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[Continued on next page]

(54) Title: ISO GAS FREIGHT CONTAINER

WO 2006/020871 A2

(57) Abstract: An ISO gas freight container for the transporting of pressurized gases at high transport pressures. The ISO gas freight container includes an ISO frame and at least one composite tank mounted on the ISO frame. The composite tank is formed of an inner liner and a composite over wrap.
ISO Gas Freight Container

Priority claim: This application claims the priority benefit of U.S. provisional application number 60/600891 filed on August 12, 2004 and hereby incorporates that application in its entirety.

Technical Field

This invention relates to freight container for moving of pressurized gases, and more particularly to a freight container using an ISO frame with composite tanks.

Background Art

ISO freight containers have been used extensively in the transportation industry to transport materials. An ISO freight container, as used herein, includes an ISO frame and one or more tanks or tubes carried in the frame. By ISO frame, as used herein, means a series 1 frame or framework sized according to ISO 668 standards (hereby incorporated by reference and attached hereto as an appendix) having corner castings or fittings as described in ISO 1161 (hereby incorporated by reference) and meeting the testing standards of ISO 1496-3 (hereby incorporated by reference, and attached hereto as an appendix). Standard series 1 frame dimensions includes widths of 8 feet and heights or 8, 8.5, 9 and 9.5 feet. Standard lengths include 10, 20, 30 and 40 feet.

ISO freight container frames are sized for transportation by truck, rail, air and ship, and the corner fittings are designed to allow for lifting, retaining and stacking of ISO freight containers. The ISO frame is designed to transmit static and dynamic forces in allow for safe and secure lifting and transporting of loaded freight containers. For instance, fully loaded ISO containers (which can weight up to 85,000 lbs) are designed to be lifted by crane or other lifting device from the corner fittings. Hence, a loaded frame may be transported by helicopter to remote locations. ISO freight containers have been used to transport pressurized gases, but at low pressures, such as 300-500 psi (see U.S. patent number 6,012,598, hereby incorporated by reference). As disclosed in this patent, transportation of ISO frames by truck is weight limited, and hence, ISO freight containers used to transport gases would have tanks only partially full due to weight limitations of the combined frame, tank and product weight. The number of tubes will change because of the weight restrictions of moving on a highway. Different countries have different
weight restrictions. The United States has to conform to the U.S. bridge formula of 55,000 lbs loaded. Other countries will range from 53,000 lbs to 85,000 lbs.

The '598 patent attempts to overcome the weight limitation by building the tanks from steel using a minimum thickness, thereby dropping the tank weight. Unfortunately, this patent addresses transportation of gases at relatively low pressures of 100-500 psi. If higher pressures are desired (allowing for the transportation of larger quantities of product), thicker steel wall structures are needed, using fairly small diameter steel tanks. For instance, a 22' diameter steel tank rated to 2900 psi having a length of 38.5 feet, weighs about 6000 pounds. An 8' high, 40 foot long ISO frame could accommodate about 16 of such tubes, but the tubes alone would weigh in excess of 96,000 pounds, exceeding by substantial margins road weight limitations, even without product.

Attempts have been made to build composite low weight transportation tanks, such as the tank design shown in U.S. patent number 6,189,723 (hereby incorporated by reference). The '723 patent is directed to a large 5.5 foot diameter, 20 foot long composite tank for the transportation of liquids. The tank is transported by attaching the tank to a banded skid frame at the front and rear of the tank. This tank is not thought suitable for transportation of high pressure gases as the composite materials are not of sufficient strength, nor is the skid frame adapted to allow the mounted tank to be transported by ship, truck or rail.

Composite tanks for ship or truck transportation of compressed gases are disclosed in U.S. patent number 6,339,996. The system disclosed in the '996 patent is directed to a bank of vertically orientated composite cylinders to allow for separation of fluids and gases. The truck and ship board designs create an integrated transportation system, that is, the tanks/frames are not designed to be removed from one transport vehicle and moved to another transport vehicle. The tanks have an upper manifold and a lower manifold to facilitate removal of gases and liquids. The '996 also briefly discussed a modular system using vertically orientated composite tanks, but does not disclose a transportation frame.

What is lacking is a light weight transport container for transportation of high pressured gases that can also be used as a distribution storage container, and where the
transport container can be transported by several different modes of transportation, including rail, truck, air and ship, including helicopter carriage or air transport vehicle.

**Disclosure of the Invention**

An ISO gas freight container for the transporting of pressurized gases at high transport pressures. The ISO gas freight container includes an ISO frame and at least one composite tank mounted on the ISO frame. The composite tank is formed of an inner liner and a composite overwrap.

**Brief Description of Drawings**

**FIG. 1** is a side view of one embodiment of the ISO gas freight container of the present invention.

**FIG. 2** is a top view of one embodiment of the ISO gas freight container of the present invention.

**FIG. 3** is a bottom view of one embodiment of the ISO gas freight container of the present invention.

**FIG. 4** is an end view of one embodiment of the ISO gas freight container of the present invention using a bulkhead.

**FIG. 5** is an end view of another embodiment of an ISO gas freight container without a bulkhead.

**FIG. 6** is a cross section through a composite tank showing the bosses.

**FIG. 7** is a front view of one embodiment of a saddle.

**Best Mode for Carrying Out the Invention**

Shown in figure 1 is an ISO frame 1. Positioned within the frame is one or more preferably horizontally orientated composite tanks 2. Composite tanks 2 are adapted to transport pressurized gases such as compressed natural gas, hydrogen, helium, argon, acetylene, oxygen and nitrogen. The number of tanks in a particular frame will depend on the particular ISO frame size, and the type and pressure of the transported gas. For instance, a 1CC ISO frame can accommodate thirty-two 10 foot length tubes each about of about 24 inch diameter when transporting hydrogen gas at 7,000 psi. A 1AAA ISO frame can transport seven, eight or nine 40 foot tubes of about 32 inches diameter when transporting compressed natural gas at 3,000 psi. The number and sizes (both length and diameters) of the transported tanks can vary based upon the product, transport pressures
and desired transport volumes. For a frame transporting a single gas, it may be preferred to use a single composite tank at high pressures to maximize transport volume; for instance, combine a 1AA ISO frame with an 88 inch diameter composite tank at high transport pressures of 5000 (or greater) psi. For transport purposes, the larger length ISO frames (20, 30 and 40 feet) are preferred, with 40 foot length frames (1 AX, 1A, 1AA, and 1AAA) being the most preferred. While high transport pressure, as used herein, is considered to being at pressures of about 1000 psi and greater, it is preferred to transport at pressures of 3000 psi and up to about 15,000 psi; for instance, a preferred high transport pressure for CNG is about 3000-4000 psi, with 3600 psi being more preferred; a preferred high transport pressure for hydrogen is about 6000-15000 psi, with 6000-10000 psi being more preferred, and about 7000 psi being most more preferred.

Any ISO frame can be utilized provided that the frame is suitably adapted to support the carried tanks. The ISO frame should be approved. One embodiment of a 40 foot long ISO frame is shown in figures 1-4. The frame is generally constructed of A-500 steel, where the four main structural components are: bottom I beams 21 and 30 (sized as 12"x 4"x 0.69"), corner square tubes 16 (sized as 6" x 6" x 0.5"”), and top square tubing 29 (sized at 3” x 3” x 0.375”). Also shown are end bulkhead 14 (figure 5)(sized at 3/8-1/2 inch plate steel), and corner fittings or castings 17 (per ISO 688 and ISO 1161). Bulkhead 17, as shown are plates having opening therethrough aligned with the tank centers. The tank bosses 100 (figure 6)(later described) are positioned through these openings and help position and support the tanks in the frame. Instead of a bulkhead 17 plate that completely encloses the frame ends, a horizontal or vertical strip having suitable openings could be used, as shown by the dotted lines in figure 4. Note however, that replacing the bulkheads will entail resizing the remaining frame members to ensure that the frame meets ISO test standards.

Additional members can be added to the frame based upon the carried tanks. For instance, if the carried tanks are bottom supported instead of bulkhead supported, support members across the bottom in will be needed, such as members 23, 24, 25, 26 and 27, as shown in Figure 3 (generally, 3/16 thick steel, either plate, channel or tubing). In multiple tank designs, additional surround members 22 may be provided to prevent tank separation in the middle of the frame due to bowing of the frame that may occur during lifting or
stacking (up to 15 frames high) of the loaded frames. Other stiffening frame members can be used, such as braces 19 and 20. As shown, the posts 16 and support members 28, 29, 27, and 30 are connected to ISO corner castings 17. The ISO corner castings are used to lift and secure the frame in transit.

The frame shown in figures 1-4 can also be used in a 20 foot long embodiment, but using different sized members: the 20 foot frame includes posts 16 (sized at 6" x 6" x 3/16" tubing), bottom rails 21 (sized at 6" x 4" x 3/16" tubing) top rails 29 (sized at 3" x 3" x 3/16" tubing), and braces 19 (4" x 2" x 3/16" tubing), 20, 22 (sized at 5 inch A36 channel). Other supports are members 23, 24, 25, 26, 27, 28 and 29 which may or may not be required, based upon the tank configuration and tank support configuration. Figure 5 shows an alternative open end frame embodiment instead of a bulkhead, shown are cross braces 30, sized at 3" x 2" x 3/16" tubing. The structural members, as sized herein for the 20 foot embodiment, are sized for the open end frame of figure 5. The bottom support design, as shown in figure 2, can vary based upon the tank support system.

Generally, joints are welded together according to the standards of the American Welding Society. The ISO frame's eight corner castings 17 (four top and four bottom) along with rails and end posts (and braces where needed) form a base structure that generally satisfies the requirements of ISO 1496-3 Sections 5.1-5.5. However, as noted above, any ISO frame will work with the invention.

The second component of the invention is the composite tank or tanks 16. A typical tank 12 is shown installed in the ISO frame (in a four tank embodiment) in figures 1-4. The diameter of the tanks or tubes 12 can vary from about 22" up to about 88" in diameter D, but it is preferred that the tank conform to ANSI/AS NGV2, ISO/FDIS 11439, and A.S.M.E. regulations (1998 ASME Boiler & Pressure Vessel Code X (each incorporated by reference) or U.S. Department of Transportation standards. For tanks used in countries other than the United States, other standards may be more applicable.

The tank includes a main body section 12 of a generally cylindrical configuration and a pair of end sections 14 of generally of ellipsoidal, parabolic or hemispheroidal configurations, with ellipsoidal being preferred as this geometry accommodates additional volumes. Bosses 31 are provided at one or both ends of the vessel to provide one or two ports communicating with the interior of the vessel. Boss 31 includes an outwardly
projecting neck portion 31 shown in figure 6. The boss neck portion 31 can be utilized to support the tank in an ISO frame, such as shown in figure 1.

Tanks include an inner liner 40 and an outer composite shell overwrap 41. By "composite" is meant a fiber reinforced resin matrix material, such as a filament wound or laminated structure. Outer shell overwrap 41 is a composite shell fabricated from a mechanically strong material such as fiber reinforcing material in a resin matrix. The fiber may be fiberglass, aramid fibers (such as poly-paraphenylene terephthalamide or Kelvar fibers), carbon, graphite, or any other generally known fibrous reinforcing material, or a combination thereof, capable of creating the desired strength overwrap structure. The resin matrix may be epoxy, polyester, vinylester, thermoplastic or any other suitable resinous material capable of providing the properties required for the particular application in which the vessel is to be used. The set temperature of the resin must be below the melting point of the inner shell material and overwrap materials.

Inner liner 40 is a generally fluid impervious liner disposed in outer shell overwrap 41 against the inside surface thereof. The inner liner 40 may be made of plastic or other elastomers and can be manufactured by compression molding, blow molding, injection molding or any other generally known technique. Liner can also be a metal liner, such as steel, aluminum or stainless, or a lined metal liner, such as Teflon (polytetrafluoroethylene) coated steel, with the end caps welded to the cylindrical body. Using a composite overwrap allows thinner walled metal inner liners to be employed, thereby reducing the weight of the metal liner/composite overwrap from that of a similar strength non-wrapped metal tank. Boss 32 may be composed of an alloy of aluminum, steel, nickel or titanium, although it is understood that other metal and nonmetal materials, such as composite materials, are suitable.

One tank embodiment uses a boss 32 constructed of aluminum (6061-T6) and imbedded in the tank in accordance with U.S. patent number 5,429,845 (hereby incorporated by reference). The bosses 30 are incorporated into a tank having an inner liner of high-density polyethylene (HDPE) liner and an outer overwrap of filament wound carbon fiber and E-glass fiber. The HDPE meets ASTM 1248 Type III, Grade P34, Class C, Category 5 standards; the carbon fiber is single strand T-700SC available from Toray Carbon Fibers of America in Decatur Alabama; the E-glass utilized is a single
strand suitable for filament winding systems; the resin is an epoxy based resin compatible with E-glass and carbon fibers. The preferred manufacturing method is filament winding of the composite laminate onto the HDPE liner (which can have an initial skin coat of resin or resin impregnated wrap to improve binding of the filament overwrap) using circumferential wound layers or helical wound layers, or a combination of both as needed for the required strength. Lincoln Composites, Inc. of Lincoln, Nebraska is building filament wound HDPE liner tanks suitable for use in the present invention.

While HDPE is more expensive than steel, HDPE is lighter and is not contaminated by contact with a gaseous product. A steel tank can become contaminated if not lined, and once contaminated, that tank should not be used for transportation of a different product. As an example, a 36 inch diameter tank transporting of compressed natural gas at 3000 psi can have an inner liner of 0.750” 80,000 pound tensile steel with a composite 0.586 inch thick overwrap of filament wrapped carbon fibers. A 42 inch diameter tank for transporting of hydrogen at 7,000 psi can have an inner liner of 0.248 inch HDPE with an over wrap thickness of about 1.161” carbon fibers (the HDPE and overwrap will thicken at the ends to support the bosses, as shown in U.S. patent number 5,429,845.

A comparison between a standard 3AAX 2900 psi 38.5 foot steel tube and a comparable composite/steel tube at the same pressure shows the weight efficiency of the composite tank structure:

Steel 22” tube @ 2900 psi weighs 6056 lbs
Steel/Composite (S/C) 22” tube @ 2900 psi weighs 3305 lbs

<table>
<thead>
<tr>
<th>Volumes in scf</th>
<th>Hydrogen</th>
<th>Natural Gas</th>
<th>Oxygen</th>
<th>Helium</th>
<th>Nitrogen</th>
<th>Argon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>14,026</td>
<td>20,085</td>
<td>18,299</td>
<td>15,718</td>
<td>16,244</td>
<td>18,299</td>
</tr>
<tr>
<td>S/C</td>
<td>16,316</td>
<td>23,362</td>
<td>19,468</td>
<td>16,769</td>
<td>17,438</td>
<td>19,390</td>
</tr>
</tbody>
</table>

As the pressures are increased, the ability to carry more product becomes even more significant:

| Steel/Composite at 3000 psi (Volumes scf) |
|---------------|----------|--------|--------|----------|--------|
| Dia weight    | H₂       | Natural Gas | O₂     | He       | N      | Ar     |
| 42”           | 12,564 lbs | 60,617 | 86,729 | 72,508   | 52,078 | 64,735 | 72,244 |

7

SUBSTITUTE SHEET (RULE 26)
<table>
<thead>
<tr>
<th>Size</th>
<th>Weight (lbs)</th>
<th>Linear Feet</th>
<th>Steel</th>
<th>Composite at 3600 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>36&quot;</td>
<td>9,206</td>
<td>63,878</td>
<td>53,404</td>
<td>45,947</td>
</tr>
<tr>
<td>32&quot;</td>
<td>7,260</td>
<td>50,375</td>
<td>42,115</td>
<td>36,235</td>
</tr>
<tr>
<td>30&quot;</td>
<td>6,375</td>
<td>44,403</td>
<td>37,122</td>
<td>31,939</td>
</tr>
</tbody>
</table>

**Steel/Composite at 3600 psi**

<table>
<thead>
<tr>
<th>Size</th>
<th>Weight (lbs)</th>
<th>Linear Feet</th>
<th>Steel</th>
<th>Composite at 3600 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>42&quot;</td>
<td>15,025</td>
<td>97,495</td>
<td>84,358</td>
<td>72,429</td>
</tr>
<tr>
<td>36&quot;</td>
<td>11,019</td>
<td>71,714</td>
<td>62,051</td>
<td>53,276</td>
</tr>
<tr>
<td>32&quot;</td>
<td>8,685</td>
<td>56,897</td>
<td>49,230</td>
<td>42,268</td>
</tr>
<tr>
<td>30&quot;</td>
<td>7,629</td>
<td>49,785</td>
<td>43,076</td>
<td>36,985</td>
</tr>
</tbody>
</table>

As noted, further weight reductions can be made by using a HDPE inner liner. For instance, at 38.5 foot long 22 inch diameter composite tube using an HDPE inner liner at a high transport pressure of 7,000 psi for hydrogen will weigh 1,014 lbs and carry 27,994 scf of product.

The composite tanks may have an outer coating to protect the composite layer and resin matrix from ultra-violet degradation or to improve tank impact resistance. One outer covering that can be used is taught in U.S. patent number 5,476,189 (hereby incorporated by reference) and is marketed by Lincoln Composites under the Tuffshell mark. A gel coat or paint can be also be used for added protection, or an added outer layer of glass alone can be used. Additionally, a fabric screen or lightweight metal or plastic screen could be integrated into the frame to provide needed protection.

The tanks are mounted in the ISO frame in a fashion to allow the tanks to expand both radially and lengthwise upon pressurization. For instance, a an 88 inch diameter single 38.5 foot long tank can be expected to expand about two inches in length and about 0.5 inches in diameter when pressurized to 5000 psi. Hence, if the bosses 32 are utilized to mount the tanks on a bulkhead, there should be sufficient room to allow the needed expansion and for the bosses to slide in the bulkhead openings. A compressible foam or other elastomeric material can be provided adjacent to the boss between the tank and the bulkhead to allow for a secure fit in the bulkhead when the tank is not pressurized. Further, the openings in the bulkhead can be lined, for instance with Teflon, to reduce sliding friction.

When multiple tanks are used in an ISO frame, the expansion of the tanks into adjacent space must also be taken into account. Compressible saddles of elastomeric...
materials may be placed between tanks or integrated into the tank outer layer to provide an offset and cushion expansion. An example of a saddle 60 is shown in figure 7, showing a block of elastomeric material designed to fit between two tanks. The saddle 60 top and bottom surface reflects the tank curvatures; for a saddle placed on a bottom support, only the saddle top side would reflect tank curvature. Saddles may not be needed if the tanks are supported at the bosses (such as through the use of a bulkhead) as the tanks as described are very rigid structures when pressurized and generally do not sag when supported from the bosses. However, unpressurized tanks sag and saddles or other supports may be needed. It is preferred that the elastomeric material have memory, or the ability to return to an uncompressed state, providing separation or offset between the tanks for later expansion upon pressurization. Obviously, vertical or horizontal support plates (such as steel tubing, channels or plates) could be integrated into the interior of the frame to provide tank separation (and such supports may still require a lining or cushioning to reduce frictional rubbing during transportation or charging/discharging of the tanks); however, such supports add additional weight and are not preferred.

Common multiple tank designs are four 42 inch diameter tanks or sixteen 22 inch diameter tanks. The ISO gas frame container can be filled with tanks of differing diameters, or only partially filled with composite tanks, leaving a portion of the frame vacant for other uses, such as placement of compressors, pumps, etc. The ISO gas frame container can also utilize different length tanks within the same ISO frame. However, to accommodate different length tanks, a tank support (such as a partial baffle plate) may be required in the interior of the frame.

Positioned in the bosses 32 are a series of valves (not shown) to control the filling and discharge of the tanks. It is preferred that a valve be positioned in the interior of the tank to prevent accidental spill in the event the neck of the boss is sheared off. One or more manifold systems may be present at one of both ends of the tanks to allow simultaneous filling/discharge of multiples tanks. In a multiple tank embodiment, several independent manifold systems may be present allowing the frame container to carry more than one type of gas.

Other components can be mounted on the frame to satisfy customer requirements, such as a compressors or pumps for loading and unloading of the gases, pressure
regulators, battery operate remotely interrogatable GPS systems to track to location of a particular ISO freight container, pressure monitors on the manifold system that communicate with a cellular or satellite communication system to send a remote alarm based upon pressure a pressure drop or significant change in monitored pressure, temperature monitors, etc.

As described, the use of a composite overwrap on the inner liner of the tank structure allows transportation of gases at high transport pressures within an ISO frame and allows the entire loaded structure to fall within weight limitations for transport, particularly highway transport. A composite tube weights about 1/3 (with a steel inner liner) to 1/5 (with a HDPE inner liner) that of a comparable steel only tank. The weight savings allows for more product to be shipped at one time and possibly for fewer shipments to satisfy a customer's needs.

Additionally, a product loaded ISO gas freight container can be used for storage and distribution. For instance, a charged ISO gas freight container as disclosed herein can be dropped off at a remote location and used as storage of the gas until needed. Indeed, the product can be discharges as needed from a charged ISO frame gas container. Upon full discharge, the ISO gas freight container can be swapped out with another charged ISO gas freight container. Common gas transport containers do not provide this added flexibility, as these transport containers do not meet specifications for onsite storage facilities.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein. As used herein, "about" can include variations of 10%.
APPENDIX

INTERNATIONAL
STANDARD

ISO
668

Fifth edition
1995-12-15

Series 1 freight containers —
Classification, dimensions and ratings

Conteneurs de la série 1 — Classification, dimensions et masses brutes maximales
ISO 668:1995(E)

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.

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.

International Standard ISO 668 was prepared by Technical Committee ISO/TC 104, Freight containers.

This fifth edition cancels and replaces the fourth edition (ISO 668:1988), which has been technically revised.

Annex A forms an integral part of this International Standard.

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International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland
Series 1 freight containers — Classification, dimensions and ratings

1 Scope

This International Standard establishes a classification of series 1 freight containers based on external dimensions, and specifies the associated ratings and, where appropriate, the minimum internal and door opening dimensions for certain types of containers.

These containers are intended for intercontinental traffic.

This International Standard summarizes the external and some of the internal dimensions of series 1 containers. The dimensions of each type of container are defined in the appropriate part of ISO 1496, which is the authoritative document for internal container dimensions.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.


3 Definitions

For the purposes of this International Standard, the following definitions apply. See also ISO 830:1981, Freight containers — Terminology.

3.1 freight container: Article of transport equipment

a) of a permanent character and accordingly strong enough to be suitable for repeated use;

b) specially designed to facilitate the carriage of goods by one or more modes of transport, without intermediate reloading;

c) fitted with devices permitting its ready handling, particularly its transfer from one mode of transport to another;

d) so designed as to be easy to fill and empty;

e) having an internal volume of 1 m³ (35,3 ft³) or more.

The term "freight container" includes neither vehicles nor conventional packing.

3.2 ISO container: Freight container complying with all relevant ISO container standards in existence at the time of its manufacture.
3.3 **rating, R:** The gross mass, \( R \), of a container which is both the maximum mass for operation and the minimum mass for testing.

3.4 **nominal dimensions:** Those dimensions, disregarding tolerances and rounded to the nearest convenient whole number, by which a container may be identified.

Nominal dimensions are usually expressed in imperial units.

3.5 **internal dimensions:** Dimensions of the largest unobstructed rectangular parallelepiped which could be inscribed in the container if inward protrusions of the top corner fittings are disregarded.

Except where otherwise stated, the term "internal dimensions" is synonymous with the term "unobstructed internal dimensions".

3.6 **door opening:** Term usually reserved for the definition of the size of the (and) door aperture, i.e. the width and height dimensions of the largest parallelepiped which could possibly be passed into the container through the door aperture in question.

### Table 1 — Nominal lengths

<table>
<thead>
<tr>
<th>Freight container designation</th>
<th>Nominal length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1AAA 1AA 1A 1AX</td>
<td>m</td>
</tr>
<tr>
<td>1BBB 1BB 1B 1BX</td>
<td>9</td>
</tr>
<tr>
<td>1CC 1C 1CX</td>
<td>6</td>
</tr>
<tr>
<td>1D 1DX</td>
<td>3</td>
</tr>
</tbody>
</table>

1) In certain countries there are legal limitations to the overall length of vehicle and load.

5. **Dimensions, tolerances and ratings**

5.1 **Reference temperature for measurements**

The dimensions and tolerances apply when measured at the temperature of 20 °C (68 °F); measurements taken at other temperatures shall be adjusted accordingly.

5.2 **External dimensions, tolerances and ratings**

5.2.1 **External dimensions and tolerances**

The external dimensions and permissible tolerances given in table 2 are applicable to all types of containers, except that a reduced height is permissible for tank, open top, bulk, platform and platform-based type containers.

5.2.2 **Ratings**

The ratings given in table 2 are applicable to all types of containers, except that for particular traffic higher values are permissible for 1BB, 1BB, 1B, 1BX, 1CC, 1C and 1CX containers of any type. Such containers are considered as ISO containers provided that their maximum gross mass (\( R \)) does not exceed 30,480 kg and that they are tested and marked to these ratings (see 3.3).

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2) In some countries, in order to conform to current commercial practice, the term "weight" is used (incorrectly) instead of "mass".
5.3 Internal dimensions and door openings

5.3.1 Dimensions with projecting top corner fitting

Where a top corner fitting projects into the internal space (specified by table 3), that part of the corner fitting projecting into the container shall not be considered as reducing the size of the container.

5.3.2 General cargo containers for general purposes (see ISO 1496-1)

The type code numbers shall be in accordance with ISO 6346.

5.3.2.1 Minimum internal dimensions

Internal dimensions of containers shall be as large as possible, but, in any case,

- closed containers type 00 shall comply with the requirements for minimum internal length, width and height given in table 3;

- containers type 02, having partial opening(s) in the side(s), shall comply with the requirements for minimum internal length and height given in table 3;

- containers type 03, having an opening roof, shall comply with the requirements for minimum internal length and width given in table 3;

- containers types 01 and 04, having openings in the sides and/or roof, shall comply with the requirements for minimum internal length given in table 3;

- closed, vented containers types 10 and 11 shall comply with the requirements for minimum internal length, width and height given in table 3;

- closed, ventilated containers type 13 shall comply with the requirements for minimum internal length, width and height given in table 3.

5.3.2.2 Minimum door opening dimensions

Closed-type containers designated 1A, 1B, 1C and 1D (types 00 and 02) shall have a door opening, preferably having dimensions equal to those of the internal cross-section (height and width) of the containers and, in any case, not less than the values given in table 3.

Closed-type containers designated 1AA, 1BB and 1CC (types 00 and 02) shall have a door opening, preferably having dimensions equal to those of the internal cross-section (height and width) of the containers and, in any case, not less than the values given in table 3.

Closed-type containers designated 1AAA and 1BBB (types 00 and 02) shall have a door opening, preferably having dimensions equal to those of the internal cross-section (height and width) of the containers and, in any case, not less than the values given in table 3.

5.3.3 Thermal containers (see ISO 1496-2)

The internal dimensions and door openings of thermal containers shall be as large as possible. Door openings shall preferably have dimensions equal to those of the internal cross-section of the containers.

The internal dimensions shall be measured from inner faces of battens, bulkheads, ceiling air ducts, floor air ducts, etc., where fitted.

The minimum internal width shall be 2 200 mm (7 ft 2 5/8 in) for container types 20, 21, 22, 30, 31, 32, 40, 41 and 42.

5.3.4 Other types of container

The internal dimensions, door openings and end openings (if any) shall be as large as possible.

5.4 Corner fitting locations

Centre-to-centre distances (length and width) and diagonal tolerances for corner fittings are given in annex A.
### Table 2 — External dimensions, permissible tolerances and ratings for series 1 freight containers

<table>
<thead>
<tr>
<th>Freight container designation</th>
<th>Length, L (tol.)</th>
<th>Width, W (tol.)</th>
<th>Height, H (tol.)</th>
<th>Rating, Rkg (gross mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm   ft in</td>
<td>mm   ft in</td>
<td>mm   ft in</td>
<td>kg    lb</td>
</tr>
<tr>
<td>1AAA</td>
<td>12 192 -10 -3/8</td>
<td>2 438 0 -5</td>
<td>2.895 0 -6 9 6</td>
<td>30 480 67 200</td>
</tr>
<tr>
<td>1AA</td>
<td>12 192 -10 -3/8</td>
<td>2 438 0 -5</td>
<td>2.591 0 -6 8 6</td>
<td>25 400 59 000</td>
</tr>
<tr>
<td>1A</td>
<td></td>
<td></td>
<td>2 438 0 -8</td>
<td>25 400 59 000</td>
</tr>
<tr>
<td>1AX</td>
<td></td>
<td></td>
<td>&lt; 2 438 &lt; 8</td>
<td>25 400 59 000</td>
</tr>
<tr>
<td>1BBB</td>
<td>9 125 -10 -3/16</td>
<td>2 438 0 -5</td>
<td>2.890 0 -5 8 6</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1BB</td>
<td>9 125 -10 -3/16</td>
<td>2 438 0 -5</td>
<td>2.891 0 -5 8 6</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1B</td>
<td></td>
<td></td>
<td>2 438 0 -8</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1BX</td>
<td></td>
<td></td>
<td>&lt; 2 438 &lt; 8</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1C</td>
<td>9 098 0 -6 -1/4</td>
<td>2 438 0 -5</td>
<td>2.591 0 -5 8 6</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1C</td>
<td>9 098 0 -6 -1/4</td>
<td>2 438 0 -5</td>
<td>2.591 0 -5 8 6</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1CX</td>
<td></td>
<td></td>
<td>&lt; 2 438 &lt; 8</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1D</td>
<td>2 991 0 -5 -3/16</td>
<td>2 438 0 -5</td>
<td>2 438 0 -5 8 6</td>
<td>10 160 22 400</td>
</tr>
<tr>
<td>1DX</td>
<td></td>
<td></td>
<td>&lt; 2 438 &lt; 8</td>
<td>10 160 22 400</td>
</tr>
</tbody>
</table>

1) See 5.2.2.
2) In certain countries there are legal limitations to the overall height of vehicle and load (for example for railroad services).

---

### Table 3 — Minimum internal dimensions and door opening dimensions for series 1 freight containers

Dimensions in millimetres

<table>
<thead>
<tr>
<th>Freight container designation</th>
<th>Minimum internal dimensions</th>
<th>Minimum door opening dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height Width Length</td>
<td>Height Width</td>
</tr>
<tr>
<td>1AAA</td>
<td>2 330 11 996 11 998 8 931</td>
<td>2 556 2 261 2 134</td>
</tr>
<tr>
<td>1AA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1BBB</td>
<td>Nominal container external height minus 241 mm</td>
<td>2 330 8 931 8 931 5 867 2 802</td>
</tr>
<tr>
<td>1BB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1CC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                              |                             | 2 286                           |
Annex A
(normative)

Corner fittings

Corner fitting locations (centre-to-centre distances and diagonal tolerances) are given in Table A.1 and Figure A.1.

<table>
<thead>
<tr>
<th>Freight container designation</th>
<th>$S$ (ref.)</th>
<th>$P$ (ref.)</th>
<th>$K_1$ max. 1</th>
<th>$K_2$ max. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>ft</td>
<td>in</td>
<td>mm</td>
</tr>
<tr>
<td>1AAA 1A 1AX</td>
<td>11 985</td>
<td>39 3 7/8</td>
<td>2 259 7 4 31/32</td>
<td>19 3/4</td>
</tr>
<tr>
<td>1BBB 1BB 1B 1BX</td>
<td>8 918</td>
<td>29 3 1/8</td>
<td>2 259 7 4 31/32</td>
<td>16 5/8</td>
</tr>
<tr>
<td>1CC 1C 1CX</td>
<td>5 853</td>
<td>19 2 7/16</td>
<td>2 259 7 4 31/32</td>
<td>13 1/2</td>
</tr>
<tr>
<td>1D 1DX</td>
<td>2 787</td>
<td>9 1 23/32</td>
<td>2 259 7 4 31/32</td>
<td>10 3/8</td>
</tr>
</tbody>
</table>

NOTE — Attention of manufacturers is drawn to the vital importance of accurately maintaining the reference dimensions of $S$ and $P$ (see figure A.1). The tolerances to be applied to $S$ and $P$ are governed by the tolerances shown for the overall length and width in the International Standard and in ISO 1161.

1) $K_1$ is the difference between $D_1$ and $D_2$ or between $D_3$ and $D_4$; therefore $K_1 = |D_1 - D_2|$ or $K_1 = |D_3 - D_4|$.

2) $K_2$ is the difference between $D_3$ and $D_4$; therefore $K_2 = |D_3 - D_4|$.
ISO 668:1995(E)

C₁ Corner fitting measurement 101.5 mm (4 in
C₂ Corner fitting measurement 89 mm (3 1/2 in)
D Distance between centres of apertures, or projected reference points therefrom, of diagonally opposite corner fittings, resulting in six measurements: D₁, D₂, D₃, D₄, D₅ and D₆
H Overall height
L External length of the container
P Width between centres of apertures in corner fittings
S Length between centres of apertures in corner fittings
W External width of the container

NOTE — Dimensions L, H and W are measured along the appropriate edges.

Figure A.1 — Corner fitting locations
Series 1 freight containers — Specification and testing —

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

Conteneurs de la série 1 — Spécifications et essais —
Partie 3: Conteneurs-citernes pour les liquides, les gaz et les produits solides en vrac pressurisés
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<th>Page</th>
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</thead>
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<td>8</td>
</tr>
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<td>8</td>
</tr>
<tr>
<td>6.5 Test No. 4 — External restraint (longitudinal)</td>
<td>9</td>
</tr>
<tr>
<td>6.6 Test No. 5 — Internal restraint (longitudinal)</td>
<td>9</td>
</tr>
<tr>
<td>6.7 Test No. 6 — Internal restraint (lateral)</td>
<td>10</td>
</tr>
<tr>
<td>6.8 Test No. 7 — Rigidity (transverse)</td>
<td>10</td>
</tr>
<tr>
<td>6.9 Test No. 8 — Rigidity (longitudinal)</td>
<td>11</td>
</tr>
<tr>
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Series 1 freight containers — Specification and testing —

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

1 Scope

1.1 This part of ISO 1496 specifies the basic specifications and testing requirements for ISO series 1 tank containers suitable for the carriage of gases, liquids and solid substances (dry bulk) which may be loaded or unloaded as liquids by gravity or pressure discharge, for international exchange and for conveyance by road, rail and sea, including interchange between these forms of transport.

1.2 Except where otherwise stated, the requirements of this part of ISO 1496 are minimum requirements. Tank containers to be used for the carriage of dangerous goods may be subject to additional international and national requirements as applied by competent authorities.

1.3 The container types covered by this part of ISO 1496 are given in table 1.

1.4 The marking requirements for these containers shall be in accordance with the principles embodied in ISO 6346.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 1496. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 1496 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 668:1988, Series 1 freight containers — Classification, dimensions and ratings.


ISO 1496-3:1995(E)

Table 1 — Container types

<table>
<thead>
<tr>
<th>Type of cargo and ISO type code designation&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Minimum test pressure&lt;sup&gt;2&lt;/sup&gt; (bar gauge)</th>
<th>Code basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquids</td>
<td>Gases</td>
<td>Horizontal discharge</td>
</tr>
<tr>
<td>Non-dangerous</td>
<td>Dangerous</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>71</td>
<td>72</td>
</tr>
<tr>
<td>70</td>
<td>73</td>
<td>65</td>
</tr>
<tr>
<td>71</td>
<td>74</td>
<td>86</td>
</tr>
<tr>
<td>72</td>
<td>86</td>
<td>88</td>
</tr>
<tr>
<td>75</td>
<td>6</td>
<td>+</td>
</tr>
<tr>
<td>76</td>
<td>77</td>
<td>10 (10.5)</td>
</tr>
<tr>
<td>78</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Open</td>
<td></td>
</tr>
</tbody>
</table>

NOTE — For all containers, other than 1D and 1DX, it is essential that the design requirements of 5.1.5 are also taken into consideration.

1) The ISO type code designation does not imply the approval of any competent authority for the transport of specific goods or products the tank container may carry. The type code depends only on the test pressure (see 5.13).

2) The test pressure given is the minimum value of the respective class. Any tank container with a test pressure in the range between a given minimum pressure and the next higher minimum pressure belongs to the lower class.

3) 1 bar = 100 kPa. Test pressure is expressed in bars since relevant intergovernmental codes, often implemented by national legislation, retain this unit of pressure.

4) The number 70 may, in addition, be used to designate tank containers for which the type code relevant to the test pressure is not used.

3 Definitions

For the purposes of this part of ISO 1496, the definitions given in ISO 830, together with the following, apply. However, for practical reasons, certain definitions taken and adapted from ISO 830 are given below.

3.1 tank container: Freight container which includes two basic elements, the tank or tanks and the framework and complies with the requirements of this part of ISO 1496.

3.2 framework: Tank mountings, end structure and all load-bearing elements not present for the purposes of containing cargo, which transmit static and dynamic forces arising out of the lifting, handling, securement and transporting of the tank container as a whole.

3.3 tank(s): Vessels(s) and associated piping and fittings which are designed to contain the cargo carried.

3.4 compartment: A section of the tank formed by the shell, ends or complete bulkheads.

NOTE 2 Baffles, surge plates or other perforated plates do not form tank compartments within the meaning of this definition.

3.5 gas: Fluid substance having a vapour pressure greater than an absolute pressure of 300 kPa at 50 °C or as otherwise defined by the competent authority.

3.6 liquid: Fluid substance having a vapour pressure not greater than an absolute pressure of 300 kPa at 50 °C.

3.7 dry bulk: Assemblies of separate solid particles normally substantially in contact with one another which are, or may be rendered, capable of fluid flow.

3.8 dangerous goods: Those substances classified as dangerous by the United Nations committee of experts on the transport of dangerous goods or by the competent authority as defined in 3.9.

3.9 competent authority: The authority or authorities designated as such in each country or in each specific case by the governments concerned for the approval of tank containers.

3.10 maximum allowable working pressure: That pressure assigned for operation by either a competent authority or other responsible person to a particular tank, above which that tank is not intended to be operated.
3.11 test pressure: The gauge pressure at which the tank is tested (see 6.13.2).

3.12 total capacity: That volume of water which will completely fill the tank at 20 °C.

3.13 ullage: That portion of the total capacity of the tank not occupied by its cargo, expressed as a percentage of the total capacity.

4 Dimensions and ratings

4.1 External dimensions

The overall external dimensions and tolerances of tank containers covered by this part of ISO 1496 shall be those established in ISO 668, except that tank containers may be of reduced height, in which case they shall be designated 1AX, 1BX, 1CX and 1DX. No part of the tank container, its associated fittings and/or equipment shall project beyond these specified overall external dimensions.

4.2 Ratings

The values of the rating, R, the maximum gross mass of the container, shall be those specified in ISO 668. However, taking account of the high density of many fluid cargoes, the values of the rating R chosen for the design and testing of 1BB, 1BB, 1B, 1CC and 1C tank containers may be higher than those specified in ISO 668. For all containers in operation, such values shall in no case exceed the rating allowed for 1AAA, 1AA and 1A containers in ISO 668.

5 Design requirements

5.1 General

All tank containers shall be capable of fulfilling the following requirements for the framework, the design and construction of the tank and any optional provisions.

5.1.1 The ability of the tank container to withstand the specified design loads shall be established by calculation or test.

5.1.2 The strength requirements for tank containers are given in diagrammatic form in annex A (these requirements are applicable to all tank containers as complete units except where otherwise stated).

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

5.1.4 The tank container shall be capable of withstanding the test loads and loadings specified in clause 6.

5.1.5 Each tank container shall be designed to withstand the effects of inertia of the tank contents resulting from transport motions. For design purposes, these effects may be taken to be equivalent to loadings of 2Rg longitudinally, Rg laterally and 2Rg vertically. These loadings may be considered individually to be evenly distributed and to act through the geometric centre of the tank. Vertical loadings are total loadings including dynamic effects. It should be noted that the above loadings do not give rise to an increase in pressure in the vapour space. For design purposes, an equivalent pressure loading may be used.

5.1.6 Each tank container shall be capable of withstanding the requirements of 5.1.5 and the static head produced in the tank container while loaded to its rating R. Due regard shall be given to the liquid/dry bulk of highest density that is to be carried and to any compartment of the tank.

5.1.7 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 tank containers indicated in annex A and demonstrated by the tests described in clause 6 shall not be exceeded in any mode of operation.

5.1.8 Any closure in a tank container, which if unsecured could lead to a dangerous situation, shall be provided with an adequate securing system having, so far as may be practicable, external indication of the positive securing of that closure in the appropriate operating position.

5.1.9 Fork-lift pockets shall not be provided in tank containers.

NOTE 2 Fork-lift transport of tank containers is considered dangerous because of stability problems with loaded or partly-loaded tanks and the danger of impact damage from the forks of fork-lift trucks.

5.1.10 The tank container materials shall be suitable for, or adequately protected from, the cargo and the environment in which the tank container may be operated.
Due regard should be given to the problems of variation in ambient temperature, corrosive atmospheres, the possibility of uncontrolled cargo release in fire, etc.

5.1.11 The design of tank containers of types 1AAA and 1BBB shall take into special account the problems of the dynamic instability of these containers, compared with 1AA and 1BB tank containers, when operating in the road/rail environment in a partially laden condition.

5.2 Corner fittings

5.2.1 General

All tank containers shall be equipped with top and bottom corner fittings. The requirements and positioning of the corner fittings are given in ISO 1161. The upper faces of the top corner fittings shall protrude above the top of all other components of the tank container by a minimum of 6 mm3 (see 5.3.5).

5.2.2 Doubler plates

Whenever reinforced zones or doubler plates are provided to afford protection in the top corner fittings, such plates and their securing elements shall not protrude above the upper faces of the top corner fittings. These plates shall not extend more than 750 mm2 from either end of the container but may extend the full width.

5.3 Base structure

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

5.3.2 All tank containers, other than 1CC, 1C, 1CX, 1D and 1DX, shall be capable of being supported only by load-transfer areas in their base structure.

1CC, 1C and 1CX tank containers may have intermediate load-transfer areas as an optional feature. If so, these tank containers shall meet the requirements in 5.3.2.1, 5.3.2.2 and annex B.

5.3.2.1 Consequently, these tank containers shall have end transverse members and sufficient intermediate load-transfer areas (or a flat underside) of sufficient strength to permit vertical load transfer to

or from the longitudinal members of a carrying vehicle, which are assumed to lie within the two 250 mm3 wide zones defined by the dotted lines in figure B.1.

Special consideration shall be given in the base structure design to the risk of failure from fatigue.

5.3.2.2 The lower faces of the load-transfer areas in the container base structure, including those of the end transverse members, shall lie in one plane located

12,5 mm \( \pm 5 \) mm2 above the plane of the lower faces of the bottom corner fittings of the tank container (base plane).

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 fitting to afford protection to the understructure.

Such plates shall not extend more than 550 mm3 from the outer end and not more than 470 mm2 from the side faces of the bottom corner fittings, and their lower faces shall be at least 5 mm3 above the lower faces of the base plane of the container.

5.3.2.3 The transfer of load between the underside of any bottom side rails which may be fitted and carrying vehicles is not envisaged.

5.3.2.4 Load-transfer area requirements are given in

5.3.3 For 1D and 1DX tank containers, the level of the underside of the base structure is not specified, except insofar as it is implied in 5.3.4 and 5.3.5.

5.3.4 When the tank container is loaded to its rating R, no part of the tank or its associated shell fittings shall project downwards below a plane situated 25 mm2 above the base plane (bottom faces of the bottom corner fittings).

5.3.5 For tank containers under dynamic conditions, or the static equivalent thereof, with the tank container loaded in such a way that the combined mass of the tank container and test load is equal to 1,8R, no part of the base of the tank container shall deflect more than 6 mm2 below the base plane (bottom faces of the bottom corner fittings).

\[ 3) \quad 5 \text{ mm} = \frac{3}{16} \text{ in}; \quad 6 \text{ mm} = \frac{1}{4} \text{ in}; \quad 12,5 \text{ mm} = \frac{1}{2} \text{ in}; \quad 25 \text{ mm} = 1 \text{ in}; \quad 250 \text{ mm} = 10 \text{ in}; \quad 470 \text{ mm} = \frac{19}{16} \text{ in}; \quad 550 \text{ mm} = 22 \text{ in}; \quad 750 \text{ mm} = 29 \frac{1}{2} \text{ in} \]
5.4 End structure

For tank containers other than 1D and 1DX, the sideways deflection of the top of the tank container with respect to the bottom of the tank container at the time it is under full transverse rigidity test conditions (see 6.8) shall not cause the sum of the changes in length of the two diagonals to exceed 60 mm.  

5.5 Side structure

For tank containers other than 1D and 1DX, the longitudinal deflection of the top of the tank container with respect to the bottom of the tank container at the time it is under full longitudinal rigidity test conditions (see 6.9) shall not exceed 25 mm.  

5.6 Tank

5.6.1 Design and construction

5.6.1.1 Each tank or compartment thereof shall be designed and constructed to good technical practice.  

5.6.1.2 Each tank or tanks shall be firmly secured to structural elements of the tank framework. The tank or tanks shall be capable of being filled and emptied without removal from the framework.  

5.6.1.3 Tanks or tank compartments without vacuum relief devices shall be designed to withstand an external pressure of at least 40 kPa above the internal pressure.  

Tanks equipped with vacuum relief valves shall be designed to withstand an external overpressure of 21 kPa or greater.  

5.6.2 Corrosion allowance

In addition to the requirements of 5.1.10 an allowance for corrosion shall be taken into consideration where necessary.  

5.6.3 Tank openings

5.6.3.1 All tank openings except those fitted with pressure relief devices shall be provided with adequate closures to prevent accidental escape of the contents.  

5.6.3.2 Tank nozzles and outlet fittings shall be substantially made and attached to the tank in such a manner as to minimize the risk of breakage. Protective covers or housings shall be used wherever necessary to comply with this requirement (see 4.1 and 5.3). Wherever possible, hinged device should be fitted so that they open away from the likely vicinity of any personnel.  

5.6.3.3 Any tank opening located below the normal level of the contents and fitted with a valve capable of being operated manually shall be provided with an additional means of closure on the outlet side of the valve. Such additional means of closure may be a contents-tight cap, bolted blank flange, or other suitable protection against accidental escape of the contents. All valves, whether fitted internally or externally, shall be located as close to the tank shell as practicable.  

5.6.3.4 Stop valves with screwed spindles shall be closed by clockwise motion of the handwheel.  

5.6.3.5 All tank connections, such as nozzles, outlet fittings and stop valves, shall be clearly marked to indicate their appropriate functions.  

5.6.4 Pressure and vacuum relief devices

5.6.4.1 Each tank or compartment thereof intended to carry non-dangerous cargo shall be fitted with a pressure relief device set to be fully open at a pressure not greater than the tank's test pressure, to prevent excessive internal overpressure. Such devices shall be connected to the vapour space of the tank and located as near to the top of the tank and as near to the tank's (or tank compartment's) mid-length as practicable. In those cases where the tank container is used with both dangerous and non-dangerous cargo, the relief devices shall be set in accordance with 5.6.4.3.  

5.6.4.2 Pressure relief devices, installed as required in 5.6.4.1, should have a minimum relief capacity of 0.05 m³/s of standard air (an absolute pressure of 100 kPa at 15 °C). This may be considered as providing overpressure protection under non-emergency conditions, but should not be considered as adequate protection for a tank container, or compartment thereof, against excessive overpressure under full fire exposure conditions, dry bulk dust explosion or higher dry bulk pressurization.

4) 25 mm = 1 in; 60 mm = 2 3/8 in; 21 kPa = 0.21 bar; 40 kPa = 0.4 bar; 100 kPa = 1 bar; 0.05 m³/s = 106 ft³/min
5.6.4.3 Tanks, or a compartment thereof, intended for the carriage of dangerous goods shall be provided with pressure relief devices meeting the relevant regulations to the satisfaction of the competent authority.

5.6.4.4 Each pressure relief device shall be plainly and permanently marked with the pressure at which it is set to operate.

5.6.4.5 A tank container, or a compartment thereof, with an external design pressure of less than 40 kPa 8) shall be equipped with a vacuum relief device set to relieve at an absolute pressure of 79 kPa 9), except that a lower absolute setting may be used, provided that the external design pressure is not exceeded. The vacuum relief device shall have a minimum through area of 284 mm² 10) and shall conform to the requirements of the competent authority. The use of combination pressure/vacuum relief devices is allowed.

NOTE 4 The above requirements are intended to protect against collapse of the tank or compartment thereof, during conditions of normal ambient temperature variations. They will not necessarily prevent collapse if a tank, or a compartment thereof, is, for example, closed tightly immediately after steam cleaning or discharged without opening the manhole cover.

5.6.5 Inspection and maintenance openings

Tank containers shall be provided with manholes or other openings to allow for complete internal inspection, unless exempted by the competent authority.

The size of manholes shall be a minimum of 500 mm 11) in diameter and shall be determined by the need for men and machines to enter the tank to inspect, maintain or repair the inside, taking into account the requirements of the governing competent authority.

5.6.6 Gauging devices

Gauging devices which may be in direct communication with the contents of the tank shall not be made of easily destructible material.

5.6.7 Sealing (customs requirements)

Adequate provision shall be made for the sealing of the tank in accordance with international customs agreements.

5.7 Optional features

5.7.1 Gooseneck tunnels

Gooseneck tunnels shall be provided as mandatory features in 1AAA tank containers and may be provided as optional features in 1AA, 1A and 1AX tank containers. The dimensional requirements are specified in annex C; all other parts of the base structure shall be as specified in 5.3.

5.7.2 Walkways

Where provided, walkways shall be designed to withstand a loading of not less than 3 kN 12) uniformly distributed over an area of 600 mm × 300 mm 13).

Longitudinal walkways shall have a minimum width of 400 mm 14).

5.7.3 Ladders

Where provided, ladders shall be designed to withstand a load of 200 kg 15) on any rung.

5.7.4 Tank insulation

When insulation is provided, the design and construction shall be such that the insulation will in no way impinge on the specified requirements nor interfere with the proper function of the tank fittings.

Due regard shall be given to the requirements of 5.1.10.

5.7.5 Tank heating and refrigeration

When heating or refrigeration is provided, due consideration shall be given to the safety of the tank and its contents. Suitable safeguards shall be provided to avoid the development of excessive temperature and stresses.

6 Testing

6.1 General

Unless otherwise stated, tank containers complying with the design and construction requirements specified in clause 5 shall, in addition, be capable of withstand ing the tests specified in 6.2 to 6.11. The pressure test (test No. 12) shall be applied to every

8) 40 kPa = 0.4 bar; 79 kPa = 0.79 bar; 284 mm² = 0.44 in²; 400 mm = 16 in; 500 mm = 19 3/4 in; 600 mm × 300 mm = = 24 in × 12 in; 3 kN = 675 lbf; 200 kg = 440 lb
tank container and shall, where practicable, be carried out last if other tests are to be performed.

Tank containers intended for the carriage of dangerous goods shall, in addition, comply with the test requirements of the relevant regulations to the satisfaction of the competent authority.

NOTE 5 Dynamic tests are not included pending possible development of a satisfactory and reproducible test specification.

6.1.1 The symbol $P$ denotes the maximum payload of the container to be tested, that is,

$$ P = R - T $$

where

$ R $ is the rating;

$ T $ is the tare.

The symbol $W$ denotes the container payload with the total capacity filled with water.

NOTE 6 $ R $, $ P $, $ T $ and $ W $, by definition, are 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:

$$ R_g, P_g, T_g, W_g $$

the units of which are in 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.

6.1.2 The tank container under test, unless otherwise stated, shall be loaded with a suitable fluid/dry bulk to achieve the test load or loading specified.

If the test load or loading cannot readily be met by the above method, or if such a method is undesirable, the tank container shall be loaded with a suitable fluid/dry bulk and a supplementary load or loading shall be applied. The total load or loading thus applied shall be such as to simulate uniform loading.

Variations of 20% of the calculated bending moment diagrams of the uniformly loaded tank container shall be considered acceptable.

NOTE 7 Other alternative test load or loadings (for example for longitudinal and lateral internal restraint tests) may be used, provided that they achieve the specified test loading.

6.1.3 The test loads and loadings specified for all the following tests are minimum requirements.

NOTE 8 Special attention is drawn to the loading induced during operation of types 87 and 88.

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

a) the dimensional and design requirement clauses 4 and 5 of this part of ISO 1498;

b) ISO 688;

c) ISO 1161.

6.2 Test No. 1 — Stacking

6.2.1 General

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

Table 2 specifies the force to be applied as a test to each pair of corner fittings and the superimposed mass that the test force represents.

6.2.2 Procedure

The tank container, filled completely with water, shall be placed on four level pads, one under each bottom corner fitting. The pads shall be centralized under the fittings and shall be substantially of the same plan dimensions as the fittings.

The tank 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 2.

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 bottom face of the bottom corner fitting specified in ISO 1161. If equivalent fittings are used, they shall be designed to produce the same effect on the container under 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.
Table 2 — Forces to be applied in stacking tests

<table>
<thead>
<tr>
<th>Container designation</th>
<th>Test force per container (all four corners simultaneously)</th>
<th>Test force per pair of end fittings</th>
<th>Superimposed mass represented by test force</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kn</td>
<td>lbf</td>
<td>kn</td>
</tr>
<tr>
<td>1AAA, 1AA, 1A and 1AX</td>
<td>3 392</td>
<td>763 200</td>
<td>1 698</td>
</tr>
<tr>
<td>1BB, 1B, 1B and 1BX</td>
<td>3 392</td>
<td>763 200</td>
<td>1 698</td>
</tr>
<tr>
<td>1CC, 1C and 1CX</td>
<td>3 392</td>
<td>763 200</td>
<td>1 698</td>
</tr>
<tr>
<td>1D and 1DX</td>
<td>3 392</td>
<td>763 200</td>
<td>1 698</td>
</tr>
<tr>
<td></td>
<td>396</td>
<td>210 600</td>
<td>448</td>
</tr>
</tbody>
</table>

NOTE — The test force of 3 392 kn per container is derived from the superimposed mass of nine-high stacking, i.e. eight containers stacked on top of one container, all being rated to 24 000 kg, and an acceleration of 1,8g. (The corner posts of such containers are known as having been tested to 86 400 kg (190 480 lb).)

Each corner fitting or equivalent fitting shall be offset in the same direction by 25.4 mm (1 in) laterally and 38 mm (1 1/2 in) longitudinally.

In the case of tank containers with identical ends, only one end need be tested.

6.2.3 Requirements

On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

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

6.3.1 General

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

This test shall also be regarded as proving the ability of the tank container to withstand the forces arising from acceleration of the payload in lifting operations.

6.3.2 Procedure

The tank container under test shall be loaded in such a way that the combined mass of tank container and test load is equal to 2R (see 6.1.2) 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 tank container other than 1D or 1DX, the lifting forces shall be applied vertically.

For a 1D or 1DX tank container, lifting shall be by means of slings, the angle of each leg being at 60° to the horizontal.

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

6.3.3 Requirements

On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

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

6.4.1 General

This test shall be carried out to prove the ability of a tank 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.

6.4.2 Procedure

The tank container under test shall be loaded in such a way that the combined mass of tank container and test load is equal to 2R (see 6.1.2), and 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.

6) 25.4 mm = 1 in; 38 mm = 1 1/2 in
Lifting forces shall be applied at

30° to the horizontal for 1AAA, 1AA, 1A and 1AX tank containers;

37° to the horizontal for 1BB, 1BB, 1B and 1BX tank containers;

45° to the horizontal for 1CC, 1C and 1CX tank containers;

60° to the horizontal for 1D and 1DX tank 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 tank container shall be suspended for 5 min and then lowered to the ground.

6.4.3 Requirements

On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

6.5 Test No. 4 — External restraint (longitudinal)

6.5.1 General

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

6.5.2 Procedure

The tank container shall be loaded in such a way that the combined mass of the tank container and test load is equal to $R$ (see 6.1.2), and shall be secured longitudinally to rigid anchor points through the bottom apertures of the bottom corner fittings at one end of the tank container.

A force of $2Rg$ shall be applied horizontally to the tank container through the bottom apertures of the other bottom corner fittings, first towards and then away from the anchor points.

7) 38 mm = 1 1/2 in

6.5.3 Requirements

On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

6.6 Test No. 5 — Internal restraint (longitudinal)

6.6.1 General

Separate tests shall be carried out to prove the ability of the tank container to withstand the effects of the inertia of the tank contents both on the tank itself and the tank-to-framework connections under the conditions of longitudinal acceleration envisaged in 5.1.

NOTES

9 The effects of vertical acceleration are deemed to be covered by tests Nos. 2 and 3.

10 Containers without longitudinal frames are deemed to be covered by test No. 4.

6.6.2 Procedure

The tank container shall be loaded in such a way that the combined mass of the tank container and test load is equal to $R$.

The tank container shall be positioned with its longitudinal axis vertical (a tolerance of 3° is acceptable). It shall be held in this position for 5 min either

a) by means of supports at the lower end of the base structure of the tank container acting only through the two bottom corner fittings giving both vertical and horizontal securement, and by means of anchor devices acting through the corner fittings at the upper end of the base structure in such a manner as to provide horizontal restraint only; or

b) by means of supports under the four downward-facing corner fittings.

Alternative procedure b) may be used only for those types of tank containers where the tank is supported solely by the base structure of the container or where, in the opinion of the competent authority, the tank container is adequately tested with respect to tank-to-framework connections by tests Nos. 4 and 8.
Tank containers which are not structurally symmetrical with respect to internal divisions or tank-to-framework connections shall be tested at both ends.

6.6.3 Requirements

On completion of the tests, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

6.7 Test No. 6 — Internal restraint (lateral)

6.7.1 General

Separate tests shall be carried out to prove the ability of the tank container to withstand the effects of the inertia of the tank contents both on the tank itself and the tank-to-framework connections under the conditions of lateral acceleration envisaged in 5.1.

NOTES

11 The effects of vertical acceleration are deemed to be covered by tests Nos. 2 and 3.

12 Containers without longitudinal frames are deemed to be covered by test No. 4.

6.7.2 Procedure

The tank container shall be loaded in such a way that the combined mass of the tank container and test load is equal to \( R \).

The tank container shall be positioned with its transverse axis vertical (a tolerance of 3° is acceptable). It shall be held in this position for 5 min either

a) by means of supports at the lower end of the base structure of the tank container acting only through the two bottom corner fittings given both vertical and horizontal securement, and by means of anchor devices acting through the corner fittings at the upper end of the base structure in such a manner as to provide horizontal restraint only; or

b) by means of supports under the four downward-facing corner fittings.

Alternative procedure b) may be used only for those types of tank containers where the tank is supported solely by the base structure of the container or where, in the opinion of the competent authority, the tank container is adequately tested with respect to tank-to-framework connections by tests Nos. 4 and 6.

6.7.3 Requirements

On completion of the tests, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

6.8 Test No. 7 — Rigidity (transverse)

6.8.1 General

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

6.8.2 Procedure

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

When testing the two end frames separately, vertical restraint need only be applied at the end frame under test.

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

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

For allowable deflection under full test loading, see 5.4.

6.8.3 Requirements

On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the
6.9 Test No. 8 — Rigidity (longitudinal)

6.9.1 General

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

6.9.2 Procedure

The tank container in tare condition (7) shall be placed on four level supports, one under each 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 and in the same side frame as a top corner fitting to which the force is applied.

Forces of 75 kN$^9$ shall be applied either separately or simultaneously to each of the top corner fittings on one end of the tank container in lines parallel both to the base of the tank container and to the planes of the sides of the tank container. The forces shall be applied first towards and then away from the top corner fittings.

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

For allowable deflections under full test loadings, see 5.5.

6.9.3 Requirements

On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

6.10 Test No. 9 — Load-transfer area test

6.10.1 General

This test shall be carried out to simulate, statically, the known dynamic condition when the load-transfer areas are only partially in contact with the carrying vehicle, within the space provided between the twistlock and the bottom corner fitting.

This test only confirms the strength of the structure in relation to static load-carrying ability.

6.10.2 Procedure

The tank container shall be loaded in such a way that the combined mass of the tank container and test load is equal to 2k, and shall be supported by means of four supports, each with a supporting area of 150 mm $\times$ 150 mm. The supports shall be positioned at the inner ends of the allowable transverse support area.

The tank container shall remain supported in this way for a minimum of 5 min.

Repeat the test with the supports positioned at the outer ends of the allowable transverse support area.

In the case of tank containers with symmetrical load-transfer areas, only one end need be tested. Where the load-transfer areas are not symmetrical, both ends shall be tested.

6.10.3 Requirements

Upon completion of the test, the tank container shall not show leakage, permanent deformation or abnormality which will render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

6.11 Test No. 10 — Walkways (where provided)

6.11.1 General

This test shall be carried out on all walkways, where provided on a tank container, to prove the ability of the walkway to withstand the loads imposed by persons working thereon.

6.11.2 Procedure

A concentrated load of not less than 300 kg$^9$ shall be uniformly distributed over an area of 600 mm $\times$ 300 mm located at the weakest area of the walkway.

---

$^9$ 75 kN = 16 850 lbf; 150 mm $\times$ 150 mm = 6 in $\times$ 6 in; 600 mm $\times$ 300 mm = 24 in $\times$ 12 in; 300 kg = 660 lb
6.11.3 Requirements

On completion of the test, the walkways shall show neither undue deformation nor any abnormality which renders them unsuitable for use.

6.12 Test No. 11 — Ladders (where provided)

6.12.1 General

This test shall be carried out on all ladders, where provided on a tank container, to prove the ability of the ladder to withstand the loads imposed by persons working thereon.

6.12.2 Procedure

A load of 200 kg\(^{10}\) shall be positioned at the centre of the widest rung.

6.12.3 Requirements

On completion of the test, the ladders shall show neither undue deformation nor abnormality which would render them unsuitable for use.

6.13 Test No. 12 — Pressure test

6.13.1 General

This test shall be carried out on every tank container to prove the ability of the tank to withstand the specified internal pressure. Where practicable, it shall be carried out last if other tests are to be performed, but before the addition of thermal insulation, if any.

Shot-blasting or other preparation normally required prior to applying lining or insulation need not be performed prior to this test.

6.13.2 Procedure

The tank shall be hydraulically tested.

If the liquid/gas tank is provided with compartments, in addition to hydraulic testing, each compartment shall be tested with the adjacent compartments empty and at atmospheric pressure.

The test pressure shall be measured at the top of the tank or compartment with the tank container in its normal position. The test pressure shall be maintained for as long as is necessary to enable a complete examination of the tank and its fittings to be made, but in any case for not less than 30 min.

Relief devices, where fitted, shall be rendered inoperative or removed for the purpose of this test.

The pressure at which the tank is tested shall be selected with regard to the intended use of the tank, in accordance with the regulations applied by the competent authority and the requirements of 5.1.8. This pressure will determine the type code designation of the tank container in accordance with table 1.

6.13.3 Requirements

During the test, the tank shall show no leakage. On completion of the test, the tank container shall not show leakage or permanent deformation or abnormality which would render it unsuitable for use, and the dimensional requirements affecting handling, securing and interchange shall be satisfied.

7 Identification and marking

7.1 The marking requirements of these tank containers shall be in accordance with the principles embodied in ISO 6346 for the identification and marking of freight containers.

7.2 At least the following data allowing tank identification shall be permanently attached to the tank in a readily accessible position. These data shall be permanently marked by stamping, embossing or other means and shall not be painted so as to obscure the markings:

a) date of original hydraulic test, year and month;

b) test pressure, in kilopascals and bars;

c) maximum allowable working pressure, in kilopascals and bars;

d) total capacity, in litres;

e) date of hydraulic re-test, year and month;

f) type code designation (optional mark).

---

10) 200 kg = 440 lbf
7.3 As far as possible, the data plate shall include the information required by the competent authorities, thus reducing to a minimum the number of separate plates required. All data plates should be located as close to one another as possible.

If any of the required data is included on other data plates, it need not be duplicated in order to satisfy the requirements of this part of ISO 1496.
Annex A  
(normative)

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

NOTES

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

14 The figures in this annex correspond to the tests described in 6.2 to 6.12 only where marked.

15 For definitions of R, P, T and W, see 6.1.1.

<table>
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<tr>
<th>Figure No.</th>
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<th>Side elevations</th>
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<td></td>
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<tr>
<td>Stacking</td>
<td>848 kN</td>
<td>848 kN</td>
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<tr>
<td></td>
<td>(648 - (T_p - W_p)) kN</td>
<td>(648 - (T_p - W_p)) kN</td>
</tr>
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<td></td>
<td>(648 - (T_p - W_p)) kN</td>
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<td><strong>Not applicable to 1D and 1DX tank containers</strong></td>
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<td>Stacking</td>
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<td>Test No. 1</td>
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<td><strong>Applicable to 1D-and 1DX tank containers only</strong></td>
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<td>Figure No.</td>
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<td>A.2</td>
<td>Top lift</td>
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<td>A.3</td>
<td>Top lift</td>
<td>Side elevations</td>
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<td>A.6</td>
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Not applicable to 1D and 1DX containers

Applicable to 1D and 1DX tank containers only

Applicable to all tank containers
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<td>Tank-frame connections through all corner fittings</td>
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<td>A.8</td>
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<td>Test No. 5 [see 6.6.2 b]</td>
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<td></td>
<td>Tank-frame connections through bottom structure only</td>
<td></td>
</tr>
<tr>
<td>A.9</td>
<td>Internal restraint (lateral)</td>
<td><img src="image5" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>Test No. 6 [see 6.7.2 a]</td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
<tr>
<td>A.10</td>
<td>Internal restraint (lateral)</td>
<td><img src="image7" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>Test No. 6 [see 6.7.2 b]</td>
<td><img src="image8" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>Tank-frame connections through bottom structure only</td>
<td></td>
</tr>
<tr>
<td>Figure No.</td>
<td>End elevations</td>
<td>Side elevations</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>A.11</td>
<td>R rigidity (transverse) Test No. 7</td>
<td>![Image] 150 kN</td>
</tr>
<tr>
<td>A.12</td>
<td>R rigidity (transverse) Test No. 7</td>
<td>![Image] 150 kN</td>
</tr>
<tr>
<td>A.13</td>
<td>Lashing/securement</td>
<td>![Image] 150 kN</td>
</tr>
<tr>
<td>A.14</td>
<td>Lashing/securement</td>
<td>![Image] 150 kN</td>
</tr>
<tr>
<td>A.15</td>
<td>Lashing/securement</td>
<td>![Image] 150 kN</td>
</tr>
<tr>
<td>A.16</td>
<td>Lashing/securement</td>
<td>![Image] 150 kN</td>
</tr>
<tr>
<td>A.17</td>
<td>R rigidity (longitudinal) Test No. 8</td>
<td>![Image] 75 kN</td>
</tr>
<tr>
<td>A.18</td>
<td></td>
<td>Applicable to all tank containers except 1D and 1DX</td>
</tr>
<tr>
<td>A.19</td>
<td>Load-transfer area tests</td>
<td>![Image] 75 kN</td>
</tr>
<tr>
<td></td>
<td>End zones</td>
<td>Areas of support</td>
</tr>
<tr>
<td></td>
<td>Intermediate zones</td>
<td></td>
</tr>
<tr>
<td>Figure No.</td>
<td>End elevations</td>
<td>Side elevations</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>A.20</td>
<td>Lashing/securement (This type of loading is not permissible except as applied in clause 4)</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td>A.21</td>
<td>Lashing/securement</td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
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</table>

Optional features

<table>
<thead>
<tr>
<th>A.22</th>
<th>Walkways Test No. 10</th>
<th><img src="image3" alt="Diagram" /></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>300 kg (660 lb) per specified area</td>
<td>300 kg (660 lb)</td>
</tr>
<tr>
<td></td>
<td>Applies to all tank containers (where walkways are provided)</td>
<td></td>
</tr>
</tbody>
</table>

A.23

<table>
<thead>
<tr>
<th>Ladders Test No. 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 kg (440 lb) on any rung</td>
</tr>
</tbody>
</table>

200 kg (440 lb)

Applies to all tank containers (where ladders are provided)
Annex B
(normative)

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

B.1 The base structures of containers, i.e. the end transverse members and such intermediate members as may be fitted (or such flat undersides 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
11 wide zones defined by the dashed lines in figure B.1.

B.2 Containers having transverse members spaced more than 1 000 mm
11 apart (and not having a flat underside) shall have load-transfer areas as indicated in figures B.2, B.3 and B.4 capable of meeting the following requirements.

B.2.1 Each pair of load-transfer areas associated with an end transverse member shall be capable of transferring loads of not less than R, 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 2R/n, where n is the number of pairs of intermediate load-transfer areas, i.e. loads which may occur during transport operations.

B.2.2 The minimum number of pairs of intermediate load-transfer areas is:

For 1CC, 1C and 1CX containers (if fitted) 2
For 1BBB, 1BB, 1B and 1BX containers 2
For 1AA, 1A and 1AX containers 3
For 1AAA, 1AA, 1A and 1AX containers fitted with a non-continuous gooseneck tunnel 4

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

— 1 700 mm to 2 000 mm
11 for containers having the minimum number of pairs of load-transfer areas for the container concerned;

— 1 000 mm to 2 000 mm
11 for containers having one more pair of load-transfer areas than the minimum required for the containers concerned.

B.2.4 Each load-transfer area shall have a longitudinal dimension of at least 75 mm
11.

B.3 Minimum requirements for load-transfer areas in the vicinity of the gooseneck tunnel are shown in figure B.5.

NOTE 18 In figures B.2, B.3 and B.4, the load-transfer areas associated with the container base are shown in black. Gooseneck tunnel transfer areas are also shown in black in figure B.5.

11) 75 mm = 3 in; 250 mm = 10 in; 350 mm = 14 in; 1 000 mm = 39 3/8 in; 1 000 mm to 2 000 mm = 39 3/8 in to 78 3/4 in; 1 700 mm to 2 000 mm = 66 15/16 in to 78 3/4 in; 3 150 mm to 3 600 mm = 124 1/4 in to 137 7/8 in; 1 250 mm
2 = 2 in

19
NOTE — See footnote 11) for conversion of dimensions to inches.

Figure B.1 — Zones for longitudinal members

NOTE — See footnote 11) for conversion of dimensions to inches.

Figure B.2 — Minimum number of pairs of load-transfer areas — 1CC, 1C and 1CX containers (if fitted), and 1BBB, 1BB, 1B and 1BX containers
NOTE — See footnote 11) for conversion of dimensions to inches.

**Figure B.3** — Minimum number of pairs of load-transfer areas — 1AA, 1A and 1AX containers without gooseneck tunnel

NOTE — See footnote 11) for conversion of dimensions to inches.

**Figure B.4** — Minimum number of pairs of load-transfer areas — 1AAA, 1AA, 1A and 1AX containers with gooseneck tunnel (with minimum localized structure)
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 mm².

(See annex C for details of tunnel section.)

NOTES

1. Where continuous tunnel side members are provided, the load transfer areas situated between 3 160 mm and 3 500 mm from the end of the container may be omitted.

2. See footnote 11) for conversion of dimensions to inches.

Figure B.5 — Minimum requirements for load-transfer areas near the gooseneck tunnel
Annex C
(normative)

Dimensions of gooseneck tunnels (where provided)

See 5.7.2. The space required to constitute a gooseneck tunnel into which the gooseneck of a trailer may fit is shown in figure C.1.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L_4$</td>
<td>$D$</td>
<td>$W_c$ max.</td>
</tr>
<tr>
<td>mm</td>
<td>3,500</td>
<td>3,150</td>
<td>900</td>
</tr>
<tr>
<td>in</td>
<td>137 7/8</td>
<td>124 1/4</td>
<td>38 5/8</td>
</tr>
</tbody>
</table>

NOTES
1. Tolerance $A_1$ shall be measured in the back part of the tunnel, over a length of about 600 mm (23 5/8 in).
2. 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.5.

Figure C.1
Claims

1. An ISO gas freight container comprising a ISO frame and at least one composite tank positioned within said ISO frame, said composite tank being adapted to contain a gas at pressures in excess of about 1000 psi.

2. The ISO gas freight container of claim 1 wherein said composite tank includes a liner and an overwrap shell.

3. The ISO gas freight container of claim 2 wherein said liner is constructed of HDPE.

4. The ISO gas freight container of claim 2 wherein said liner is a metal liner.

5. The ISO gas freight container of claim 1 wherein the ISO frame is selected from 1A, 1AA, 1AAA, 1C, or 1CC ISO frames.

6. The ISO container of claim 1 having a series of composite tanks positioned in said ISO frame.

7. The ISO gas freight container of claim 1 wherein said composite tank includes a boss and said ISO frame includes at least one bulkhead, and a portion of said boss extends through said bulkhead.

8. The ISO gas freight container of claim 2 wherein said overwrap comprises carbon fibers.

9. The ISO gas freight container of claim 2 wherein said composite tank is adapted to contain a gas at pressures in excess of about 3000 psi.

10. The ISO gas freight container of claim 2 wherein said composite tank is adapted to contain a gas at pressures in excess of about 4000 psi.

11. The ISO gas freight container of claim 2 wherein said composite tank is adapted to contain a gas at pressures in the range of about 3000-15,000 psi.

12. The ISO gas freight container of claim 1 wherein said composite tank is positioned horizontally in said ISO frame.

13. The ISO gas freight container of claim 8 wherein said overwrap further comprises glass fibers.

14. The ISO gas freight container of claim 13 where said overwrap includes an outer coating resistant to UV degradation.
15. The ISO gas freight container of claim 1 wherein said composite tank has a
diameter of about 88 inches.

16. A method of transporting compressed gases comprising providing an ISO gas
freight container comprising a ISO frame and at least one composite tank positioned
within said ISO frame, said composite tank being adapted to contain a gas at pressures in
excess of about 1000 psi, loading said at least one composite tank with a gas at a desired
pressure, positioning said ISO gas freight container on a transport vehicle, and moving
said transport vehicle to a desired location.

17. The method of claim 16 wherein said gas is selected from the list of natural gas,
hydrogen, helium, argon, oxygen, nitrogen or acetylene.

18. The method of claim 16 wherein said transport vehicle is selected from the list of
railcar, truck, ship, each adapted to carry bulk cargo, and helicopter.

19. The method of claim 16 wherein said loaded ISO gas freight container is lifted
onto said transport vehicle by crane.

20. A method of claim 16 where said loaded ISO gas freight container is transported
to a desired location, removed from said transport vehicle, and left at said desired location
for storage and later distribution.

21. The ISO gas freight container of claim 1 wherein said at least one tank comprises
at least two tanks, each tank having a separate manifold for loading and discharging each
tank separately.
FIG. 5