61,5 min.	2,42 min.
l_1	46^{0}_{-1}	$1,81^{0}_{-0,04}$
l_2	5 max.	0,196 max.
l_3	46^{0}_{-1}	$1,81^{0}_{-0,04}$
l_4	45^{0}_{-1}	$1,77^{0}_{-0,04}$
l_5	$3^{+0,5}_{0}$	$0,12^{+0,02}_{0}$
l_6	$35,5^{+1}_{0}$	$1,4^{0}_{-0,2}$
l_7	30 max.	1,18 max.
l_8	$19^{0}_{-0,5}$	$0,75^{0}_{-0,02}$
l_9	$63,2^{0}_{-0,6}$	$2,488^{0}_{-0,023}$
R_1	3 ± 0,2	0,12 ± 0,008

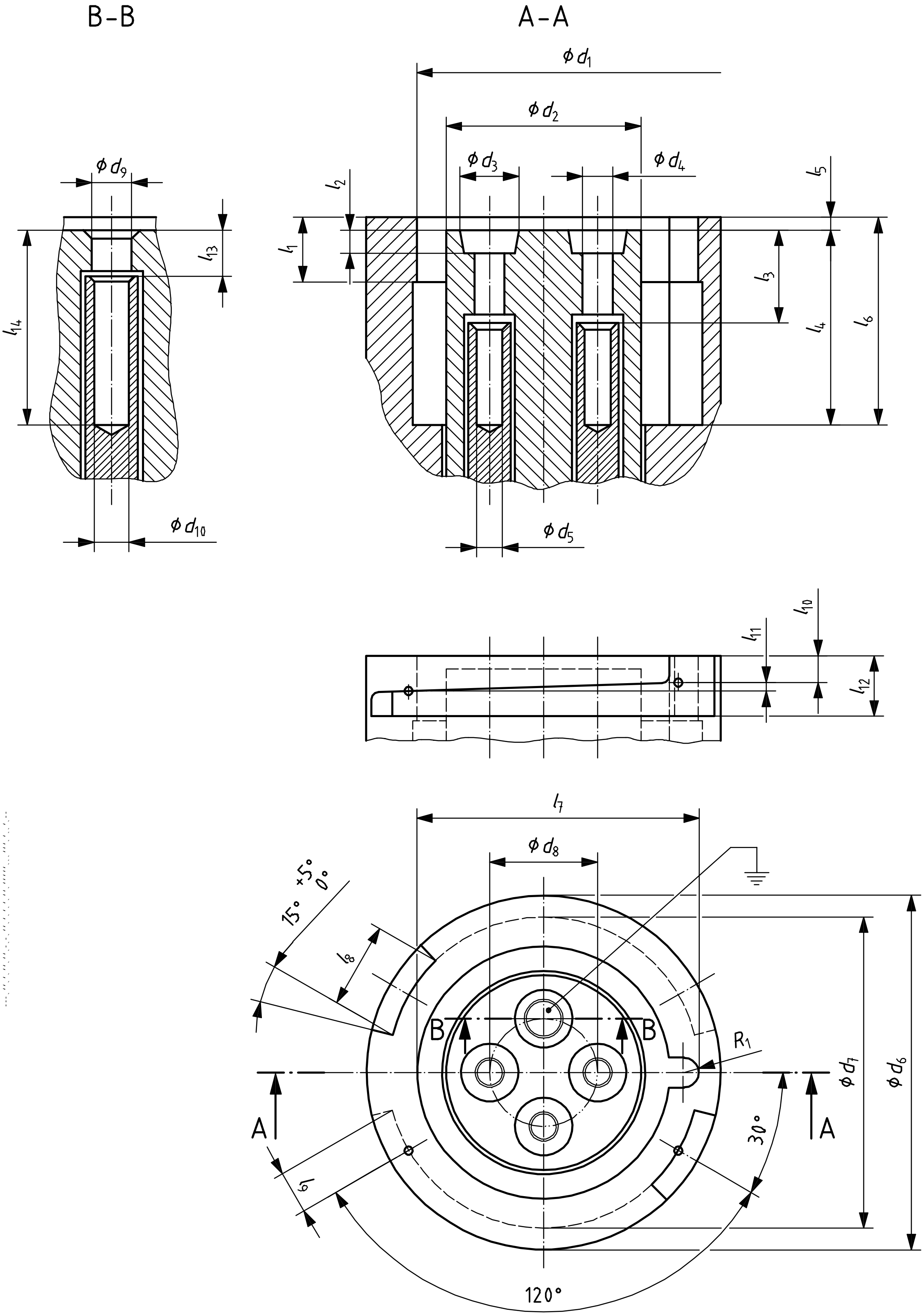


Figure K.2 — Electric socket, four-pin, 380/440 V, 50/60 Hz, 32 A

Table K.2 — Dimensions for Figure K.2

Dimension	Value	
	mm	in
d_1	$58{,}6\ ^{+0{,}6}_{0}$	$2{,}307\ ^{+0{,}023}_{0}$
d_2	$47\ ^{0}_{-1{,}5}$	$1{,}85\ ^{0}_{-0{,}06}$
d_3	$13{,}6\ ^{+1}_{0}$	$0{,}535\ ^{+0{,}004}_{0}$
d_4	$7\ ^{+0{,}6}_{0}$	$0{,}275\ ^{+0{,}023}_{0}$
d_5	6 nom.	0,236 nom.
d_6	$82\ ^{0}_{-0{,}5}$	$3{,}23\ ^{0}_{-0{,}02}$
d_7	$72\ ^{0}_{-0{,}5}$	$2{,}83\ ^{0}_{-0{,}02}$
d_8	$25 \pm 0{,}5$	$0{,}984 \pm 0{,}02$
d_9	$9{,}1\ ^{+0{,}6}_{0}$	$0{,}358\ ^{+0{,}023}_{0}$
d_{10}	8 nom.	0,315 nom.
l_1	15 min.	0,60 min.
l_2	$5{,}3\ ^{+3}_{0}$	$0{,}208\ ^{+0{,}012}_{0}$
l_3	$21{,}5\ ^{+1}_{-0{,}5}$	$0{,}846\ ^{+0{,}04}_{-0{,}02}$
l_4	45 min.	1,77 min.
l_5	$3\ ^{0}_{-1}$	$0{,}12\ ^{0}_{-0{,}04}$
l_6	48 min.	1,89 min.
l_7	$64{,}6\ ^{+0{,}5}_{0}$	$2{,}54\ ^{+0{,}02}_{0}$
l_8	$20\ ^{+0{,}5}_{0}$	$0{,}787\ ^{+0{,}02}_{0}$
l_9	12 min.	0,47 min.
l_{10}	$6{,}2\ ^{0}_{-0{,}2}$	$0{,}244\ ^{0}_{-0{,}008}$
l_{11}	$2\ ^{+0{,}2}_{0}$	$0{,}08\ ^{+0{,}008}_{0}$
l_{12}	14 min.	0,55 min.
l_{13}	$9{,}5\ ^{+1}_{-0{,}5}$	$0{,}374\ ^{+0{,}04}_{-0{,}02}$
l_{14}	45 min.	1,77 min.
R_1	$3{,}5 \pm 0{,}2$	$0{,}137 \pm 0{,}008$

Annex L
(normative)

Electrical power supplies for thermal containers (9.2)

L.1 This part of ISO 1496 has been drawn up, insofar as the electrical aspects (Clause 9) are concerned, on the assumption that the containers will be used in conjunction with electrical power supply installations which meet certain basic requirements. In order to ensure that containers built in accordance with this part of ISO 1496 can be relied upon to function safely and satisfactorily wherever they are required to operate, the desirable basic requirements for electrical supply installations are set out in Clauses L.2 to L.9.

L.2 Electrical power supply systems intended for use with thermal containers should be designed and constructed in accordance with appropriate national standards and/or legislation where such exist. Where no such national standards or legislation exist, design and construction should be in accordance with the relevant recommendations of the International Electrotechnical Commission.

L.3 Power supply systems should be provided with outlet sockets (receptacles) suitable for use with the plugs described in 9.2.8. These sockets are shown in Annex K alongside the corresponding plug.

L.4 Where the voltage of the local electricity supply is not within the range covered by 9.2.1, suitable means of transformation should be employed to change the voltage to an acceptable value.

L.5 Each power supply outlet socket should be fitted with a suitable isolating switch or circuit breaker, preferably interlocked so that the plug cannot be inserted or withdrawn while the switch or circuit breaker is in the ON position.

L.6 Each power supply outlet socket should be provided with a linked three-phase circuit breaker of suitable rating, which will give protection against the effects of short circuits but which will not be caused to operate by the starting current of the container machinery, up to the limits specified in 9.2.4. Power supply circuit breakers should have the following characteristics:

Current	**Tripping time**
100 A	3 s min.
180 A	1,0 s max.
360 A	0,2 s max.

L.7 Each power supply outlet socket shall be capable of individually supplying a current consistent with the requirements of 9.2.2. However, in assessing the load to be supplied by groups of outlet sockets, an appropriate diversity factor may be taken into account.

L.8 Three-phase power supply systems should be connected for standard phase rotation, as defined in 9.2.3. Outlet sockets should be connected as shown in Annex K.

L.9 It should be noted that in some countries there may be a requirement for the equipment to operate from supplies fitted with a residual current device (rcd).

Annex M
(normative)

General requirements for 220 volt and dual voltage equipment

M.1 220 volt equipment

M.1.1 220 volt equipment shall be designed to operate on any electrical power supply when the nominal voltage measured between phases at the receptacle is as follows:

a) 50 Hz: 180 V min., 230 V max.;

b) 60 Hz: 200 V min., 250 V max.

M.1.2 The equipment shall be provided with a 60 A four-pin (three poles plus earth) male plug with screwed retaining ring as shown in Figure K.1.

NOTE Figure K.2 illustrates the related socket.

M.2 Dual voltage equipment

M.2.1 Dual voltage equipment shall be designed to operate on both electrical power supplies in accordance with 9.2.1 and electrical power supplies in accordance with M.1 above.

M.2.2 Equipment shall be provided with two separate flexible power cables of adequate electrical capacity, one to be used when operating from electrical power supplies as per 9.2.1 and the other to be used for electrical power supplies as described in M.1. The former shall be fitted with a male plug as shown in Figure K.1.

M.2.3 Both power cables shall be permanently attached to the refrigeration and/or heating unit and both shall have a minimum length of 18 m.

M.2.4 Dual voltage equipment shall include storage space(s) large enough to securely stow both power cables. If portions of the cables are intended to be stored in a compartment during operation, the storage space(s) shall be ventilated.

M.2.5 The electrical circuit design shall be such that when the controls are set for one voltage range, the power cable for the other voltage range shall be electrically disconnected at the equipment.

Annex N
(informative)

Conversion of SI units to non-SI units

For the convenience of users of this part of ISO 1496, the conversion of values expressed in SI units to approximate values expressed in non-SI units is given below, in numerical order regardless of their dimensions.

SI units	**Non-SI units**	**SI units**	**Non-SI units**
1,5 mm	5 ft	300 mm	12 in
2 m/s	6 ft/s	310 mm	12 3/8 in
3 mm	1/8 in	340 mm	13 5/8 in
5 mm	3/16 in	345 mm	13 13/16 in
5 m3/h	180 ft^3/h	350 mm	14 in
6 mm	1/4 in	385 mm	15 3/8 in
6 m	20 ft	390 mm	15 5/8 in
10 Pa	1 mm H_2O = 3/64 in H_2O	440 mm	17 5/8 in
10 m	33 ft	470 mm	18 1/2 in
10 m^3/h	355 ft^3/h	550 mm	22 in
12,5 mm	1/2 in	600 mm	24 in
15 m	50 ft	690 mm	27 5/8 in
$12,5^{+5}_{-1,5}$ mm	$\left(1/2\right)^{+3/16}_{-1/16}$ in	750 mm	29 1/4 in
17,8 kN	4 000 lbf	760 mm	30 in
25 mm	1 in	990 mm	38 15/16 in
25,4 mm	1 in	1 000 mm	39 3/8 in
38 mm	1 1/2 in	1 490 kg/m	1 000 lb/ft
60 mm	2 3/8 in	1 700 mm	66 15/16 in
75 kN	16 850 lbf	1 828 mm	72 in
100 kPa	14,5 psi	2 000 mm	78 3/4 in
100 mm	4 in	2 730 kg	6 000 lb
100 mm/s	4 in/s	2 980 kg/m	2 000 lb/ft
142 cm^2	22 in^2	3 150 mm	124 1/4 in
150 kN	33 700 lbf	3 500 mm	137 7/8 in
180 mm	7 3/16	5 460 kg	12 000 lb
185 mm	7 1/4 in		
200 mm	8 in		
220 mm	8 13/16 in		
250 Pa	25 mm H_2O = 1 in H_2O		
250 mm	10 in		
285 mm	11 3/8 in		
290 mm	11 5/8 in		
300 kg	660 lb		

Bibliography

[1] IEC 60309-1, *Plugs, socket-outlets and couplers for industrial purposes — Part 1: General requirements*

[2] IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes — Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

[3] ISO 10368:2006, *Freight thermal containers — Remote condition monitoring*

[4] ISO 6346:1995, *Freight containers — Coding, identification and marking*

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