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INTERNATIONAL SAFETY PANEL

SAFETY BRIEFING PAMPHLET SERIES # 30

Safe Handling of Tank Containers

By

Bill Brassington

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TT CLUB

STRAANG

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This publication is one of a series developed by the International Safety Panel ("Safety Panel") of ICHCA International Limited ("ICHCA"). The series is designed to inform those involved in the cargo-handling field of various practical health and safety issues. ICHCA aims to encourage port safety, the reduction of accidents in port work and the protection of port workers' health.

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This document has been produced in association with the International Tank Container Organisation (ITCO). ITCO was formed in 1998 as a result of the merging of International Tank Container Leasing Association (ITCLA) and the European Portable Tank Association (EPTA). The purpose of ITCO is to act as a voluntary non-profit trade association representing the international tank container industry to the public and governmental bodies and to advance the interests of the industry.

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SAFE HANDLING OF TANK CONTAINERS

1 Introduction

1.1 This document is one of a number of Briefing Pamphlets published by ICHCA International and forms one of a series on the safe handling of containers and container related equipment.

1.2 In the freight container industry, the term "tank" usually refers to a 20 ft tank container consisting of a stainless steel pressure vessel supported and protected within a steel frame. Tanks are often thought to just carry dangerous goods.

1.3 However this perception is far from the whole truth, as the term "tank" can cover a number of containment designs that carry all sorts of bulk liquids, powders, granules and liquefied gases; tank containers are a type of tank. Tanks come in various sizes, can be pressurised or non-pressurised and can be carried as a discrete cargo transport (or loading) units (CTU) or carried within another container.

1.4 For the purposes of this pamphlet, the term tank container will be used to describe all tank designs covered within section 2. Where a specific type or design is being referred to directly it will be called by its type or design name to differentiate it from the generic tank container.

1.5 This pamphlet will concentrate on the most significant designs which are generally 20 ft intermodal loading units designed to carry pressurised liquids or liquefied gases. However the text will include some information and details about as many of the various designs as is possible.

1.6 Tank containers are built to the same exacting standards as other series 1 ISO freight containers and with a few exceptions can be handled in exactly the same way as all intermodal freight containers.

2 Types of Tank Containers

2.1 ISO Tank Containers

2.1.1 Length — 10ft (2.991m), 20ft (6.058m), 30ft (9.125m) and 40ft (12.192m). Under ISO 668 it would be possible to include a 45ft (17.192m) long unit to the list. However in the international tank industry approximately 95 % of all tanks built are 20ft long.

2.1.2 Width — 8ft (2.438m) wide

2.1.3 Height — Generally 8ft (2.438m) and 8ft 6in (2.591m). There are also "half high" tanks that are typically 4ft (1.219m) and 4ft 3in (1.296m) tall

2.1.4 Volume — 9,000 to 27,000 litres.

2.1.5 Stacking — The combined mass of the superimposed load shall not exceed the allowable stack weight shown on the Safety Approval Plate, generally 192,000 kg. Note: **see section 12.2 for more information about stacking of loaded containers.**

2.1.6 Transport — Can be carried on all modes of transport and deep and short sea routes within cells or on deck

2.2 Tank Swap Bodies

2.2.1 Length — Under European (**CEN**) standards the majority of tank swap bodies (often referred to as swap tanks) have a length of 7.15m, 7.45m, 7.85m or 13.6m. The CEN standard EN 1432 for swap tanks also includes four other lengths: 6.05m (20ft), 7.15m, 9.125m (30ft) and 12.192m (40ft). However these standards do not appear to be used too often as many manufacturers produce different lengths of swap tanks to suit particular cargoes depending on road regulations (length and mass).

The most common length is 7.15m which has approximately 80% of the market.

2.2.2 Width — 2.5m and 2.55m wide.

2.2.3 Height — 2.670m (EN 1432) and 2.591m.

2.2.4 Volume — 30,000 to 36,000 litres.

2.2.5 Stacking — Some designs can be stacked but this is an optional feature in EN 1432. Where they can be stacked they are tested for a superimposed mass of two identical, laden tanks. Note**: see section 12.2 for more information about stacking of loaded containers.**

2.2.6 Transport — Originally designed for road, rail and RO-RO / short sea and often not stacked. Swap tanks with top lift capability can be stacked on deck on deep sea vessels.

Tank swap bodies have reduced stacking capability when compared with ISO designs. This precludes stacking of these units in the lower tiers of an on-deck stow. The extra width of the design, prevents stacking within most deep sea cells or adjacent to other containers on deck

2.3 Domestic Loading Units

2.3.1 Domestic loading units can be built to suit the requirements of the local customer and can therefore have any dimensions which comply with local road and rail regulations.

2.3.2 **These units are not shipped internationally and would be transported by road or rail only.**

3 Tank Designs

3.1 ISO Tank Containers

3.1.1 There are three main structural types of tank container used in the international transport of bulk liquids and liquefied gases - beam, frame and collar. All designs have been manufactured since the 1970s.

3.1.2 All designs can be top lifted, must be stackable and the pressure vessel / barrel as well as all valves and other service equipment must remain within the ISO envelope, i.e. no part can protrude past the outer faces of the corner fittings.

3.1.3 *Frame Tanks*

3.1.3.1 This design consists of two end frames separated by two main beams at low level forming a support frame. Since there is more material in the support frame than with other designs the tare is relatively high. Often the lower beams are “castellated” a method of lightening the main beams by cutting

Picture 2

Picture 1

holes to reduce the tare and therefore to increase the payload. Top rails are often light weight, play little part in the overall structural strength and often there to support the walkway. Top rails in these cases are not usually attached to the pressure vessel. In some designs these rails can be attached using mechanical fasteners (nuts and bolts) but are more often welded in place.

3.1.3.2 The pressure vessel is supported from the main beams generally on saddle supports which are in the form of bolted clamps or welded interface supports.

3.1.3.3 The two pictures above show a 20,000 litre (Picture 2) and a 25,000 litre design (Picture 1). Both are insulated. Both pictures show a the cut away castellated light weight main beam. It is also possible to see that the beam is elevated above the level of the corner fitting in Picture 2 whereas Picture 1 shows the beam is lower with the bottom face of the beam about 16 mm above the lower face of the bottom corner fitting. Picture 1 also shows a top rail significantly lower than its top corner fittings.

3.1.4 ***Beam Tanks***

3.1.4.1 A beam tank is supported by a series of bearers attached to the end frames which interface with the pressure vessel at various locations on the periphery of the barrel. The interface consists of plates that are welded to the pressure vessel and the bearers to ensure load sharing and a “barrier” between carbon steel and stainless steel components.

3.1.4.2 The example shown in Picture 3 is a typical beam tank with no top or bottom side rails. The tank is attached using four beams that connect at the four corner fittings of each end frame. The walkway is supported using brackets attached to the pressure vessel.

Picture 3

3.1.4.3 Picture 4 shows a different design where the attachment of the pressure vessel is made using fabricated brackets attached to the corner posts and the end frame corner braces. Top side rails are fitted to the top corner fittings.

3.1.4.4 The tank container is also un-insulated.

Picture 4

3.1.4.5 Both examples show low volume pressure vessels 17,500 lt.

3.1.4.6 Picture 5 shows four 10ft ISO International beam tanks, being carried as two 20ft units. In this example two 10ft units are connected using approved horizontal interbox connectors and the design tested in that configuration. They can then be loaded, handled and stowed in the same way as any 20ft ISO tank container.

Picture 5

3.1.5 ***Collar Tanks***

3.1.5.1 The collar tank is probably the simplest of all the tank designs with a minimum of differing materials in contact with the pressure vessel. Attachment of the pressure vessel to the end frames is by means of a stainless steel collar which is welded to the pressure vessel end dome at the edge (out-set) or to the crown of the domed ends of the pressure vessel (in-set). The collar connects with the side posts, top and bottom rails and the diagonal braces via interface flanges.

3.1.5.2 The collar is continuous at the front / non discharge end. At the rear of the tank container some collar tank designs have a break in the collar where the discharge valve is located.

3.1.5.3 Picture 6 shows an insulated 25,000 litre collar tank. Once insulated it is virtually impossible to distinguish between the inset and outset collar design.

Picture 6

3.2 Tank Swap Bodies (Swap Tanks)

3.2.1 The options for the design of the swap tanks are far less sophisticated than for ISO tanks. However the most important difference relates to their handling and stacking capabilities. All swap tanks have bottom fittings at the ISO 20ft or 40ft locations. Generally the bottom fittings are wider than their ISO counterparts, this is so that the bottom aperture is in the correct ISO position / width while the outer face of the bottom fitting extends to the full width if the unit (2.5 / 2.55m).

3.2.2 ***Stackable***

3.2.2.1 The majority of recently built swap tanks are now stackable and 85 % of all swap tanks have top and side lifting capability.

3.2.2.2 When considering stacking swap tanks it is important to differentiate between swap tanks and ISO containers which can be done by looking at the configuration of the top fitting and the side post. One of the characteristics that will be seen on the majority of all of these units is the double side lifting aperture, one in the post and the other in the fitting as shown in Picture 7. The second aperture in the post is required so that the unit can be lifted using a side lifter.

3.2.2.3 The second identifying characteristic is the stepped back top fitting. As the top fittings are generally the same as those found on ISO tank containers, the positioning must be identical to that of the 20ft / 40ft ISO container; the fitting is set back from the post face to accomplish this.

Picture 7

3.2.2.4 A typical example of a swap tank is shown in Picture 8. The pressure vessel is attached to the "end" frames and there is a protective bottom rail / end frame to ensure that the risk of direct contact with the pressure vessel is minimised.

3.2.2.5 The unit is insulated.

Picture 8

3.2.2.6 The example shown in Picture 9 is a 12.192m long powder tank with top lift capabilities. Note the presence of the two apertures in the side posts and corner fittings indicating that the container is wider than ISO. This design is similar to that of the ISO collar tank.

Picture 9

3.2.2.7 The swap tank should never be lifted from the side when loaded.

3.2.3 ***Non Stackable***

3.2.3.1 There are swap tanks which are not stackable or capable for lifting using traditional spreaders. The design of these earlier models was similar to the frame tank with the pressure vessel being supported from the bottom side beams. Some non stackable swap tanks are still built today to meet the particular needs of the industry, particularly intra-European.

Picture 10 shows an example of a modern non stackable demountable swap tank. The notable features are the two grapple lift points (highlighted in yellow and arrowed). The second feature is the legs which are shown in the erected (down) position. Legs of this design enable the swap tank to be demounted from the transport truck / trailer and left for loading, unloading or storage.

Picture 10

3.3 Compartments and Baffles

3.3.1 The IMDG Code prescribe minimum filling rules for tank containers. Generally, these require tanks filled with free-flowing liquids, including liquefied gases, to be filled to not less than 80% of their volume. Further information on the rules governing the minimum and maximum degrees of filling of tank containers laden with dangerous goods and goods not regulated as dangerous for transport are given in Annex 2 section A2.2.

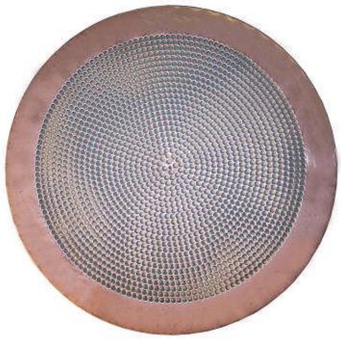
3.3.2 *Baffles*

3.3.2.1 The majority of tank containers are built with a single chamber free from any sharp corner / edges. The smoothness of this simple internal design provides the operator with an easy to clean surface.

3.3.2.2 Baffles (more properly known as surge plates within the IMDG Code) are required to ensure the longitudinal stability of the tank container is maintained when it is loaded to less than 80% of the pressure vessel's volume.

3.3.2.3 Baffles are fitted within the single chamber pressure vessel to reduce the free flow of liquids as the container is moved during transport. Picture 11 shows the upper of two transverse surge plates fitted to the interior of a pressure vessel. However Picture 12 shows an example of a full diameter surge plate as is more commonly fitted than the design shown in Picture 11

Picture 11



Picture 12

3.3.3 *Compartments*

A limited number of tank containers are built with two or more discrete compartments. The single shell is constructed in the same manner as a normal tank container, except that one or more watertight bulkheads are welded across the shell's cross section. Outwardly there will be loading and discharge valves and a manway for each compartment. Each of these compartments is capable of carrying a different cargo or in some cases it is possible to carry a single cargo in one compartment and leave the other compartments empty. See also section 10.2.6.

3.3.4 *Marking*

3.3.4.1 At the time of writing this pamphlet there was no regulation or requirement to mark tank containers to indicate if they are fitted with baffles or built with compartments. However the IMDG Code requires that the water capacity at 20ºC shall be marked on a corrosion resistant metal identification plate fitted to every portable tank. The plates should also show the water capacity of each compartment at 20ºC. An entry shown in this section of the plate indicates that the tank container is divided into compartments but does not indicate the number of compartments unless there is more than one value shown.

3.3.4.2 New rules have been prepared and will come into effect with the publication of the 2012 edition of the IMDG Code. These require tank containers where the shell or compartment is divided by surge plates into sections of not more than 7,500 litres to have a letter “S” marked in either of the capacity sections on the identification plate.

Note 1: There is no requirement to indicate the number of compartments into which a tank container is divided

Note 2: The marking of the identification plate with a volume in the compartment capacity or adding the letter “S” for shells and compartments fitted with surge plates can not be easily seen by container handlers except by close inspection of the identification plate

Note 3**:** Tank containers with removable surge plates may be incorrectly marked, i.e. the identification plate is marked with the letter “S” when the surge plates have been removed.

3.3.4.3 Tank containers filled with different dangerous goods in different compartments must display the appropriate marks and/or placards for each hazard and for all dangerous goods carried.

3.3.5 ***Recording***

3.3.5.1 There do not appear to be any mandatory requirements in the dangerous goods regulations or regulations referring to non-regulated goods to indicate in any documentation accompanying the consignment as to whether tank containers are fitted with surge plates or divided into compartments. However there is a requirement to indicate the quantity of each dangerous goods carried as part of that consignment.

3.3.5.2 As part of the guidance that this pamphlet offers, it is recommended that the number of spaces made within the tank container either by surge plates or compartment is marked in the appropriate section of the Dangerous or Non Regulated Goods Note (see Annex 4 Figures A4.2 and A4.3).

3.3.5.3 Furthermore where the Goods Note has a space in which the number of baffles and/or compartments can be filled in. It is **strongly recommended** that an entry is made in these sections even to record that there is only a single compartment or no baffles are fitted.

4 Tank Groups

4.1 Liquids

4.1.1 Tank containers built for liquids may:

- have a stainless steel or mild steel pressure vessel shell;
- be un-insulated or insulated
- have heating or cooling equipment;
- be lined with a protective coating

4.2 Pressurised Liquefied Gases

4.2.1 Tank containers for pressurised liquefied gases usually have a mild steel pressure vessel shell. A few specialised tank containers for these gases may have a stainless steel shell.

Picture 13

4.2.2 Where high ambient temperature or direct sunlight can affect the cargo then a heat shield can be fitted above the top of the pressure vessel (see Picture 13)

4.2.3 Rarely for tank containers, the pressure vessel shell may be totally un-insulated.

4.3 Powders and Granules

4.3.1 Tank containers for powders and granules are generally low pressure vessels manufactured from aluminium alloys. An example is shown in picture 14.

Picture 14

4.3.2 The nature of the powder or granule will dictate the design as will the loading / unloading process in which the tank container is to operate.

4.3.3 The discharge process for powders and granules differs from liquids and gases insomuch as the cargo may not "flow". Therefore tank containers for powders and granules may be manufactured with hopper discharge chutes built along the underside of the shell, or with specialist discharge mechanisms which facilitate the discharge.

4.3.4 Tank containers that carry powder and granules may be mounted on tipping chassis / trailers

4.4 Tank Containers for Deeply Refrigerated Liquefied Gases

4.4.1 Some tank containers are designed and constructed to transport liquefied gases at extremely low temperatures, at around –200°C or lower. They may be referred to as "cryogenic tanks" within the freight container industry. Picture 15 shows an example of a 20 ft cryrogenic tank

4.4.2 Due to the nature of the cargoes carried the level of insulation varies A typical cryogenic tank container will have an outer metal jacket surrounding the pressure vessel. A near-perfect vacuum is created between the outer metal jacket and the pressure vessel; this provides the insulation.

Picture 15

4.4.3 In addition the space may be filled with an insulating material. Some tanks may consist of a metal vacuum jacket, an outer shell containing a small quantity of liquefied nitrogen and an inner shell intended to contain the actual liquefied gas to be transported.

4.4.4 These highly specialised tank containers represent less than 1% of the worldwide total. They do not have any refrigeration equipment (for example as reefer tank containers do).

5 Service Equipment, Fittings and Fixtures

5.1 The definition of service equipment is made in Annex 1 however in this section the use of *fittings* will be used as a substitute and will encompass service equipment as defined by the IMDG Code and the closing devices for openings on tank shells which the IMDG Code considers to be part of the shell rather than as service equipment. *Fittings* are therefore defined as items attached to the tank shell that perform a role that relates to the loading or discharge of the cargo, or the safety of the pressure vessel.

5.2 A separate term *fixtures* will be used to define all those items that are attached to the frame or which perform a role that protects the pressure vessel.

5.3 **Fittings (top of shell)**

5.3.1 ***Access / Loading Hatch referred to as a Manway***.

5.3.1.1 One or more manways are cut into the top of the shell and each consists of a neck ring, a lid and a gasket seal. The neck ring will be fabricated from a compatible material to the shell and is a shaped pad that is welded to the pressure vessel.

5.3.1.2 Manways are provided to allow access by suitably qualified technicians and repairers into the shell for periodic inspection. They are also often used on standard tank containers as an opening for filling.

5.3.1.3 ISO 1496 / 3 states that the “size of the manway shall be a minimum of 500 mm in diameter and shall be determined by the need for men and machines to enter the tank to inspect, maintain or repair the inside. However the nature of the cargo and the designation of the tank will set the specific manway lid configuration.

5.3.1.4 Domed manway lids – these are hinged and sealed against the neck rings by a number of “swing bolts” – see picture 16.

Picture 16

Picture 17

Picture 18

5.3.1.5 Flat bolted flanged manway lids – circular, flat plates are used to cover the manways by attaching them to the neck ring using a number of bolts. Picture 17 and Picture 18 show two examples of bolted manway lids each with a secondary use. Picture 17 shows a configuration of valves mounted on the lid and Picture 18 shows an example of a bolted manway lid with a smaller diameter loading hatch. This allows a top loading facility and increased internal pressure.

5.3.1.6 The number of swing bolts or flange bolts varies from type to type and the pressure rating of the tank. However when they are fully tightened they should form a pressure tight seal that will contain a pressure greater than the test pressure of the tank.

5.3.1.7 Where bolts are used in place of studs and nuts to secure the bolted manway lid care needs to be taken at the time of manufacture, maintenance and periodic testing to ensure that the bolts used are of the correct length so that they may be fully tightened.

Note 1: See Annex 6 for more information on manway lid operation

Note 2: Once the container has been filled, opening the manway hatch / lid is generally **not required** until the tank container arrives at its destination.

Note 3**:** Many tanks have vacuum relief valves that are not sized to allow tanks to be discharged without opening the manway or other fittings. If a tank container needs to be opened, this must be carried out by a suitably qualified person.

5.3.2 *Pressure Relief Valves*

Picture 19

5.3.2.1 In general all tank containers whether they are designed for dangerous or non regulated goods are fitted with one or more spring loaded pressure relief valves which comply with the recommendations for their design, set pressures and venting capacity set forth in the United Nations Recommendations on the Transport of Dangerous Goods - Model Regulations (Orange Book). The pressure relief valves (see Picture 19) are fitted in the top space of the shell as close to the longitudinal and lateral centre so that they always remain in contact with the gas or vapour even during the extremes of bad weather.

5.3.2.2 Pressure relief valves can come in two forms:

5.3.2.2.1 Valves may be high pressure only to prevent a build up of pressure that may result in the tank exploding, or,

5.3.2.2.2 Valves may be “twin acting” in that they are designed to relieve both excess pressure and to provide vacuum-relief in case partial vacuum conditions arise in the shell. The vacuum relief ensures that the tanks will not implode due to low pressure.

5.3.2.3 Vacuum relief valves are also fitted on tanks that normally operate at atmospheric pressure to protect the tank against, for example, the effect of low ambient temperature that may cause a reduced internal pressure.

5.3.3 *Frangible Discs*

Picture 20

5.3.3.1 The IMDG Code requires that tank containers complying with portable tank instructions T5, T10, T12, T14, T16, T18, T19, T20, T22 and T23 (see Annex 5 paragraph A5.1.3) be fitted with a frangible disc (see picture 20) in series underneath the pressure relief valve.

5.3.3.2 Frangible discs are fitted to provide:

- protection to the pressure relief valve from the corrosive effect of the substances and/or their vapours being carried
- a guarantee that toxic vapours will only be released in extreme conditions
- protection to the pressure relief valve from any kind of malfunction caused by the cargo
- additional security for higher hazard cargoes. They may also be used to indicate an increase in the internal pressure within the tank that is still below the pressure setting of the pressure relief valve

5.3.3.3 In addition to the frangible disc a "tell tale" indicator is required to provide a means of monitoring the pressure between the frangible disc and the pressure relief valve.

5.3.3.4 The purpose of the "tell tale" indicator is to detect whether the frangible disc has broken due to excess internal pressure. A typical "tell tale" indicator would be a pressure gauge connected to the void between the frangible disc and the pressure relief valve which indicates current and maximum pressure. Picture 21 shows an example of the "tell tale" pressure indicator and the frangible disc tail (arrowed).

Picture 21

5.3.3.5 **If a change in pressure in the void is recorded the Shipper must be notified immediately**

5.3.4 *Vapour (Airline) Valves*

5.3.4.1 During loading and discharge a means of preventing a build up of pressure or vacuum must be achieved. Such a build up could be prevented by leaving the manway lid open which in itself could be considered as a risk. Therefore a smaller opening can be provided in the vapour space to prevent any such build up. Due to the hazardous nature of some cargoes opening the pressure vessel to the atmosphere would constitute a severe risk. The solution is a closed (vapour recovery) system with more than one valve fitted which allows greater flexibility in load and discharge arrangements.

5.3.4.2 The most common type of airline valve fitted to tank containers is the ball valve (see Picture 22). Picture 23 shows a less common butterfly airline valve. However there are a large number of other valves used such as fire safe, plug valves, quick coupling assemblies, etc. One or more of the valves may be fitted with a pressure gauge. This gauge should not be confused with the pressure gauge associated with, and fitted to, pressure relief valves (see section 5.3.2).

Picture 22

Picture 23

Picture 24

5.3.4.3 Picture 24 shows a cluster of three ball type vapour valves with a small pressure gauge; each is capped with a blanking / closing plate.

5.3.4.4 Vapour valves can vary in size from 1½" (38 mm) to 3" (75 mm).

5.3.5 ***Top Discharge / Outlets***

5.3.5.1 Dangerous cargoes which may only be carried in tank containers complying with portable tank instructions T5, T8, T9, T10, T13, T14 and T19 to T22 can only be discharged from the top. To provide flexibility in use during their service life, many tank containers are built to cater for both means of discharge, often with a bottom outlet and the provision for top discharge; effectively a pad attached to the pressure vessel and a blanking plate. For cargoes requiring top discharge, tank containers fitted with bottom discharge openings must have the bottom outlet valves removed and the openings blanked off by welding inside and out.

5.3.5.2 Conversion of bottom outlet tanks (see section 5.4.1) to top discharge is permitted by the dangerous goods regulations. However, many tank containers intended for the transport of these dangerous goods will be manufactured from the outset without any bottom openings. Often they are "dedicated" to just one dangerous good throughout their service life.

5.3.5.3 Rarely some tank containers may retain both their bottom discharge facility and have top discharge possibilities. This is usually because although the use of bottom discharge tank containers is allowed, customer preference may be to carry out top discharge operations.

5.3.5.4 Outwardly it is difficult to identify containers with top outlet / discharge. The bottom discharge opening, if originally fitted, will be blanked over and a valve will be fitted over the top opening. There may be a sump pot in the bottom of the shell directly under the top outlet but this will only be visible on non insulated tanks.

5.3.5.5 In practice a top outlet assembly consists of at least three valves with blanking plates. One of the valves is located over the top of a "siphon tube" (sometimes called a "dip tube", "dip pipe", "siphon pipe") – see the valve on the left in Picture 24. This is a vertical pipe, typically of 2 inches to 3 inches /40 mm to 75 mm in diameter which extends from the top of the shell

(Picture 25) to close to the bottom (Picture 26). The length is critical for maximum discharge. Therefore they are not interchangeable between different tanks.

Picture 25

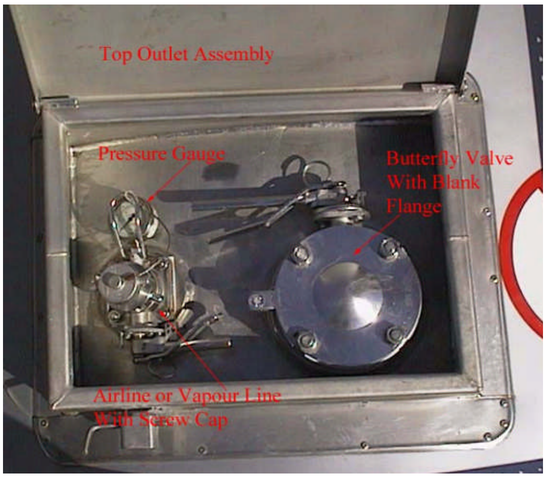
Picture 26

5.3.5.6 In the same area as the valve over the siphon pipe there will usually be at least two other valves – see the two valves to the right in Picture 24. They may have the same diameter or one may be larger than the other. One of these will be intended to be used either for filling with a pipe or hose temporarily bolted onto the flange once the covering plate has been removed or as a vapour return line. The second is intended to be used either as connection for pressure discharge or it, too, may be used as a vapour return line.

5.3.5.7 The siphon tube is usually manufactured from the same material as the shell but can be lined on the internal and external surfaces when the cargo demands this.

5.3.6 ***Spill Boxes***

5.3.6.1 All of the above items can be normally found within the top outlet or manway spill box. These are chambers, sometimes fitted with a hinged lid or lids ("storm door(s)") that retain any spills from the loading / discharge process. Picture 27 shows an example of a top outlet spill box.



Picture 27

5.3.6.2 Each spill box will have one or more drains which will discharge any liquids clear of the tank container pressure vessel, cladding and insulation.

5.3.6.3 Drain tubes are generally surface mounted on newer containers and are usually made of clear, see-through plastic so that any liquid or solidified material can be seen and dealt with. They assist with the drainage of rainwater, melt water from snow and ice and any products spilt in the spill box during loading. On some older designs the drain tubes are covered by the insulation and cladding and cannot be seen. In the case of these tank containers, the outlets are located at the base of the tank. Many false incidents have been reported with these older tank containers said to be leaking when liquid is seen dripping from the drain tubes when all that may be happening is that rain water, condensate or melt water is running off, perhaps when the tank container has moved from an extremely cold climate to a warmer one causing snow and ice to melt.

5.3.6.4 On some tank containers the storm door(s) cover the pressure relief valve. The dangerous goods regulations require the vapour escaping from the relief valve to be discharged unrestrictedly. If the escaping vapour is flammable, there is a further requirement that the vapour must be directed away from the shell in such a manner that it cannot impinge on it (see paragraph 6.7.2.15.1 of the IMDG Code). Tank containers fitted with storm doors which restrict the flow of escaping vapour and, particularly if the doors will direct escaping flammable vapour back down onto the tank shell, should not be accepted for carriage.

5.4 **Fittings (bottom of shell)**

5.4.1 ***Bottom Outlet Assemblies***

5.4.1.1 Bottom outlet assemblies permit the filling but more importantly the discharge of tank containers. The dangerous goods regulations provide for three levels of protection on outlet assembly configuration depending on the nature of the cargo.

5.4.1.2 ***Bottom outlet not allowed***

5.4.1.2.1 Certain cargoes must not be discharged from a bottom valve. These are covered by the portable tank instruction designation T5, T8, T9, T10, T13, T14 and T19 to T22. There should be no bottom outlet arrangement on tanks carrying such cargoes, or where previously fitted, the valve(s) must be removed and the opening in the shell plated over as described in paragraph 5.3.5.1.

5.4.1.3 ***Two serial devices***

5.4.1.3.1 For cargoes with a designation T1, T3 and T6 there must be at least two serially mounted and mutually independent shut off devices fitted within the bottom valve assembly.

5.4.1.3.2 The first closure will often be a valve which closes inside the shell, usually call the “foot valve” (see Picture 29), or an externally closing butterfly valve (see Picture 30). External valves are more usual in the case of tank containers with just two closures. The second closure would then generally be a threaded cap (see Picture 31) or a bolted blank flange.

5.4.1.3.3 However with only three cargo designations permissible with the two serial device valve assembly, the majority of tank containers will be fitted with three serial devices to increase the number of regulated cargoes permitted to be carried.

5.4.1.3.4 The dangerous goods regulations allow for products which easily crystallise or which are viscous to be transported in bottom discharge portable tanks with only two closures. However, competent authority is required when this option is used (see, for example, paragraph 6.7.2.6.2 in the IMDG Code).

5.4.1.4 ***Three serial devices***

5.4.1.4.1 For cargoes with a designation T2, T4, T7, T11, T12, T15 to T18 and T23 there must be at least three serially mounted and mutually independent shut off devices fitted within the bottom valve assembly.

Picture 29

Picture 30

Picture 31

5.4.1.4.2 The first (internal) closure will typically be a foot valve, (Picture 29), followed as closely as possible by a (external) butterfly valve (Picture 30) and finally by a threaded cap or a bolted blank flange (Picture 31). Picture 32 shows the assembly *in-situ* and Picture 33 the full assembly showing the spring loaded foot valve.

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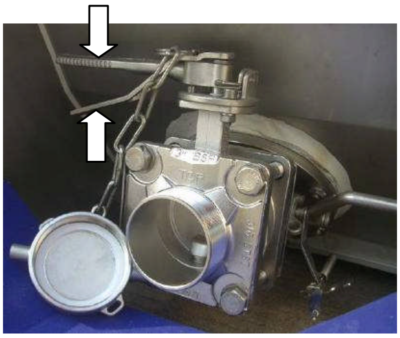
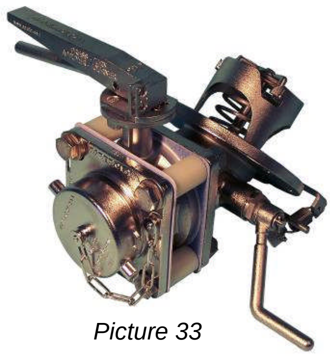


Picture 32



Picture 33

5.4.1.4.3 To operate the valve the threaded cap or blanking plate must be removed and the discharge hose attached. The two parts of the butterfly valve handle are then squeezed together (see Picture 32) and the handle rotated through 90˚ in order to open it. Finally the foot valve is opened by rotating the handle forwards and downwards.

5.4.1.5 **Tank fittings must only be operated by a suitably qualified technician or operator who has in their possession the full details of:**

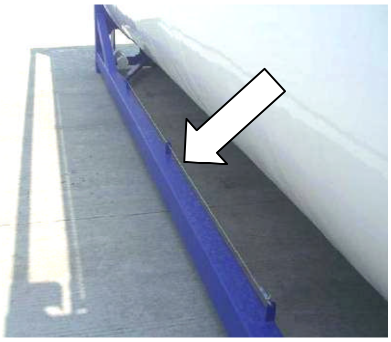
- **the load status of the tank**
- **the cargo**
- **whether the tank is under pressure or not.**

5.4.1.6 When the tank container is being transported all fittings which can be manually closed, must be in their safe closed position and should be closed using a customs or cleaning seal. **Containers in transport found to have any valve in the open position should be stopped and the shipper notified for instructions.**

5.4.1.7 Whilst most liquid tank containers are fitted with a butterfly valve as the external valve, other types may be encountered including ball valves, fire safe, plug valves, gate valves, diaphragm valves etc. Also, whilst the threaded cap or blind flange represent what is fitted to the majority of tank containers intended for liquids other connections/closures may be found such as various proprietary makes of quick couplings or dry-break couplings. They are acceptable alternatives on dangerous goods tank containers if they will totally prevent liquid flow when closed.

5.4.2 *Remote Operating Devices*

5.4.2.1 When three shut of devices are required the first (foot valve) must be fitted with a remote operating device. This device consists of steel cable, often plastic coated stainless steel, or a rod which leads from the foot valve along one side of the container (arrowed in Picture 34). Should there be an incident where the loading / discharge process should be halted, then the steel wire is pulled hard. The action of pulling the wire, or rod, will lift the foot valve operating handle over the cam position snapping the valve closed.



Picture 34

Picture 35

Picture 36

5.4.2.2 Picture 36 shows a second example of a spring loaded grab handle fitted behind the top access ladder that can be used to remotely close the foot valve. Picture 35 shows the connection of the remote operating cable to the foot valve.

5.4.2.3 The international dangerous goods regulations have not always required tank containers to be fitted with a remote closure. It only became compulsory to fit them on tank containers constructed from around 2001 – 2002 onwards, i.e. second generation UN portable tanks. There may be first generation tank containers constructed in the last century still in service without remote closures. There is no requirement in the international regulations for these older tank containers to be retro-fitted with them.

5.4.3 ***Fusible Links***

5.4.3.1 On closer examination Picture 35 shows two cables attached to the foot valve remote operating mechanism. The second cable is attached to a fusible link; these are usually fitted directly behind the bottom discharge valve assembly.

Picture 37

5.4.3.2 This link is designed to break should it be subjected to the higher temperatures associated with a fire. The link, arrowed in Picture 37, will break and the spring will then pull the foot valve remote operating mechanism closing the valve.

5.4.3.3 Fusible links are generally fitted to tank containers carrying certain flammable liquids into the US. However many tank containers are built without this provision. The absence of the spring and link does not constitute a hazard to the operator.

5.4.4 ***Discretionary Fittings***

5.4.4.1 A large number of fittings may be fitted in addition to the mandatory fittings. These include level indicators, low level alarms, high level alarms, electric operating systems, hydraulic operating systems, pneumatic operating systems, etc. The dangerous goods regulations prohibit the use of “sight glasses” as a means of checking the level of liquids inside shells (see, for example, 6.7.2.16.1 of the IMDG Code.

5.4.4.2 Some tank containers may be fitted with “dip sticks”, a metal stick with marking on it to measure the quantity of liquid in the shell these are only likely to be seen on old tanks as they are not often fitted to more recently build tank containers. Others may have an “ullage bar”, a detachable T-shaped piece of metal, held in place under the manway lid or in the spill box. Most modern tank containers have neither device. However, they may have a “calibration chart” fixed near the manway on which a table is given converting depth of liquid to number of litres of cargo.

5.5 ***Fittings on T50 pressurised Liquefied Gas Tanks***

5.5.1 The regulations are more complex with regards to liquefied gas tanks in that the working pressure is dependent upon any insulation that is provided. The tanks are designated as bare, sunshielded or insulated.

5.5.2 ***Liquid and Vapour Load / Discharge Assemblies***

5.5.2.1 Liquefied gases by their very nature have to be loaded and discharged using different methods than liquids. Unlike liquid tanks, where either a top or a bottom valve assembly is specified, the liquefied tanks will have two such assemblies, both of which must consist of three serially mounted and mutually independent shut off devices. They should be used both for loading and discharging purposes.

5.5.2.2 One of the valve assemblies will be for the liquid phase of the cargo and the other for the vapour phase and it is a mandatory requirement that each is marked accordingly. In order to ensure that the separate elements of the cargo are discharged separately and correctly the liquid and vapour assemblies will be a different size.

5.5.2.3 The dangerous goods regulations allow two different types of first, internal closing valve, a stop valve for example in the form of a foot valve or "an excess flow valve". This kind of valve is more commonly used on tanks intended for the transport of gases liquefied by overpressure.

5.5.2.4 On most T50 tank containers, the two valve assemblies are located at one side of the frame just above the bottom longitudinal rail or a similar position on beam tanks (see 3.1.4). On some T50 tank containers the two valve assemblies may be located in a recess at the mid point of the rear end. This is usually protected by a door (see Picture 38)

Picture 38

Some liquefied gas cargoes, such as chlorine, are not permitted to be discharged from a bottom opening. In these cases all openings into the tank must be above the liquid level.

5.5.3 ***Manways***

5.5.3.1 The manway for liquefied gas tanks will generally be a bolted design, but unlike the standard liquid tanks it may be located in the head (end) of the container or in the top

5.5.4 ***Sun Shields***

5.5.4.1 Sun shields are fitted to tank containers carrying liquefied gas (T50). They are one of the designs approved for carrying this type cargo. Bare tanks are rare due to the significant increase in the required maximum allowable working pressure which makes them uneconomic to produce.

5.5.4.2 Sunshield tanks (Picture 39) are the most popular. They are relatively inexpensive to produce and the tare weight is less than that of the higher pressure un-insulated tanks.

Picture 39

5.5.5 ***Pressure Relief Devices***

5.5.5.1 T50 tank containers are fitted with pressure relief devices, usually pressure relief valves, just like tanks for liquids. They have to be situated in the same place, i.e. as close to the lateral and longitudinal centre of the top of the shell. They are often taller than the pressure relief valves fitted to liquids tanks. This is to ensure they open sufficiently to allow sufficient vapour to escape.

5.5.5.2 Some tank containers such as those for toxic liquids will have to be fitted with a bursting disc in series with the relief valve, just like liquid tanks. They have to be fitted with a tell tale pressure gauge which, just like liquid tanks must be monitored and reported to the shipper if it is showing that the frangible disc has ruptured.

5.5.6 *Non-mandatory Fittings on T50 Tanks*

5.5.6.1 Some T50 tank containers may be fitted with devices for measuring filling levels. Often these will be fitted in a recess similar to that described in section 5.3.6 in the rear end of the shell.

5.5.7 **Tank fittings must only be operated by a suitably qualified technician or operator who has in their possession the full details of:**

- the load status of the tank
- the cargo
- whether the tank is under pressure or not

5.6 Fittings on T75 Deeply Refrigerated Liquefied Gas Tanks

5.6.1 *Liquid and Vapour Load / Discharge Assemblies*

5.6.1.1 The loading and discharging assemblies on tanks intended for the transport of T75 deeply refrigerated liquefied gases are, by far, the most complex. Any number of valves and pieces of pipework that are usually found along one side of these tank containers may be found within one or more compartments. For each compartment there will be a connection for the liquefied gas to enter or leave the tank as well as for the vapour. These will have three closures as with the tanks for liquids and pressure liquefied gases. However they will be very different to the three closures on the other kinds of tank. This is due to the nature of the substances carried and the design of the tanks which, as noted above in paragraph 4.4.2, usually have a steel outer vacuum jacket surrounding the actual shell. In place of the foot valve fitted to liquid tanks, there are usually two *external* valves. The inner valve is usually pneumatically operated. It requires a source of pressure to be attached to it to open and hold it open.

5.6.2 *Controls for Filling Levels*

5.6.2.1 Additional valves may be fitted to control filling levels. It is commonplace for these tanks to be fitted with internal vertical pipes rising from the floor nearly to the top. Each one will be marked with the name of the gas for which it gives the maximum filling level. Once the shell has been filled to the required mass, for example so as not to exceed the maximum permitted weight of its CSC approval, liquefied gas overflows. There will be valves and associated pipework to control this process

5.6.2.2 These tanks are also usually fitted with flow gauges, usually circular, by which the filling level may be determined.

5.6.3 *Pressure Raising Coils*

5.6.3.1 Some of these tank containers can self-discharge. This is achieved by diverting some of the liquefied gas into a pressure raising coil to turn it into gas and thereby raising pressure. This source of pressure is piped to the top of the shell to push out the remaining liquefied gas. Tanks containers with this possibility usually have a visible pressure coil, perhaps underneath or on the opposite side to the valve compartments.

5.6.4 *Cryogenic Pumps*

5.6.4.1 Some of these tank containers will be fitted with their own pumps located in the compartments on the side. These pumps have to be cooled down to the temperature of the liquefied gas inside the shell before they can be used. There will be associated pipework and valves on such tanks for the purpose of cooling the pumps down and for diverting the liquefied gas flow through the pump itself.

5.6.5 *Pressure Bleed Valves*

5.6.5.1 Tank containers are built to a given pressure rating which is linked to its "holding time" (see Annex 1 Definitions). Although every precaution possible is taken to reduce the ingress of ambient heat into the tank shell, some heating from ambient sources will occur leading to boiling of a small amount of the liquid and consequential pressure rise (which should be well within the capacity of the shell to withstand). Most T75 tank containers are fitted with a special automatic bleed valve to allow this low level pressure to drain away during transport. It may be switched on and off manually. When switched off, this minor rise in pressure is not automatically drained off. The latest edition of the IMDG Code in force at the time of preparation of this pamphlet does not contain any restriction concerning leaving the valve in an operational condition though it is possible to interpret paragraph 7.1.8.1.3 of the IMDG Code to mean that this valve should be closed when T75 tank containers are carried on board sea-going vessels.

5.6.6 *Vacuum Connection*

5.6.6.1 There will be a connection on the outer surface of the vacuum jacket to which gauges may be temporarily attached to measure the vacuum level and/or to attach a pump to draw a near perfect vacuum between the jacket and the shell. The location of this connection will varies from design to design.

5.6.7 *Formation of Ice on Fittings and Pipework*

5.6.7.1 It is possible for ice to form on fittings and pipework on T75 tank containers even in the hottest and most arid of conditions. The formation of ice in this way is not necessarily an indication that the tank container is leaking. The ice is formed from water vapour in the air condensing on the pipework, etc.

5.7 Fixtures

5.7.1 *Walkways*

5.7.1.1 A light weight walkway usually constructed of perforated aluminium plate is often fitted on top of tank containers. It can be held in place by connections to one or both of the top side rails or to brackets attached to the end frame and pressure vessel.

5.7.1.2 Where the tank container is fitted with a walkway or access platform on top of the tank container. It should be of adequate dimensions in a single plane and with no tripping hazards and constructed of a non slip surface material allowing suitable drainage.

5.7.1.3 ITCO recommends that it should be at least 460mm wide with slope less than 10° and be positioned to give safe access to the manway lid and sampling areas. Those tank containers that have a small diameter shell and require step down to access such areas should also have adequate flooring at the lower level.

Note: The walkway and supporting structure, including top side rails, are lightweight and only designed to support two persons. Over crowding the walkway or excessive loading can result in it failing with a severe risk of personnel falling.

5.7.2 ***Access Ladders***

5.7.2.1 The tank containers shown in this pamphlet generally have an access ladder built into the end frame as shown in Picture 40 and Picture 41. It should be remembered that the ladder should only be used when suitable steps or an access platform adjacent to the tank container is not available. See section 13.

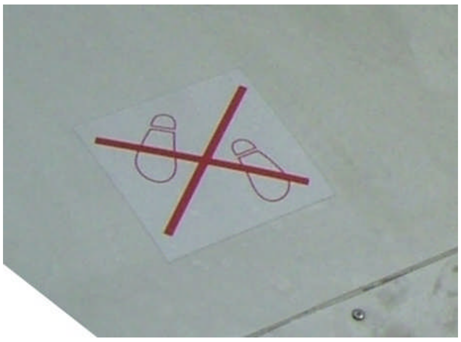
Picture 40

Picture 41

5.7.3 ***Insulation***

5.7.3.1 Insulated tank containers will generally be enclosed in a preformed insulation material or wrapped in insulation matting. Both types of insulation will be then covered with either a GPR, stainless steel or an aluminium cladding jacket.

Note: The cladding / insulation material is not designed to withstand a person standing on it. Picture 42 is an example of the warning signs typically fitted. Standing on the cladding may damage it and there is a risk of falling.



Picture 42

5.7.4 ***Heating and Cooling***

5.7.4.1 The majority of insulated tank containers will have some form of heating capability. The principle means of applying the heat is by steam, hot water or hot glycol being piped through heating coils welded directly onto the exterior of the barrel. Inlet and outlet connections should be clearly marked (see Picture 43).

Picture 43

5.7.4.2 Hot water/hot glycol heating systems have a covered trough filled with the appropriate liquid. An electrical heating coil is immersed in the trough and a thermostat switches on an electric pump to circulate the heated liquid through the steam coil. Some tanks have a separate coil for the heated liquid. Glycol is often preferred because for example it has a lower freezing temperature than water.

5.7.4.3 Another means of applying heat is by electrical heating coils attached to the exterior of the barrel. There are a number of proprietary systems fitted to tank containers so the operating instructions for the system concerned must be followed. In principle, at least two thermostats are provided on these systems, one of which registers the temperature of the heating coil and one of which registers the temperature of the cargo.

5.7.4.4 All means of heating will be enclosed by the insulation and cladding.

Note: The operation of heating systems of tank containers, including connection and disconnection, repairs or maintenance, should **only** be undertaken by trained personnel.

5.7.5 *Earthing Connections*

5.7.5.1 It is recommended that vehicles used to transport tank containers laden with substances which could generate static electricity provide good electrical continuity from the tank shell to the vehicle and then to ground.

5.7.5.2 All tank containers approved for the transport of liquids meeting the flashpoint criteria of Class 3 (flammable liquids with a flashpoint temperature of 60^{o}C or below including any subsidiary danger of this kind and substances transported hot, at or above their flashpoint temperature), i.e. cargoes that are likely to be susceptible to ignition from static electricity, must be capable of being electrically earthed. This also applies to tank containers approved for the transport of flammable gases, whether pressurised, liquefied or deeply refrigerated liquefied flammable gases.

5.7.5.3 Further, during loading, transport, cleaning and similar operations, measures should be taken to prevent electrostatic discharges. Picture 43 shows the earthing connection that should be connected to a suitable ground point during all loading and discharge operations.

6 Tank Container Safety

6.1 General

6.1.1 ISO tank containers built to ISO 1496 / 3 and swap tanks built to CEN 1432 and complying fully with the IMDG Code are inherently safe - there have been very few recorded examples where the pressure vessel has been damaged sufficiently to permit a serious leak.

6.1.2 Tank containers shall not be offered for transport:

- if containing liquids having a viscosity less than 2,680 mm^2/s at 20˚C or at the maximum temperature of the substance during transport in the case of a heated substance, with a degree of filling of **more than 20% but less than 80%** unless the shells of portable tanks are divided into sections of not more than 7,500 litre capacity by partitions or surge plates; (see also Annex 2 section A2.2.
- with residue of substances previously transported adhering to the outside of the shell or service equipment;
- when leaking or damaged to such an extent that the integrity of the portable tank or its lifting or securing arrangements may be affected; and
- unless the service equipment has been examined and found to be in good working order. For certain dangerous substances, a lower degree of filling may be required.

6.1.3 Tank containers shall not be filled or discharged while they remain on board a ship.

6.2 Design

6.2.1 Swap tanks may have thinner wall thickness than is required for the transport of dangerous goods by sea. Shipping lines may be approached to ship laden new swap tanks from non-European ports. So long as the cargo carried is classified as non-regulated or the shell wall thickness complies with the IMDG Code requirements then the swap tank may be shipped. See also sections 6.1.2 and 12.3.

6.2.2 Designers of tank containers and legislators concerned with the carriage of hazardous substances recognise that there is a need for fail safe features built into any opening in the pressure vessel. These features are described below:

6.2.3 *Manways*

6.2.3.1 The number of swing bolts or flange bolts varies from type to type and the pressure rating of the tank. However, when they are fully tightened they must form a pressure tight seal that is at least as high as the test pressure of the tank

Note**:** Failure to tighten the swing or flange bolts correctly can result in the cargo leaking if the tank container is overturned.

6.2.3.2 The manway is protected from swipe damage by the spill box where one is fitted.

6.2.4 ***Pressure Relief Valves***

6.2.4.1 Pressure (or combined pressure / vacuum valves) provide safety against over or under pressurisation conditions in the tank shells. Where the container is carrying certain specified dangerous goods the pressure relief valve is fitted with a secondary security feature, the frangible disc, which prevents an accidental release of the cargo's vapour.

6.2.4.2 The degree of filling requirements (see Annex 2 section A2.2) ensures that there is always a vapour space at the top of the pressure vessel so that the pressure relief valve is exposed to the vapour only.

6.2.4.3 The pressure relief valve is protected from swipe damage by the spill box where fitted.

6.2.5 ***Airline Valves***

6.2.5.1 When not in use airline valves are blanked or capped off to prevent accidental operation of the valve.

6.2.5.2 The airline valve is protected from swipe damage by the spill box where fitted.

6.2.6 ***Top Discharge Openings / Valves***

6.2.6.1 When not in use top discharge openings and valves are blanked off to prevent accidental operation of the valve.

6.2.6.2 The top discharge fittings are protected from swipe damage by the spill box where fitted.

6.2.7 ***Bottom Discharge Valves***

6.2.7.1 The bottom discharge valve comprises of two or more separate and serial closure methods as described in section 5.4.1. All pressure vessels are fitted with an internal foot valve that can retain the contents of the pressure vessel without any additional closure. External valve devices, such as the ball or butterfly valves which provide the secondary closure device, are attached to the pressure vessel using fittings that are designed to fail without damaging the pressure vessel.

6.2.7.2 It is of great importance that containers carrying hazardous cargoes are fitted with the correct bottom discharge valve combinations. The internal foot valve must be fitted and closed during transport otherwise damage to the external valves can result in the cargo being accidentally discharged. Picture 44 shows an example where the internal valve should retain the cargo following the shear section breaking.

Picture 44

Note: Should a shear force be applied to the bottom discharge assembly there is a risk that a small quantity of the cargo may be released. Therefore when handling tank containers every effort should be made to ensure that the tank container is landed on level surface free from objects that are likely to damage the bottom valve assembly.

6.2.7.3 It is also important that all fittings, especially discharge valves, should not protrude outside of the envelope formed by the outer faces of the corner fittings. Picture 45 shows a bottom discharge valve that has the end of the valve protruding outside of the end frame. There is a severe risk of the valve being damaged and some of the cargo being released. **Such containers should not be shipped.**

Picture 45

6.2.7.4 On large capacity tank containers, the outlet valve handle often protrudes outside the end frame when open. It is most important that outlet valves on tank containers where this can happen are closed before the tank is handled and transported. Serious damage to outlet assemblies and even tank shells may occur if handles protruding beyond the frame are struck, for example by another container being placed next to it.

6.2.8 *Tank Frames*

6.2.8.1 The design of tank frames are such that the in the event of a catastrophic failure of the frame as a result of the container being knocked off a stack or the tank container being involved in a roll-over accident, the pressure vessel will remain intact as shown in Picture 46

Picture 46

6.3 Operational Safety

6.3.1 **Under no circumstances should lifting of tank containers by fork lift truck be attempted. The only exception to this may be in the case of, for example, off-shore 10 foot tank containers fitted with properly designed and maintained fork lift pockets.**

6.3.2 Many of the fittings and fixtures attached to the tank container can protrude outside of the ISO envelope when they are open or erected such as:

- Leaving temporarily fitted steam traps on the outlet pipes of steam coils
- Wrapping electric cables of heating systems around corner posts in stead of placing these in the proper holder or tray
- Leaving temporary adaptors on airline connections
- Not closing manway lids full after use
- Not closing top outlet valve handles
- Not closing airline valves on top of tanks
- Waterlogged insulation material causing it to sag and/or bulge outside the allowable external dimensions
- Collapsible handrails not properly stowed away

Note: **Where any item protrudes outside of the envelope the tank container must not be shipped**

6.3.2.1 As stated in paragraph 5.3.6 spill boxes are fitted with a drain tube to allow waste material to be drained. However it is important to note that liquids escaping from these tubes are not always dangerous. There have been a large number of false alarms raised because operators erroneously believed that the tank container was leaking. However on closer examination the liquid was found to be melt or rain water.

6.3.3 *Cryogenic Tanks*

6.3.3.1 Cryogenic tanks do not have any refrigeration equipment but rely on the vacuum insulation to reduce heat gain and retain the gaseous cargo in a liquefied state. All such tanks have a maximum “holding time”, a maximum time from filling before heat gain from ambient sources causes a pressure rise sufficient to open the pressure relief valves. The “holding time” will vary from tank to tank and should be made know to handlers and vessel operators as exceeding the holding time can be dangerous.

6.3.4 *Tank Container Heating*

6.3.4.1 If steam heating is being undertaken, it is essential that suitable precautions are taken to prevent anyone being scalded.

- Each steam coil is designed to a specific maximum pressure.
- Pressure should never be introduced into a steam coil in excess of its maximum pressure rating as there will be a risk of frangible the steam coil and even causing serious damage to the tank shell.

6.3.4.2 Electrically heater tank containers do not have their own power source so that a power cable has to be plugged into an external power source.

- Most tank containers have a power cable but there is no standard length for the cable.
- It may be that extension cables have to be supplied to reach the power point. Care must be taken that these are in good condition and of the appropriate power rating.
- Most electrical systems are designed for operation from a 380 Volt three phase supply, usually 32 amps. It is important to ensure that only the correct voltage and amperage power source is used.
- Only the correct plug and socket should be used.

7 Documentation

7.1 When goods are offered for transport, shippers have to prepare documentation suitable for the modes of transport and the type of the cargo. The form of these documents, the particulars to be entered on them and the obligations they entail may be fixed by international and national conventions, legislation, regulations and rules which apply to the different modes of transport.

7.2 As it would be impossible for this pamphlet to cover all these requirements individuals should make themselves aware of their local legislation, statutory instruments and regulations.

7.3 Documentation does not preclude the use of electronic data processing (EDP) and electronic data interchange (EDI) transmission techniques as an aid to, or in some cases in lieu of, paper documentation.

7.4 The examples shown in Annex 4 are intended to provide guidance of the detail required.

8 Marking

8.1 Mandatory

8.1.1 ISO 6346 details the mandatory markings required for tank containers. Reference is drawn to the ICHCA International Safety Briefing Pamphlet 25 – “*An Illustrated Guide to Container Size and Type Codes*”.

8.1.2 Under ISO 6346 all tank containers that are international intermodal loading units must carry:

- a four capital letter code consisting of a three letter owner identification code and an equipment identifier “U”.
- a serial number consisting of six Arabic numerals
- a check digit
- a size / type code. This is 22T6 for the majority of all 20 ft tank containers
- the maximum gross and tare masses measured in kg and lb.
- a warning of overhead electrical danger.

Note: The size/type code 22T6 relates to an ISO classification and does not correlate to the “T” codes set out in the IMDG Code.

8.1.3 Under the Convention for Safe Containers, all tank containers that are international intermodal loading units must carry a Safety Approval Plate with at least:

- an approval reference,
- the date of manufacture,
- a manufacturer’s identification number,
- maximum operation gross mass,
- allowable stacking weight for 1.8g
- transverse racking test load value
- the next examination date or Approved Continuous Examination Programme reference number

8.1.4 Under the Customs Convention for Containers, all tank containers that are international intermodal loading units must carry:

- a means to identify the owner and their address, this may be an address plate or decal or the three letter owner identification code registered with BIC
- a customs approval number

8.1.5 All international regulations require tank containers intended to carry dangerous goods to be inspected and tested at prescribed intervals. It is good practice for all tank container shells that are designed to carry pressurised cargoes to be similarly inspected and tested. All tank containers must carry:

- the date of the initial hydraulic test
- the date of each 2½ yearly intermediate inspection and test

- the date of each 5 yearly inspection and test.

8.1.6 Under the IMDG Code, all tank containers must carry:

- the Proper Shipping Name (PSN) of the contents which shall be marked on at least both sides of the tank container (see Annex 3)
- any placards associated with the class of cargo carried
- the UN number for the cargo carried (for example see Figure 1)

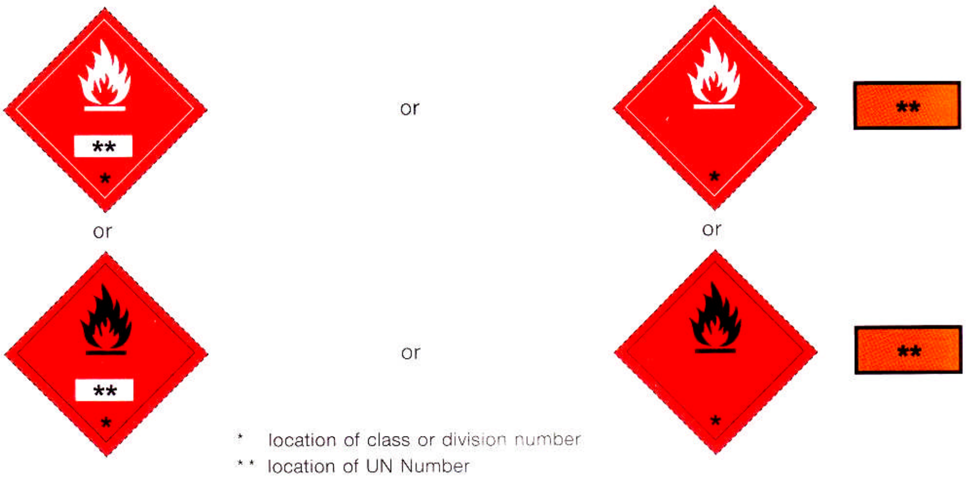


Figure 1

- an Environmentally Hazardous Substances (Aquatic Environment) mark if appropriate (see Figure 2). For maritime transport these substances are known as Marine Pollutants and subject to the provisions of Annex III of MARPOL 73/78. The mark shown in Figure 2 is a recent addition to the IMDG Code

Figure 2

- Previously the Marine Pollutant mark shown in Figure 3 was used to signal that the tank container was carrying such a cargo. This mark may be used until December 31st 2009.

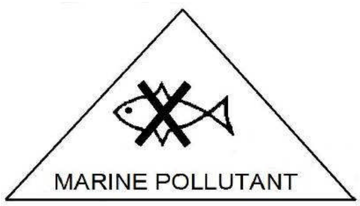


Figure 3

8.1.6.1 Tank containers containing a substance that is transported in a liquid state at a temperature equal to or exceeding 100ºC or in a solid state at a temperature equal to or exceeding 240ºC shall bear on each side and on each end the mark shown in Figure 4.

8.1.6.2 In addition to the elevated temperature mark, the maximum temperature of the substance expected to be reached during transport shall be durably marked on both sides of the tank container, immediately adjacent to the elevated temperature mark, in characters at least 100 mm high.

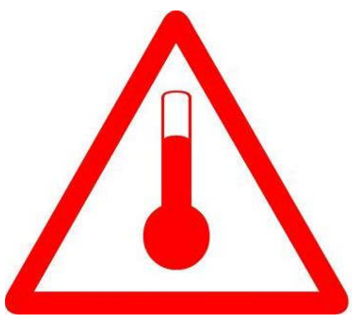


Figure 4

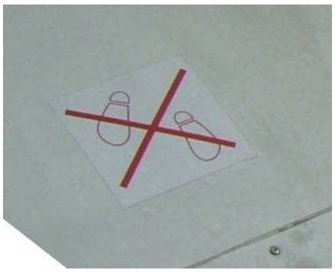
8.1.6.3 Under UIC, all tank containers that have a maximum gross mass equal to or greater than 34,000 kg must carry a super heavy decal (see Picture 47)

Picture 47

8.2 **Optional**

8.2.1 Calibration chart – a chart to provide guidance on the volume of cargo based on a dip stick measurement

8.2.2 Do not walk decal – insulated containers may have a decal similar to that shown in Picture 48 affixed to ensure that the insulation cladding is not stepped on. Stepping on it may be a slip hazard and damage the insulation material.



Picture 48 *Picture 49* *Picture 50*

8.2.3 Do not use fork truck decal. Picture 49 shows an example of the designs used.

8.2.4 Food Grade Cargo decal. Picture 50 shows a typical mark used. The rectangle below is used to enclose the name of the food stuff being carried.

8.3 **Placards, Marks and Labels**

8.3.1 There are specifications and minimum dimensions specified for the placards. They must match the designs and colours shown in Chapter 5.2 of the IMDG Code. Placards must be “diamond” shaped i.e. in the shape of a square set at 45^{o}. Each side must be at least 250mm long. There must be a line alongside the edge of each placard inset by *exactly* 12.5 mm. The class number of the hazard must be shown in the lower corner. The digits forming this number must be at least 25 mm high

Note 1: In most cases, where the class has a division number, for example 6.1, it is not required to show the division number in the lower corner. However, the display of this detail **is** mandatory when oxidisers of Class 5.1 and organic peroxides of Class 5.2 are carried

Note 2: **If a tank container is known to carry dangerous goods and does not display the class placard on the front, rear and each side, the tank container must not be accepted for transport**.

8.3.2 All the dangerous goods regulations require the marks and placards to be affixed to tank containers in such a way as to be legible and durable. All marks and placards are required to be affixed in such a way as to remain legible for up to three months in the sea.

Note: Tank containers with placards not completely adhering to the container (for example, corners which are lifting up) or with air bubbles trapped under them (and therefore not durably marked) under them should not be accepted for transport.

9 Cargoes Carried

9.1 Tank containers are used for the transportation of bulk liquids, liquefied gases, deeply refrigerated (cryogenic) gases, powders and granules. Generally the type of product will dictate the design of the tank container. However within each tank group type the products may be regulated as hazardous goods or non-regulated. Cargoes can be further designated as food grade (hazardous and non-regulated), kosher, and drug regulated, etc.

Note: Cargo handlers should be aware that some cargoes carried in tank containers can have a high specific gravity and thus even a small volume tank may carry a very heavy cargo.

9.2 Dangerous Goods

9.2.1 Tank containers can carry a variety of dangerous goods, and where the tank container is made up of two or more compartments, the tank container may carry more than one compatible dangerous good.

9.2.2 See Annex 5 for reference to dangerous goods.

9.2.3 All dangerous goods shall be referred to by their Proper Shipping Name (see Annex 3)

9.3 Non Regulated Goods

9.3.1 For the purposes of this pamphlet, non regulated goods refer to all of those products not covered by the IMDG Code, but that does not mean that some of them are not hazardous. Modes of transport other than by sea may have different designations.

9.3.2 Examples of non regulated, non food goods that are typically transported in tank containers are:

- latex
- linseed oil
- drilling mud
- emulsions
- detergents

9.3.3 Examples of non regulated food goods that are typically transported in tank containers:

- vegetable and other edible oils
- wine
- fruit juices (chilled and refrigerated)

9.3.4 Beer Tanks

One particular non regulated food grade commodity is beer. This has special requirements.

9.3.4.1 Firstly all tanks built for the carriage of beer are generally built with inert gas lines (usually CO_2) and a system for thoroughly cleaning the interior of the shell known as a “clean in place” (CIP) system.

9.3.4.2 Access to the pressure vessel is through a special elliptical manway lid which has an “In / Out” construction. This means that to remove the lid, it must be released, pushed into the pressure vessel and then pulled out by re-orientating the lid through 90˚. The manway is usually mounted in the head (end) of the tank.

9.3.4.3 The valves and fittings differ from type to type. Individual breweries have differing standards and it would not be possible to cover all versions within the scope of this pamphlet.

Note 1: Although beer tanks do not count as dangerous goods tanks they are always under pressure; the gas causing the pressure, usually CO_2, is an asphyxiant and could cause death through inhalation in confined spaces if released.

Note 2: Sometimes the ullage space of tank containers may be filled with a “nitrogen blanket”. This may happen with tank containers used for the transport of dangerous goods and non-dangerous cargoes. Whilst the pressure of this gas is too low to cause it to be considered as a dangerous good, the presence of such gases in the ullage space or in empty, unclean tank containers, may produce an asphyxiation danger.

9.4 Non regulated cargoes would not normally require the tank container to be marked with any decal or placard to indicate the cargo carried.

10 Lifting and Carrying

10.1 Basic issues

10.1.1 See International Safety Panel Briefing Pamphlet No. 5 Container Terminal Safety for more information on lifting and carrying in terminals

10.1.2 For the purposes of lifting and carrying, tank containers should be considered to be the same as other container types and all the general issues of safe handling apply. Those issues are not the subject of this pamphlet , however, it does concentrates on the specific aspects that relate to tank containers.

10.1.3 In some types of operation it may be an acceptable practice to insert semi automatic twistlocks (SATLs) into the bottom corner fittings to stack containers safely, please refer to 11.6

10.1.4 However, this method of work creates an interface between mobile equipment and pedestrians and requires great care to preclude pedestrian – machine collisions where there is an inherent risk of serious or fatal injuries to personnel on foot

10.2 General

10.2.1 A risk assessment using a hierarchy of controls as advised by the safety management should be undertaken by each terminal to determine the safest way to handle, carry and stack tank containers.

10.2.2 Arising from that assessment, the terminal should produce written procedures for receiving and identifying tank containers and how to handle them safely. Such procedures should include ensuring that container handlers are provided with all relevant information, instructions and training for handling the various types of containers.

10.2.3 Training should be based upon the risk assessment and include alertness on the part of the drivers of lifting and carrying equipment in regard to the risks.

10.2.4 All equipment used must be serviceable, having inspections and tests as required and must be suitable for the task.

10.2.5 Empty tank containers that last contained dangerous goods and have not been cleaned must be declared as EMPTY UNCLEANED or RESIDUE LAST CONTAINED under the provisions of the IMDG Code.

10.2.6 All empty tanks must be treated as still carrying the last cargo unless a valid cleaning certificate is available.

10.3 Handling Tank Containers fitted with Compartments

10.3.1 Tank containers built with two or more discrete compartments may present a number of loading and handling issues:

- The manways to each compartment may not be easily seen, or be obscured by the insulation and walkway, so container handlers may not be aware that the tank container has more than one compartment.
- Each compartment is capable of carrying a different cargo, each of which may have a different mass which may affect the centre of gravity of the tank container(see also Annex 2 section A2.1).
- Where the tank container is carrying more than one dangerous good then the shipper must ensure that each are compatible and may be carried in the same tank container (although in different compartments).

10.3.2 When loading a tank container with two or more compartments, the shipper should ensure:

- that each compartment is filled in line with the filling requirements (see Annex 2 section A2.2) especially if the capacity of the compartment is greater than 7,500 litres.
- that the cargo is loaded so that the tank container is balanced;
- that where more than one dangerous good is being shipped, that each dangerous goods has all appropriate marks and / or placards at each end and on each side adjacent to the compartment carry the particular dangerous goods.

10.3.3 Balance can be achieved by:

- loading an equal mass of each cargo into all the compartments so long as the filling requirements are maintained.
- counterbalancing a single cargo with water (in a two compartment tank container)
- loading a single cargo into the central compartment where there are three compartments

- loading two cargoes into the end compartments where there are three compartments.

10.3.4 If the tank container cannot be balanced, then the heavier end must be placed over the axles of a chassis / trailer when it is moved by road.

10.3.5 In all cases, the Dangerous Goods Note or Non Regulated Goods Note (see Annex 4 Section 4.2) should clearly indicate the contents and mass of any cargo loaded into each of the compartments.

10.4 **Lifting and Carrying Appliances**

10.4.1 Generally, most items of lifting and carrying equipment used in ports can safely handle tank containers in the same way as other freight containers, i.e. by lifting from the top corner fittings via twistlocks in a lifting frame attached to a lifting appliance, and stacking corner fitting to corner fitting.

10.4.2 However, the lifting, carrying and stacking activities should comply with the procedures specified after a general risk assessment has been undertaken.

10.4.3 There is a general need for drivers to be aware of the special nature of tank containers, the free surface effect when making turns and when coming to abrupt stops. The possible issues are detailed in Annex 2 section A2.4 Free Surface Effect.

10.4.4 The safe lifting, carrying and stacking of tank containers is of the utmost importance and is dependent on the appropriate risk assessment, the operational procedures in place and the skill, ability and attitude of the driver. In the unlikely event of hazardous substances leaking from the pressure vessel operators / drivers should immediately vacate the area and alert the appropriate emergency services.

10.4.5 Tank containers are required by law to comply with the regulations pertaining to the product carried. The level of construction is strictly regulated and the risk of a leak of hazardous substances from a tank container is far less than that from a dry freight container containing drums or packages of hazardous material.

10.4.6 When handling tank containers operators should be aware of the following exceptions:

- Tank containers are not fitted with fork lift pockets and lifting or transporting them using the tines of fork trucks is **prohibited**.
- End frame attachments should not be used to lift/carry tank containers
- ISO 3874 prohibits the use of side frames for all loaded tank containers.
- Tank containers may be lifted by slings but the lifting equipment should be of such design that there is a vertical force at the corner fittings, i.e. a chandelier spreader should be used.
- Angled slings may be used when attached to the **bottom** corner fittings only.

10.4.7 Care should be taken when attaching manually operated spreaders used in a ship's gear operation using a spring arm and chain system to lock/unlock could become snagged on the top of the tanks

10.5 Internal Movement Vehicles

10.5.1 Only trailers fit for this purpose should be used to transport tank containers around the terminal.

10.5.2 If using corner less trailers where the design of the container is such that the bottom side rail cannot be fully supported, i.e. for tank containers with a raised side beam, the tank container should only be carried on such trailers where they have been specially adapted to ensure the safety of operators and handlers.

10.5.3 Two tank containers may be loaded on suitable trailers, including the corner less types, provided they do not contain incompatible dangerous goods

11 Stacking Ashore

11.1 See International Safety Panel Briefing Pamphlet No. 5 Container Terminal Safety for more information on stacking and layouts

11.2 All handling locations should have procedures which should include a risk assessment for receiving and identifying special containers such as tank containers. The procedures should include special stacking requirements and cover segregation of incompatible goods.

11.2.1 The general segregation principles concerning dangerous goods in the IMDG Code apply equally to tank containers as to all other containers carrying dangerous goods and should be followed

11.2.2 Containers carrying dangerous goods should not be placed at the end of rows where they can be exposed to inter-sectional traffic.

11.3 There are two important messages associated with stacking tank containers:

- Not all containers have the same stacking capability as required by ISO 1496/3, and
- All containers must be stacked corner fitting to corner fitting.

11.4 The Dangerous or Non Regulated Goods Notes (see Annex 4 Figure A4.2 and A4.3) should be supplied with the Maximum Superimposed Load shown in box 18c. This value equates to the maximum load that can be placed on top of the container – often referred to as the stacking capability. For ISO tank containers the value will be at least 192,000 kg (see section 12.2).

11.5 When developing stacking plans within the risk assessment consideration should be given to the following:

- Ground surface
- Surroundings
- Segregation
- Stack height
- Visibility
- Accessibility
- Stability
- Local weather conditions
- Handling equipment
- Human factors

11.5.1 Tank containers carrying dangerous goods should be positioned so that they can be clearly seen, protected and removed for isolation should an incident occur which may place persons in danger.

11.5.2 Tank containers should never be placed on rough or stony ground; care must be taken such that contact by the full bottom surfaces of the four bottom corner fittings is all that is possible. If this is not done, it is possible, for example, for the container to rest on the bottom outlet valves thereby risking leakage.

11.5.3 Tank containers, for similar reasons should never be placed astride (out of use) rail tracks.

11.5.4 When handling tank containers every effort should be made to ensure that the tank container is landed on level surface free from objects that are likely to damage the bottom valve assembly.

11.6 The ILO Code of Practice on Safety and Health in Ports states in paragraph 6.3.2 10

> "*Wherever practicable tank containers should only be stacked one high. When it is necessary to stack tank containers more than one high it is recommended that stacking cones be used in view of the differences of tank container frame designs. Tank containers carrying highly volatile substances should not be stacked over the pressure relief valves of highly volatile flammable substances*."

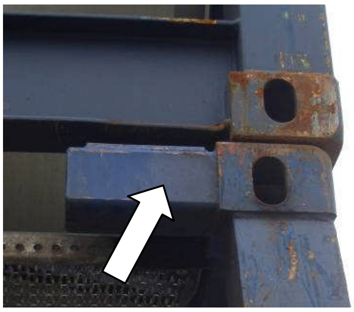
11.7 Tank containers may be stacked higher if adequate precautions are taken to prevent falling from the stack. This would be determined by carrying out a risk assessment of the area and the securing equipment to be used.

11.7.1 The design of tank containers varies as has been shown in section 2 of this pamphlet. When preparing a risk analysis for stacking any type of container on top of a tank container, the operator should consider the risk associated with each design. Failure to stack a container correctly above a tank container, i.e. corner fitting to corner fitting, may result in the stack toppling. Tank containers without full length top rails, such as the beam, collar and frame designs, may pose a greater risk of toppling however top rails of tank containers are not designed to support a fully laden mis-stacked container.

11.7.2 Tank Containers may be stacked up to a height that is determined by the terminal's own risk assessment and to a height such that the maximum superimposed load is not exceeded. When completing the risk assessment due regard should be taken of the ILO Code of Practice shown in paragraph 11.6 above.

11.8 General Stacking Considerations

11.8.1 The stacking of containers relies on the integrity and strength of the units. Stacking also relies on the transfer of the load through the corner post assemblies (comprising of the corner post, normally a square steel tube and a top and a bottom corner fitting, normally cast). **No other component or assembly on any freight container type is designed or tested to withstand these loads**. Therefore it is essential that containers are stacked corner fitting to corner fitting.

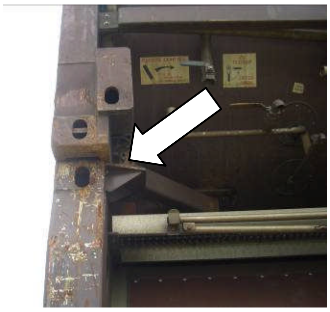


Picture 51

Picture 52

11.8.2 Picture 51 shows two corner fittings stacked almost aligned and this should be the objective of all operators involved with handling all types of containers and tank containers in particular. However the three other examples (pictures 52, 53 and 54) show that it is possible for the container stack to remain stable even though the containers are not positioned squarely above one another.

Picture 53



Picture 54

11.8.3 However the units, when stacked without their corner fittings aligned with the unit above / below, are being subjected to forces that they have not been tested against. Under the ISO 1496 series of standards, containers are tested with a 38 mm longitudinal and a 25 mm transverse offset between the corner fittings. The risk of failure increases as the offset increases.

Therefore it is essential that all containers are stacked with the corner fittings aligned as closely as practicable.

11.8.4 Many of the tank container units are fitted with incorrectly named “mis-stacking plates” as identified by the arrows in pictures 52 and 55. While these have been added to increase the surface area of the corner fittings they cannot be relied upon for supporting a stack of laden containers.

11.8.5 The design and height of top and bottom rails on tank containers vary greatly. These components are not designed for stacking.

11.8.5.1 Top rails, where present, are generally manufactured from 3 mm thick rolled hollow section tube. These are often only there as a means of connecting the walkway and are therefore only expected to support the weight of two men..

11.8.5.2 The strength of the top rails and the even loads imposed by their height differentials means there is a risk of failure associated with stacking containers on these components

11.8.5.3 Pictures 55 and 56 show two designs of bottom corner fitting / bottom rail connection but others can be seen in the preceding sections. There is a serious risk of failure if tank containers are stacked using the bottom rail.

Picture 55

Picture 56

12 Stowage on ships

12.1 With a few notable exceptions the stowage of tank containers on board ships is no different than the stowage of any other container. Like all containers, consideration should be given to the gross mass of the tank container and its impact in any given stowage location, on the stability of the ship.

Note: The gross weight of tank containers is often rated higher than the majority of other containers for example up to 36,000 kg. The actual value will be shown in box 19 of the Dangerous or Non Regulated Goods Note (see Annex 4, Figures A4.2 and A4.3).

12.2 Allowable Stacking Weight

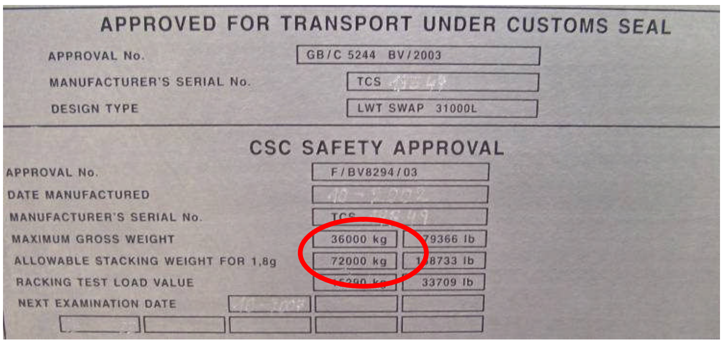
12.2.1 The allowable stacking weight represents the maximum superimposed load that any container can be subjected to and is often referred to as the stacking capability or stack height (when converted to a number of containers). The allowable stacking weight / superimposed weight should be entered onto The Dangerous or Non Regulated Goods Note (see Annex 4 Figures A4.2 and A4.3) in box 18c.

12.2.2 The stacking capability of a tank container can also be found on the Safety Approval Plate fitted on the rear of the container and generally forms part of a larger plate as arrowed in Picture 57.

Picture 57

12.2.3 The Safety Approval Plate will carry important data which is provided to assist in the safe handling of tank containers. Firstly the Maximum Gross Weight will be shown. In Picture 58 it is marked 34,000 kg and on the plate shown in Picture 59 for a different unit, it is 36,000 kg.

12.2.4 The second piece of important data is the allowable stacking weight, which is shown as 72,000 kg in the example (Picture 58).



Picture 58

12.2.5 The different designs for the tank supporting frames determine the stacking capability of the tank container. Most ISO tank containers are built to the provisions of ISO 1496 part 3 which will require that the container is built to withstand a superimposed load of 192,000 kg. This value is the equivalent of eight superimposed containers with an average mass of 24,000kg.

12.2.6 Table 1 shows the stacking configuration for a selection of average superimposed container masses. Note the mass of the bottom container is not taken into account when calculating the superimposed average mass.

Average gross mass (kg) of containers	24,000	30,480	32,500	34,000	36,000
Stack height	8 over 1	6 over 1	5 over 1	5 over 1	5 over 1
Laden container stack					

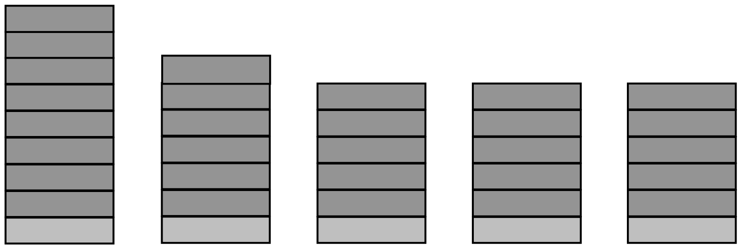


Table 1

12.2.7 There are few international tank containers in service today with a maximum gross weight rating of 30,480 kg so, as shown in Table 1, the maximum configuration will generally be five fully laden tank containers stacked over the bottom one (total six per stack).

12.2.8 However swap tanks have a different design and therefore a different stacking capability. The wider designed width of these units means that there is a step between the corner posts and the top corner fittings. Pictures 59 and 60 show examples of the step in the post.

Picture 59

Picture 60

12.2.9 Containers with a step of this nature will generally have a lower stacking capability. The container may be marked with a warning decal that indicates that there is a reduced stacking capability.

12.2.10 The safety approval plate example shown in Picture 58 is such a tank container where the maximum gross value of 36,000 kg and a reduced allowable stacking weight of 72,000 kg. This means that only two similar and fully laden containers can be stacked above it. .

12.2.11 When considering a stack of tank containers, the maximum superimposed load of the bottom container will dictate the total stack height. A container with the stacking capability of the units shown in Picture 58 can only have two containers placed above it, whether they are the stronger international or the weaker European loading unit. On the other hand a tank container with a maximum superimposed load of 192,000 kg may have up to five units loaded on top, unless a European unit is placed directly above it or third in the stack, in which case the stack height would be limited to three or four above it respectively.

12.3 **Tank Container Width**

12.3.1 Swap tanks are generally wider than ISO tank containers. However the designs of these two types of tank container are difficult to distinguish, especially when seen from a distance. The consequence of attempting to load a swap tank into a standard ISO cell guide may result in the container becoming jammed.

12.3.2 The additional width of the swap tank may also prevent it from being stowed in lower positions adjacent to other ISO containers as the spacing of the deck fittings are generally too close to be able to accommodate the additional width. Swap tanks may require stowing where there are no adjacent containers.

12.3.3 Because of the width and the possible reduced stacking capabilities, shippers who wish to move laden or empty swap tanks on deep sea routes must confirm that the ship is able to carry them. Furthermore the ship's planner must be advised when the container "slot" is booked and the container delivered to the terminal.

12.4 **Segregation**

12.4.1 Containers, including tank containers, carrying dangerous goods shall be segregated in line with the IMDG Code.

12.4.2 Containers carrying a cargo or its vapour that could adversely affect other susceptible cargoes should be stowed in separate holds.

12.5 **Emergency Response and Clean Up**

12.5.1 In the most severe case the pressure vessel could develop a leak or be punctured.

12.5.2 Such a release could represent a significant emergency response challenge so consideration must be given to the stowage location.

12.5.3 A commodity that is environmentally hazardous or a hazardous polluting substance is probably best stowed below deck where leaks or discharges can be contained within the hold of the ship. However it must be recognised that this may also present a hazard to the crew and/or emergency services personnel.

12.5.4 Commodities that are extremely difficult to clean-up (for example latex) should be stowed on deck.

12.5.5 Cryogenic liquids should never be stowed below deck.

12.5.6 Any bulk liquid released into the hold regardless of cargo carried may produce a significant clean-up challenge.

12.5.7 The guidance in dealing with release, spillage, fire or exposure to dangerous goods given in IMO's Emergency Response Procedures for Ships Carrying Dangerous Goods (EmS) and Medical First Aid Guide for Ships (MFAG) should also be followed.

12.5.8 In summary the following are important when accepting a tank container and planning for their stowage on board a ship:

- Ensure the shipper / operator has not over or under filled the tank. See section 4.2.1.9 in the IMDG Code for specific guidance in this regard
- Ensure the shipper / operator has not filled the tank so that the combined mass of the cargo and the tare of the tank container exceeded the rated maximum gross mass of the container (see 12.2.3, Annex 1 Definitions and Annex 4 section A4.2.4).
- Plan the stow based on the tank's gross mass and on the possible need to segregate its contents from other dangerous goods in the stow.
- Consider the tank container as a closed container for the purposes of segregation but keep in mind that tank containers have relief devices that may release vapours during a voyage.

  Note: For substances with *clear of living quarters* in column 16 of the Dangerous Good List, in deciding stowage, consideration shall be given to the possibility that leaking vapours may penetrate the accommodation, machinery space and other work areas. It should be kept in mind that vapours may pass down companionways and other openings into living spaces and work areas. Bulkheads, for example, between holds and engine rooms must be kept hermetically sealed.
- Consider the potential for a large spill and any attendant emergency response or clean-up activity that may be necessary.
- Tank containers loaded with a hazardous substance and stowed on deck but not intended for discharge at the terminal should not be left in the path of other containers or hatch covers being moved in the same bay. In such a case, the tanks should be either moved to another bay or, if that is not practical, placed at a safe location on the terminal as a re-handle(s).
- In planning stowage, consideration should be given to the plug-in arrangements necessary for certain cargoes in tank containers which need heating or cooling.

13 Access to Tank Container Tops and Working at Height

13.1 All tank containers where access to the interior can only be gained through a top opening or where the cargo is loaded through a hatch in the top of the container will be fitted with a means of climbing onto the container top. However these access means often will have restricted and in some cases incomplete rungs / steps.

Picture 61

Picture 62

13.2 Tank containers will have a ladder built into the rear frame, some of which can be clearly discernable as a ladder, see Picture 61, while others may appear as a climbing frame see Picture 62.

13.3 Where access is required to the top of the container, they will be marked with a warning decal as shown in Picture 63. The decal indicates a warning from all overhead hazards and power cables in particular. Operators when deciding whether to access the top of the container should make themselves aware of all potential hazards directly overhead and immediately adjacent to the container. This warning is particularly important for operations in rail transfer depots but may affect other handling operations.

Picture 63

13.4 However the ladders built into the tank container should only be considered as a means of access to the top of the container in an emergency, as the process of climbing onto the top of the container entails a risk of slipping and falling. Operational access to tank container tops should be made using suitable mobile steps or from a gantry.

13.5 When the container is loaded onto a chassis the bottom of the ladder can be as much as 1,200 mm, and the top of the container as much as 3.8 m off the ground. Furthermore on some designs of chassis the container will be slightly inclined with the front end elevated which would mean that the ladder would be inclined towards to the operator.

13.6 The steps / rungs are generally manufactured from steel or aluminium and can be slippery in the cold and wet. Operators can easily miss their step when climbing these ladders.

13.7 When transitioning from the ladder to the walkway on the container top, there are limited hand holds available for the operator to grip (see Picture 64) making the manoeuvre hazardous (see Picture 65). An operator climbing onto the top of the tank container shown in Picture 65 will be presented with either the walkway securing bracket or the miss-stacking plate, neither of which are ideal handholds. Climbing off the top of the container can be more hazardous as the operator is attempting to locate rungs / steps which are not visible and in an awkward position.

Picture 64

Picture 65

13.8 Where regular access is required to the top of containers, facilities should provide either a mobile step ladder that can be positioned next to the container (an example is shown in Picture 66) or the container can be positioned next to a fixed access gantry see Picture 67.

13.9 Access to the top of the tank container is gained by the fixed step to the right of Picture 67. Once the container is positioned next to the gantry the operator can lower the counterbalanced handrail / barrier to provide additional safety will working on the container top.

Picture 66

Picture 67

13.10 If the container is mounted on a chassis, the operator should not attempt to access the top of the container unless the tractor unit has been disconnected or immobilised to prevent accidental movement of the container.

13.11 Once access to the top of the container has been achieved it should be remembered that the operator is a minimum of 2.6 m above the ground and fall from that height could be serious. Therefore the operator should ensure that all possible safety features are employed.

13.12 Handrails

13.12.1 **ITCO recommend that hand rails are not fitted to tank containers -** see also "*Prevention of falls from ISO Tank Containers conforming to ISO 1496 – 3"* issued by ITCO (www.itco.be)

13.12.2 Where the tank container is fitted from new with a permanently installed handrail, the handrail should be a minimum height of 1,100 mm in the raised position with at least one intermediate rail.

Note 1: When handrails are installed on tank containers they must provide effective fall protection around all sides of the access and work area. Single handrails do not provide this and additional measures must be taken to prevent falls.

Note 2: Handrails that are not securely retained when not in use can increase the risk of handling failures.

13.13 Use a fall arrest system, by far the best item of personnel safety equipment that can be employed. Operators should wear an approved harness and attach themselves to the overhead cables. In Picture 68 a number of "T" shaped stanchions are positioned about the area where an operator will work on the top of the container. The connecting overhead cables have counterbalanced arrest drums supported from them to which the operator will attach their harness.

Picture 68

13.14 Do not overcrowd the top of the container. The walkways are limited in size and strength. Furthermore with too many people on the top of the container moving about can be hazardous.

14 Inspecting Tank Container Interiors

14.1 **Under no circumstances should stevedores, dockworkers, ships crew, transport workers or customs officials, who have not been properly trained and equipped, open or enter any tank container, even if the container is declared as "empty".**

14.2 When considering inspecting the interior of the tank container, one is really considering opening and entering a vessel which is an enclosed space. It should be remembered that the tank container will have carried a variety of cargoes, some of which may be hazardous or cause an oxygen depleted atmosphere (i.e. little or no oxygen).

14.3 Furthermore it is common practice that tank containers once they have been discharged may be only partially cleaned or filled with inert gases to be finally cleaned at the point of loading of the next cargo. In such cases the valves and hatches may be sealed during such transport as shown in Picture 69 (see also Annex 5 section A5.3)

Picture 69

14.4 In judging whether a tank container is safe to enter, it should be born in mind that the vapours of many liquid chemicals and gases are heavier than air so that pockets of such gases can exist even in the upper air space is considered to be safe,

14.5 Therefore inspecting the interior should not be done until the container has been certified to be safe to enter. This requires a test by a specialist and the use of personal protection equipment by properly trained operatives.

14.6 If the interior of the tank container requires inspection or even if the access hatch needs to be opened then this should only be done by, or under the supervision of, specialist operatives normally found at tank cleaning stations.

Under no circumstances should stevedores, dockworkers, ships crew, transport workers or customs officials who have not been properly trained and equipped open any tank container even if the container is declared as "empty".

Annex 1 Definitions

BIC means Bureau International des Containers et du Transport Intermodal

Cargo Transport Unit (CTU) means a road freight vehicle, a railway freight wagon, a freight container, a road tank vehicle, a railway tank or a portable tank. Used as an alternative to *Intermodal Loading Unit* (ILU)

Dangerous Goods mean the substances, materials and articles covered by the IMDG Code. In some countries the term Hazardous Materials is in their local regulations in place of Dangerous Goods. In many other countries the term Dangerous Substances is used. Except in the United States Dangerous Substances can be considered as having the same definition as Dangerous Goods

Frangible disc is also known in the tank container industry as a bursting disc or sometimes a rupture disc.

Gross Weight, more properly the gross mass, means the sum of the tare weight plus the weigth of the cargo loaded. The weight of the fully laden container must not exceed the maximum gross weight shown on the Safety Approval Plate. See also Maximum Gross Weight.

IMDG Code means the current edition of the International Maritime Dangerous Goods (IMDG) Code adopted by the Maritime Safety Committee of International Maritime Organisation (IMO).

Intermodal Loading Unit (ILU) means a container that can be interchanged between all modes of surface transport using common handling equipment and without intermediate reloading. See also *Cargo Transport Unit* (CTU).

Intermodal transport means a system of transport in which the cargo can be interchanged between all modes of surface transport using common handling equipment and without intermediate reloading.

Manway means a port, usually circular, cut into the top of the shell which enables access to the tank's interior. Each manway will be fitted with a closing hatch or cover. Also known as a manhole or accessway.

Marine Pollutants means substances which are subject to the provisions of Annex III of MARPOL 73/78, as amended.

Maximum Gross Weight the term used within the Convention for Safe Containers, 1972 and this pamphlet means the total permitted weight of the tank container and the payload. The value is shown on the Safety Approval Plate and the identical number shall be shown on the rear end of the container. Maximum Gross Weight is also be referred to as Max Gross, MGW or Rating but more properly should be referred to as Maximum Gross Mass

Maximum Holding Time means the maximum time from filling before heat gain from ambient sources causes a pressure rise sufficient to open the pressure relief valves. The holding time will vary for each tank design and the existing ambient conditions. It should be made known to container handlers and ship operators as exceeding the holding time may increase the risk of cargo escaping.

Multimodal transport means a journey involving multiple means of transport, originally used to describe road and rail transport. Multimodal is a term used within Europe to describe road and rail transport modes and is used in place of Intermodal transport within the IMDG Code.

Portable Tank means a multimodal tank used for the transport of substances of class 1 to 9. The portable tank includes a shell fitted with service equipment and structural equipment necessary for the transport of dangerous substances. The portable tank shall be capable of being filled and discharged without removal of its structural equipment. It shall possess stabilising members external to the shell, and shall be capable of being lifted when full. It shall be designed primarily to be loaded onto a transport vehicle or ship and shall be equipped with skids, mountings or accessories to facilitate mechanical handling. A portable tank for the transport of non-refrigerated liquefied gases of class 2 shall have a capacity of more than 450 litres.

Service Equipment as used in the IMDG Code means measuring instrument and filling, discharge, venting, safety, heating, cooling and insulating equipment.

Shell means the part of the portable tank which retains the substance intended for transport (tank proper), including openings and their closures, but does not include service equipment or external structural equipment. Shells may be of two basic types, either:

- "atmospheric" with little or no capability of withstanding an internal pressure higher than the external pressure; or
- "pressure vessel" which have the capability of withstanding a higher internal pressure than the external pressure acting upon the outer surface.

International regulation governing the transport of dangerous goods at sea prohibits the use of "atmospheric" tank shells and in practice there are very few of these types of tanks in service.

Structural Equipment means the reinforcing, fastening, protective and stabilising members external to the shell.

Tank Container means a portable tank with fittings, structural capabilities and dimensionsthat enable it to be handled and secured by the same means as any ISO or EN configured container.

Tare means the weight of the tank container in its unloaded state. It includes the shell. service and structural equipment.

UIC means Union International des Chemins de Fer and *UIC Rules* refers to rules for European rail transport.

Ullage means "the amount by which a container, such as a bottle, cask, or tank, falls short of being full"

Annex 2 Centre of Gravity, Ullage and Degree of Filling

A2.1 Centre of Gravity

A2.1.1 Different types of tank may have a different centre of gravity, dependent on the design and the amount of steel in the framework.

A2.1.2 Typically an empty tank will have a lower centre of gravity than will a loaded tank. However a loaded tank will have a dynamic centre of gravity that shifts marginally longitudinally and laterally and upwards as the contents surge fore or aft or from side to side. When the tank is correctly filled this should not affect stability (see section A2.4 Free Surface Effect).

A2.1.3 When handling tank containers, operators should be aware that on vehicles, including handling equipment, where a dynamic centre of gravity may affect the stability of the vehicle, the loaded tank container should be transported so that the combined centre of gravity (vehicle and tank container) is as low as practicable.

A2.2 Degree of Filling

A2.2.1 Prior to filling, the shipper shall ensure that the appropriate tank container is used and that the tank container is not loaded with cargo that, in contact with materials of the shell, gaskets, service equipment and any protective linings, is likely to react dangerously with them to form dangerous products or appreciably weaken the materials.

A2.2.2 Portable tanks shall not be filled in excess of the maximum degree of filling specified in A2.2.3 to A2.2.8. The applicability of A2.2.3, A2.2.4 or A2.2.8 to individual substances is specified in the applicable portable tank instructions (see 0 section A5.1.3).

A2.2.3 The maximum degree of filling (in %) for general use is determined by the formula:

$$\text{Degree of filling} = \frac{97}{1 + \alpha(t_r - t_f)}$$

A2.2.4 The maximum degree of filling (in %) for liquids of class 6.1 and class 8, in packing groups I and II, and liquids with an absolute vapour pressure of more than 175 kPa (1.75 bar) at 65°C, or for liquids identified as marine pollutants is determined by the formula:

$$\text{Degree of filling} = \frac{95}{1 + \alpha(t_r - t_f)}$$

A2.2.5 In these formulae, α is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (t_f) and the maximum mean bulk temperature during transport (t_r) (both in °C). For liquids transported under ambient conditions, α could be calculated by the formula:

$$\alpha = \frac{d_{15} - d_{50}}{35 d_{50}}$$

in which d_{15} and d_{50} are the densities of the liquid at 15°C and 50°C, respectively.

A2.2.6 The maximum mean bulk temperature (t_r) shall be taken as 50°C except that, for journeys under temperate or extreme climatic conditions, the competent authorities concerned may agree to a lower or require a higher temperature, as appropriate.

A2.2.7 The provisions of A2.2.3 and A2.2.4 do not apply to portable tanks which contain substances maintained at a temperature above 50°C during transport (such as by means of a heating device). For portable tanks equipped with a heating device, a temperature regulator shall be used to ensure the maximum degree of filling is not more than 95% full at any time during transport.

A2.2.8 The maximum degree of filling (in %) for solids transported above their melting points and for elevated temperature liquids shall be determined by the following formula:

$$\text{Degree of filling} = 95 \frac{d_r}{d_f}$$

in which d_r and d_f are the densities of the liquid at the mean temperature of the liquid during filling and the maximum mean bulk temperature during transport respectively.

A2.2.9 In simple terms the degree of filling for tank containers without surge plates should be greater than 80% (see Annex 2 section A2.2) and no greater than:

- 97% for general dangerous goods, or
- 95% for liquids in class 6.1 and class 8 in packaging group I and II

though the actual value for each substance is unlikely to be as high as these values.

A2.2.10 The filling level for liquefied gas containers is referred to as the filling ratio. This takes into account various parameters for temperature and pressure.

A2.2.11 The degree of filling should be filled in the appropriate box on the Dangerous or Non Regulated Goods Note (see Annex 4, figure A4.2 and figure A4.3

Note: Tank containers shall not be offered for transport:

- with a degree of filling, for liquids having a viscosity of less than 2,680 mm^2/s at 20°C, or,
- at the maximum temperature of the substance during transport in the case of a heated substance, of more than 20% but less than 80% unless the shells of portable tanks are divided, by partitions or surge plates, into sections of not more than 7,500 litre capacity;

A2.2.12 Minimum Degrees of Filling - Worked Example

Example: A substance, non-viscous, is a dangerous good. It has a liquid density of 1.51 at 20°C. It is loaded at ambient temperature. A shipper wishes to ship 20,000 kg consignments in tank containers. The only suitable tank containers do not have baffles. What capacity of tank should be chosen from a selection of tank containers with capacities 15,000 litres, 17,000 litres or 20,000 litres to carry the substance?

Step one: Calculate the volume (in litres) of the substance the shipper intends to load at the filling temperature:

$$\frac{\text{Cargo Net Mass}}{\text{Liquid Density}} = \text{Volume (litres)}$$

$$\frac{20{,}000 \text{ kg}}{1.51} = 13{,}245 \text{ litres}$$

Step two: The maximum size of an un-baffled tank which can be used to carry this non-viscous substance is calculated by:

$$\frac{\text{Volume (litres) x 100}}{80} = \text{Theoretical tank size}$$

$$\frac{13{,}245 \text{ x } 100}{80} = 16{,}556 \text{ litres}$$

If a tank container without baffles is selected with a greater capacity than 16,556 litres, it will be less than 80% full for this particular substance.

Solution: From the available ISO tank containers the 15,000 litre one must be used.

A2.2.13 Maximum Degrees of Filling – Worked Example

Paragraphs A2.2.3, A2.2.4 and A2.2.8 cover three situations for differing substances:

- maximum filling of lesser danger liquid substances loaded at ambient temperatures
- maximum filling of greater danger liquid substances or with a higher vapour pressure
- maximum filling of molten dangerous substances (carried above their melting point temperature)

Example1: The substance ACRYLONITRILE, STABLIZED, Class 3, Subsidiary Hazard 6.1, Packing Group I, UN 1093 is to be shipped in tank containers. A shipper wishes to ship 22,500 kg. The largest suitable tank container available has a capacity of 26,000 litres. Can this consignment be accepted? The substance has a liquid density at the filling temperatures:

of 0.812 at 15°C (filling temperature); and

of 0.772 at 50ºC (highest possible temperature).

Step 1 Determine the volume represented by 22,500 kilos of the substance at the filling temperature:

$$\frac{\text{Cargo Net Mass}}{\text{Liquid Density}} = \text{Volume (litres)}$$

$$\frac{22{,}500\text{ kg}}{0.812} = 27{,}709\text{ litres}$$

Conclusion: A 26,000 litre tank container is too small for the shipper's preferred consignment. The shipper must be informed as to the maximum permitted quantity that can be loaded in this tank container.

Step 2 From the Dangerous Goods List (column 14 – Portable tank provisions) UN 1093 this substance require TP2 and TP13 provisions to be applied

IMDG Code paragraph 4.2.5.3 indicates that TP13 requires self contained breathing apparatus shall be provides when this substance is transported (see Table A5.2), and TP2 directs th reader to 4.2.1.9.3 of the Code (see A2.2.4).

$$\text{Degree of filling} = \frac{95}{1 + \alpha(t_r - t_f)}$$

where α is the coefficient of cubical expansion, t_r is the reference temperature to be taken as 50ºC and t_f is the filling temperature, in this case 15^{o}C.

Step 3 Calculate the coefficient of cubical expansion (see A2.2.5):

$$\alpha = \frac{d_{15} - d_{50}}{35 d_{50}}$$

$$\alpha = \frac{0.812 - 0.772}{35 \text{ x } 0.772}$$

$$\alpha = 0.0014803$$

Step 4 Enter the coefficient of cubical expansion into the formula obtained at Step 2:

$$\text{Degree of filling} = \frac{95}{1 + 0.0014893(50\text{-}15)}$$

Degree of filling = 90.29%

Solution: The maximum degree of filling permitted by the IMDG Code of a tank container laden with this substance is 90.3%.

This means for a 26,000 litre tank container, filled with ACRYLONITRILE, STABLIZED, .only 90.29% of its capacity can be used which equates to 23,478 litres (26,000 x 0.0929 (90.29%)).

The shipper originally wanted to ship 22,500 kg of this substance, but this weight of the cargo was:

1. equated to a volume larger than the tank available (27,709 litres – Step 1)
2. is restricted to 23,478 litres by the IMDG Code and the available tank container.

The shipper an convert the volume back to net mass by multiplying the available volume by the liquid density:

23,478 litres x 0.812 = 19064 kg (80.72% of the original cargo mass)

A2.3 Ullage

A2.3.1 In the case of tank containers, ullage makes up the difference between full and the degree of filling which is defined for hazardous cargoes as per the previous section.

A2.3.2 For non regulated cargoes there are no formal requirements for ullage or the degree of filling. However similar rules should apply, with each tank between 80 and 97% filled. However many containers are shipped with the residue of the cargo on their way to be cleaned. In these cases the container should not be more than 20% full.

A2.3.3 Tank containers must not be shipped unless they comply with the appropriate regulations for cargo fillings as explained in this pamphlet. Under no circumstances should incorrectly loaded tank containers be accepted for any form of transport; road, rail or sea.

A2.4 Free Surface Effect

A2.4.1 The free surface effect is one of several mechanisms where an incorrectly filled tank container on a rail wagon or chassis / trailer, can become unstable and roll-over. It refers to the tendency of liquids to move in response to changes in the attitude of cargo holds, decks, chassis, wagons or liquid tanks in reaction to operator-induced motions.

A2.4.2 ADR, IMDG and UN all have recommendations about the filling of tank containers (see also paragraph 3.3.1). All tank containers should be filled to comply with these regulations and therefore the surging of the cargo as the tank container is moved should usually not adversely affect the cargo handler.

A2.4.3 Containers which are loaded correctly in line with the degree of filling detailed in Annex 2 section A2.2 will not be affected by free surface effect. However drivers of tractor / trailer combinations carrying a container with a high centre of gravity should be especially careful when changing lanes and turning tight corners, especially if travelling relatively fast or making sharp manoeuvres.

A2.4.4 Drivers of cargo handling equipment and hauliers should not transport tank containers which are greater than 20% and less than 80% filled. In such cases they would experience:

- **Noticeable surging of the cargo if the tank container is filled between 70 and 80%**
- **Severe surging of the cargo if the tank container is filled between 60 and 70%**
- **Dangerous surging of the cargo if the tank container is filled between 40 and 60%, to the extent that the tank container will be unstable once it is in motion.**

Note: ITCO recommends that tank containers which are not filled correctly should be stopped and the Shipper notified immediately.

Annex 3 Proper Shipping Name

A3.1 Proper Shipping Name

A3.1.1 The Proper Shipping Names of the dangerous goods are those listed in chapter 3.2, Dangerous Goods List of the IMDG Code. Synonyms, secondary names, initials, abbreviations of names, etc. have been included in the Index to facilitate the search for the Proper Shipping Name (see Part 5, Consignment Procedures of the IMDG Code). Where, in this pamphlet, the term "Proper Shipping Name" is used, it is the "correct technical name" required by regulation 4 of Annex III of MARPOL 73/78, as amended.

A3.1.2 The Proper Shipping Name is that portion of the entry in the Dangerous Goods List most accurately describing the goods. It is shown in upper-case characters (plus any numbers, Greek letters, *'sec', 'tert',* and the letters m, n, o, p, which form an integral part of the name). An alternative Proper Shipping Name may be shown in brackets following the main Proper Shipping Name (such as ETHANOL (ETHYL ALCOHOL)). Portions of an entry appearing in lower case need not be considered as part of the Proper Shipping Name but may be used.

A3.1.3 When conjunctions such as "and" or "or" are in lower case or when segments of the name are punctuated by commas, the entire name of the entry need not necessarily be shown in the transport document or package markings. This is the case particularly when a combination of several distinct entries is listed under a single UN Number. Paragraphs A3.1.4 to A3.1.6 illustrate the selection of the Proper Shipping Name for such entries.

A3.1.4 UN 1057 LIGHTERS or LIGHTER REFILLS - The Proper Shipping Name is the most appropriate of the following:

LIGHTERS

LIGHTER REFILLS

A3.1.5 UN 2583 ALKYLSULPHONIC or ARYLSULPHONIC ACIDS, SOLID with more than 5% free sulphuric acid - The Proper Shipping Name is the most appropriate of the following:

ALKYLSULPHONIC ACIDS, SOLID

ARYLSULPHONIC ACIDS, SOLID

A3.1.6 UN 2793 FERROUS METAL BORINGS, SHAVINGS, TURNINGS or CUTTINGS in a form liable to self heating. The Proper Shipping Name is the most appropriate of the following:

FERROUS METAL BORINGS

FERROUS METAL CUTTINGS

FERROUS METAL SHAVINGS

FERROUS METAL TURNINGS.

A3.1.7 Proper Shipping Names may be used in the singular or plural as appropriate. In addition, when qualifying words are used as part of the Proper Shipping Name, their sequence on documentation or packages is optional. Commercial or military names for goods of class 1, which contain the Proper Shipping Name supplemented by additional text, may be used.

A3.1.8 Many substances have an entry for both the liquid and solid state (see definitions for liquid and solid in the IMDG Code paragraph 1.2.1), or for the solid and solution. These are allocated separate UN numbers which are not necessarily adjacent to each other. Details are provided in the alphabetical index, e.g.:

NITROXYLENES, LIQUID - 6.1 UN 1665

NITROXYLENES. SOLID - 6.1 UN 3447.

A3.1.9 Except for self-reactive substances and organic peroxides and unless it is already included in capital letters in the name indicated in the Dangerous Goods List, the word STABILIZED shall be added as part of the Proper Shipping Name of a substance which without stabilization would be forbidden from transport due to it being liable to dangerously react under conditions normally encountered in transport for example TOXIC LIQUID, ORGANIC, N.O.S., STABILIZED. When temperature control is used to stabilize such substances to prevent the development of any dangerous excess pressure, then:

- For liquids: where the Self Accelerating Dew composition Temperature (SADT) is less than or equal to 50°C the provisions of IMDG Code paragraph 7.7.5 shall apply;
- For gases: the conditions of transport shall be approved by the competent authority.

A3.1.10 Hydrates may be transported under the Proper Shipping Name for the anhydrous substance.

A3.2 Generic or "Not Otherwise Specified" (N.O.S.) entries

A3.2.1 Generic and "Not Otherwise Specified" Proper Shipping Names that are assigned to special provision 274 in column 6 of the Dangerous Goods List shall be supplemented with the technical or chemical group names unless a national law or international convention prohibits its disclosure if it is a controlled substance. For explosives of class 1, the dangerous goods description may be supplemented by additional descriptive text to indicate commercial or military names. Technical and chemical group names shall be entered in brackets immediately following the Proper Shipping Name. An appropriate modifier, such as "contains" or "containing" or other qualifying words such as "mixture", "solution", etc., and the percentage of the technical constituent may also be used. For example: "UN 1993 FLAMMABLE LIQUID, N.O.S. (contains xylene and benzene), 3, PG II".

A3.2.2 The technical name shall be a recognized chemical or other name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose. In the case of pesticides, only ISO common name(s), other name(s) in the WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification, or the name(s) of the active substance(s) may be used.

A3.2.3 When a mixture of dangerous goods is described by one of the "N.O.S" or "generic" entries to which special provision 274 has been allocated in the Dangerous Goods List, not more than the two constituents which most predominantly contribute to the hazard or hazards of a mixture need to be shown, excluding controlled substances when their disclosure is prohibited by national law or international convention. If a package containing a mixture is labelled with any subsidiary risk label, one of the two technical names shown in brackets shall be the name of the constituent which compels the use of the subsidiary risk label.

A3.2.4 Examples illustrating the selection of the Proper Shipping Name supplemented with the technical goods for such N.O.S. entries are:

UN 2902 PESTICIDE, LIQUID, TOXIC, N.O.S. (drazoxolon)

UN 3394 ORGANOMETALLIC SUBSTANCE, LIQUID, PYROPHORIC, WATER-REACTIVE (trimethylgalllum).

A3.3 Marine Pollutants

A3.3.1 For generic or “not otherwise specified” (N.O.S.) entries, the proper shipping name shall be supplemented with the recognised chemical name of the marine pollutant.

A3.3.2 Examples illustrating the selection of the Proper Shipping Name supplemented with the recognised technical name of the goods for such entries are shown below:

UN 1993, FLAMMABLE LIQUID, N.O.S. (propyl acetate di-n-butyltin-2-ethylhexanoate), class 3 PGIII (50ºC c.c.) MARINE POLLUTANT

UN 1263, PAINT (triethylbrnzene), class 3 PGIII (27ºC c.c.) MARINE POLLUTANT

Annex 4 Documentation

A4.1 Booking Request

A4.1.1 The documentation chain starts with the shipper or the freight forwarder making a **Booking Request** (see Figure A4.1) to use tank containers to transport their product to the destination.

A4.1.2 Every request should include a unique **Shipper's Reference** which will be used on all future documentation and correspondence.

A4.1.3 Every shipment made in tank containers will require the shipper to book either tank containers owned by the shipping line or to use their own (shipper's own) tank and book "slots". Additionally the shipper will need to specify the size of the tank container (normally 20 ft), the volume of the pressure vessel, the average weight of the cargo, whether heating or cooling is required and what power / heat source is required to operate it and any other unique features or requirements such as holding time.

A4.1.4 Tank containers can be shipped in three states, loaded with a cargo, un-cleaned with a residue of the previous cargo or cleaned.

A4.1.5 The Shipper will need to advise the shipping line of the cargo that is to be carried. If the cargo is classified as Dangerous Goods then the shipper will need to provide the UN number, the Proper Shipping Name, the primary and secondary hazard class(es), the packing group and, if applicable, the flash point of the product being carried.

A4.1.6 The port of loading/port of discharge sections deal with the deep / short sea voyage itself, identifying the container yard (CY) where the tank container originates, the planned port of discharge and the planned dates for the loading and discharge.

A4.1.7 The steamship line will also record its booking number for the booking.

A4.1.8 Some countries may require details of the customs office to be recorded

A4.1.9 The section for special instructions should be used to indicate stowage and handling requirements and any other information that would be useful to the shipping line stevedores and transport companies.

International Tank Container Organisation

Booking Request

To:		Date:	*See A4.1.2*
Attn:		Booking Ref:	

To be quoted on all correspondence and invoices

We would like to book the following containers:	Length	Volume (lt)	Heating / Cooling	Other feature
Number of Shipping Line Tank Containers				
Number of Shipper Owned Tank Containers		**See A4.1.3**		
Approximate Cargo weight per container				

Container will be

Loaded
Un cleaned / Residue
Clean

See A4.1.4

Product name	
	See A4.1.5
Description	

Hazard Class		Packing Group:		Flash Point:	
EMS					

Vessel		Voyage	
Pre carriage location / Receiving CY		Precarriage date:	
Port of Loading		Port of loading date:	**See A4.1.6**
Port of Entry / Discharge		Port of entry date:	
Port of on carriage location / Delivery CY		Port of oncarriage date:	
Steamship Line Contract	**See A4.1.7**		

Export Customs				
	See A4.1.8			
	Telephone:		Fax:	

Special Requirements / Instructions

See A4.1.9

Other Remarks

Contact		Phone / Fax No.:	/
Company		email:	

Figure A4.1

A4.2 Dangerous Goods Note

A4.2.1 One of the fundamental requirements of a transport document for dangerous goods is to convey the essential information relative to the hazards of the goods. Therefore, unless otherwise exempted or required in the IMDG Code, the document should carry all the basic information appertaining to a consignment of dangerous goods. An example of a Dangerous Goods Note is shown in Figure A4.2.

A4.2.2 Exporter (Shipper) and Consignee information

- Box 1 the name and address of the exporter – the company from whom the cargo originates
- Box 2 a unique reference number and the same as shown on the booking request
- Box 4 a unique reference generated by the exporter relating to the total shipment, i.e. all containers in the shipment.
- Box 5 if the transport is being arranged by a freight forwarder, then they can add their own reference number into this box.
- Box 6 the name and address of the company who will be receiving the goods at the end of the transport chain.
- Box 6a if the transport is being arranged by a freight forwarder, their name and address should be entered into this box.
- Box 7 the name and address of the shipping company (Carrier) who will complete the maritime portion of the journey.

A4.2.3 Shipping Marks (Box 14)

For dangerous goods, the transport document shall contain the following information in the order presented below:

- The UN Number preceded by the letters “UN” e.g. “UN 1098”;
- The Proper Shipping Name (PSN), as described in Annex 3, including the technical name enclosed in parenthesis, as applicable e.g. “UN 1098 ALLYL ALCOHOL”;
- The primary hazard class or, when assigned, the division of the goods, including Class 1, the compatibility group letter. The words “Class” or “Division” may be included preceding the primary hazard class or division numbers e.g. “UN 1098 ALLYL ALCOHOL class 6.1”;
- Subsidiary hazard class or division number(s) corresponding to the subsidiary risk label(s) required to be applied, when assigned, shall be entered following the primary hazard class or division and shall be enclosed in parenthesis. The words “Class” or “Division” may be included preceding the subsidiary hazard class or division numbers e.g. “UN 1098 ALLYL ALCOHOL class 6.1 (class 3)”;
- Where assigned, the packaging group for the substance which may be preceeded by “PG” e.g. “UN 1098 ALLYL ALCOHOL class 6.1 (class 3) PG I”

International Tank Container Organisation

TANK CONTAINER DANGEROUS GOODS NOTE

This form may be used as a dangerous goods declaration as it meets the requirements of SOLAS 74, chapter VII, regulation 4; MARPOL 73 / 78 Annex III regulation 4.

1 Shipper	2 Transport document number	
	4 Shipper's reference	5 Freight forwarder's reference
6 Consignee	7 Carrier (to be completed by the carrier)	
6a Freight forwarder	**SHIPPER'S DECLARATION** I hereby declare that the conntenets of this consignment are fully and accurately described below by the Proper Shipping Name, and are classified, packaged, marked and labelled / placarded and are in all respects in proper condition for transport according to the applicable international and national governmental regulations.	

10 Vessel No. and date	Date	11 Port of loading	9 Additional handling information
12 Port / place of discharge	Date	13 Destination	

14 Shipping marks	* Description of goods	14a Net mass (kg)	14b Cube (m^3)

15 Container prefix	16 Seal number(s)	17 Size / Type	18 Tare mass (kg) (Safety Approval Plate)	18a Total net mass (kg)	19 Total gross mass (kg)	19a Total cube m^3
15a Serial number	15b ACEP / NED	17a Tank Volume (ℓ)	18c Stacking Load (Safety Approval Plate)	19c Number of compartments	19d Baffles fitted	19b Degree of filling

TANK CONTAINER LOADING CERTIFICATE I hereby declare that the goods decribed above have been loaded into the container identified above in accordance with the applicable provisions† **MUST BE COMPLETED AND SIGNED FOR ALL CONTAINER LOADS BY PERSON REPOSNSIBLE FOR LOADING**	21 RECEIVING ORGANISATION RECIEPT Container received in apparent good order and condition, unless stated hereon. RECEIVING ORGANISATION REMARKS:

20 Name of company		Haulier's name Vehicle reg no.	22 Name of company (OF SHIPPER PERPARING THIS NOTE)	
Name / status of declarant		Signature and date	Name / status of declarant	
Place	Date		Place	Date
Signature of declarant		DRIVER'S SIGNATURE	Signature of declarant	

* **DANGEROUS GOODS:**

You must specify : UN No., Proper Shipping Name, hazard class, packing group, (where assigned) and any other element of information required under applicable national and international governmental regulations.

† For the purose of the IMDG Code, see 5.4.2.

Figure A4.2

A4.2.4 Every document should carry at least the following container information:

- Box 14a Enter the weight of the cargo measured in kg. If there is only one compartment in the tank container enter the same value in Box 18a “Total net mass”. Otherwise Box 18a should be th sum of the weight of the different cargoes carried.
- Box 14b Enter the volume of the cargo measured in m^3. If there is only one compartment in the tank container enter the same value in Box 19a “Total cube”. Otherwise Box 19a should be th sum of the volume of the different cargoes carried.
- Calculate the degree of filling – Total cube (Box 19a) / tank volume (Box 17a).
- Box 15 Enter the container four letter prefix, e.g. ABCU.
- Box 15a Enter the six numbered serial number and a single numeral check digit, e.g.123456 7.
- Box 15b Enter the ACEP reference number e.g. ACEP NV 11/07 or Next Examination Date (NED) that is marked on the container.
- Box 16 Enter the serial number for each of the seals applied to the container in the order, bottom valve, top discharge valve, manway hatch;
- Box 17 Enter the container size and type code that is shown on the container, e.g. 22T0
- Box 18 Enter the Tare weight / mass (recorded in kg) as shown on the Safety Approval Plate
- Box 18c Enter the maximum superimposed load Allowable stacking weight / mass) as shown on the Safety Approval Plate (see Section 12.2)
- Box 19 Calculate the sum of the tare and cargo weight and enter it into this box. The value should be less than the Maximum Gross Weight / Mass shown on the Safety Approval Plate (see Picture 59, Section 12.2)
- Box 19c Enter the number of compartments the tank container is fitted with. It is highly recommended that an entry is always made in this Box even of there is only a single compartment.

A4.2.5 Declaration (Box 20)

A4.2.5.1 Box 20 shall be completed by a responsible officer of the company who is responsible for loading the container with the cargo. The responsible officer declares that the tank container has been loaded with the cargo stated in the volumes recorded.

A4.2.5.2 It shall include the Company name and the name of the responsible officer written in BLOCK CAPITALS.

A4.3 Non Regulated Goods Note

A4.3.1 Non regulated goods refer to those goods that are not covered by section 3 of the IMDG Code. They may be referred to as non hazardous or food grade, but there are instances where non regulated cargoes may be hazardous or dangerous e.g. goods which are combustible or which may cause serious disruption if released into the environment. An example is shown in Figure A4.3.

A4.3.2 The form is basically the same except there is no reference to the IMDG Code or Dangerous Goods declaration.

A4.3.3 Other information required on the form is of use to stevedores and other cargo handlers.

A4.4 Periodic Inspection Reports

A4.4.1 Every container is subject to periodic examinations. These examinations are carried out every 2½ and 5 years. The 5 year test will include a full pressure test every five years

A4.4.2 A Test Inspection Report is issued by an inspection organisation certified by a Classification Society. Additionally, tank containers are subject to and need to be periodically examined in accordance with the requirements of the International Convention for Safe Containers (CSC).

International Tank Container Organisation

TANK CONTAINER NON REGULATED GOODS NOTE

This form may be used as a Non-regulated goods declaration and complies with the requirements of ICHCA International Limited Briefing Pamphlet 30

1 Shipper			2 Transport document number			
			4 Shipper's reference		5 Freight forwarder's reference	
6 Consignee			7 Carrier (to be completed by the carrier)			
6a Freight forwarder			**SHIPPER'S DECLARATION** **I hereby declare that the contents of this consignment are fully and accurately described below by the proper name, and are marked and labelled and are in all respects in proper condition for transport according to ICHCA International Ltd Briefing Pamphlet 30**			
10 Vessel No. and date	Date	11 Port of loading	9 Additional handling information			
12 Port / place of discharge	Date	13 Destination				
14 Shipping marks	Description of goods		14a Net mass (kg)		14b Cube (m^3)	
15 Container prefix	16 Seal number(s)	17 Size / Type	18 Tare mass (kg) (Safety Approval Plate)	18a Total net mass (kg)	19 Total gross mass (kg)	19a Total cube m^3
15a Serial number	15b ACEP / NED	17a Tank Volume (ℓ)	18c Stacking Load (Safety Approval Plate)	19c Number of compartments	19d Baffles fitted	19b Degree of filling

TANK CONTAINER LOADING CERTIFICATE I hereby declare that the goods decribed above have been loaded into the tank container identified above in accordance with the applicable provisions **MUST BE COMPLETED AND SIGNED FOR ALL CONTAINER LOADS BY PERSON REPOSNSIBLE FOR LOADING**	21 RECEIVING ORGANISATION RECIEPT Container received in apparent good order and condition, unless stated hereon. RECEIVING ORGANISATION REMARKS:

20 Name of company	Haulier's name Vehicle reg no.	22 Name of company (OF SHIPPER PERPARING THIS NOTE)
Name / status of declarant	Signature and date	Name / status of declarant
Place Date		Place Date
Signature of declarant	DRIVER'S SIGNATURE	Signature of declarant

Figure A4.3

Annex 5 Dangerous Goods

A5.1 Regulations and Instructions

A5.1.1 The International Maritime Dangerous Goods Code (IMDG) will be applied to all movements by sea. It is implemented by national laws. Note the IMDG Code refers to portable tanks and any reference to them applies to tank containers.

ADR/RID or ADN may be the applicable regulations for road / rail or inland waterways transport within Europe.

A5.1.2 Dangerous goods are assigned a class and a division. A summary can be found in the International Safety Panel Briefing Pamphlet No. 3 "THE INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG) CODE".

- Section 4 Classification lists the 9 Classes of dangerous goods and describes the primary and secondary hazards.
- Section 5 describes the degree of hazard (packing group).

A5.1.3 Tank Containers (Portable Tank) Instructions and Special Provisions

A5.1.3.1 Portable tank Instructions apply to dangerous goods of classes 1 to 9 and provide specific information relevant to portable tanks provisions applicable to specific substances.

A5.1.3.2 For substances of class 1 and classes 3 to 9, the portable tank instructions indicate the applicable minimum test pressure, the minimum shell thickness (in reference steel), bottom opening provisions and pressure-relief provisions. In T23, self-reactive substances of class 4.1 and class 5.2, organic peroxides permitted to be transported in portable tanks are listed along with applicable control and emergency temperatures.

A5.1.3.3 Non-refrigerated liquefied gases are assigned to portable tank instruction T50. T50 provides the maximum allowable working pressures, bottom opening provisions, pressure-relief provisions and degree of filling provisions for non-refrigerated liquefied gases permitted for transport in portable tanks.

A5.1.3.4 Refrigerated liquefied gases are assigned to portable tank instruction T75. ***Determination* of the *appropriate portable tank instructions***

A5.1.3.5 Column 13 of the Dangerous Goods List in chapter 3.2 of the IMDG Code indicates the "Instruction" that shall be used for each substance permitted for transport in a tank container. The Instruction refers to a designation identified by an alpha-numeric designation (T1 to T75). Table A5.1 is an excerpt from paragraph 4.2.5.2.6. of the IMDG Code

These instructions apply to liquid and solid substances of classes 3 to 9.

Instruction	Min test pressure (bar)	Min shell thickness	Pressure-relief provision	Bottom opening provision
T1	1.5	See 6.7.2.4.2	Normal	See 6.7.2.6.2
T2	1.5	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T3	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.2

Table A5.1

A5.1.3.6 When no Instruction appears in the Dangerous Goods List, transport of the substance in portable tanks is not permitted unless a competent authority approval is granted.

A5.1.3.7 Special Provisions are assigned to specific dangerous goods in column 14 of the Dangerous Goods List in chapter 3.2. Each Special Provision is identified by an alpha-numeric designation (TP1 to TP91). Examples of Special Provisions are shown in Table A5.2:

TP7	Air shall be eliminated from the vapour space by nitrogen or other means
TP13	Self-contained breathing apparatus shall be provided when this substance is transported
TP20	This substance shall only be transported in insulated tanks under a nitrogen blanket

Table A5.2

A5.1.3.8 When a specific portable tank instruction is specified in the Dangerous Goods List, additional portable tanks which possess higher test pressures, greater shell thicknesses, more stringent bottom opening and pressure relief device arrangements may be used.

A5.1.4 Dangerous goods are assigned UN numbers and proper shipping names according to their hazard classification and their composition. Dangerous goods commonly carried are listed in the Dangerous Goods List.

A5.1.5 Where an article or substance is specifically listed by name (proper shipping name) this is the name that must be used for transportation documents.

Example UN 1090 Acetone

A5.1.6 UN numbers are also given for clearly defined groups of substances or articles.

Example UN 1133 Adhesives

A5.1.7 For dangerous goods not specifically listed by name “Not Otherwise Specified” (NOS) is used to cover a group of substances or articles.

A5.1.8 Specific NOS entries covering a group of substances or articles of a particular chemical or technical nature

Example UN 1477 Nitrates, Inorganic, NOS

A5.1.9 General NOS entries covering a group of substances or articles meeting the criteria of one or more classes or divisions. When general NOS entries are made, the actual chemical name (the technical name) must be given in brackets as part of the PSN

Example UN 1993 Flammable Liquid, NOS (Aluminium Martinate)

A5.1.10 A mixture or solution containing a single dangerous substance specifically listed by name in the dangerous goods list and one or more substances not subject to regulation is assigned the UN number and proper shipping name of the dangerous substance.

A5.1.11 The exceptions to the above are if the solution is specifically identified by name in the Dangerous Goods List or if the entry into the Dangerous Goods List specifically indicates that it applies to a pure substance. If the hazard class or division or physical state or packing group of the solution or mixture is different from that of the dangerous substance, there can be a significant change in the measures to be taken in emergencies.

A5.1.12 For a solution or mixture where the hazard class, the physical state or packing group is changed in comparison with the listed substance, the appropriate NOS entry shall be used including its packing and labelling provisions

A5.2 Marine Pollutants

A5.2.1 Figure A5.1 shows the mark / placard used for Environmentally Hazardous Substances (Aquatic Environment) which are known as marine pollutants in the IMDG Code.

Figure A5.1

A5.2.2 Marine pollutants shall be transported under the appropriate entry according to their properties if they fall within the criteria of any of the classes 1 to 8. If they do not fall within the criteria of these classes, they shall be transported under entry; ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S., UN 3077 or ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S., UN 3082, as appropriate, unless there is a specific entry for the substance in class 9.

A5.2.3 Column 4 of the Dangerous Goods List in the IMDG Code provides information on marine pollutants using the symbol "**P**".

A5.2.4 When a substance, material or article possesses properties that meet the criteria of a marine pollutant but is not identified in the IMDG Code, such substance, material or article shall be transported as a marine pollutant in accordance with the IMDG Code.

A5.3 Wastes

A5.3.1 Wastes, which are dangerous goods, shall be transported in accordance with the relevant international recommendations and conventions and, in particular, where it concerns transport by sea, with the provisions of the IMDG Code.

A5.3.2 Transboundary movements under the Basel Convention

A5.3.2.1 Transboundary movement of wastes is permitted to commence only when:

- notification has been sent by the competent authority of the country of origin, or by the generator or exporter through the channel of the competent authority of the country of origin, to the country of final destination; and
- the competent authority of the country of origin, having received the written consent of the country of final destination stating that the wastes will be safely incinerated or treated by other methods of disposal, has given authorization to the movement.

A5.3.2.2 In addition to the transport document required all transboundary movements of wastes shall be accompanied by a waste movement document from the point at which a transboundary movement commences to the point of disposal. This document shall be available at all times to the competent authorities and to all persons involved in the management of waste transport operations.

A5.3.2.3 In the event that packages and cargo transport units containing wastes are suffering from leakage or spillage, the competent authorities of the countries of origin and destination shall be immediately informed and advice on the action to be taken obtained from them.

A5.3.3 Classification of wastes

A5.3.3.1 A waste containing only one constituent which is a dangerous substance subject to the provisions of the IMDG Code shall be regarded as being that particular substance. If the concentration of the constituent is such that the waste continues to present a hazard inherent in the constituent itself, it shall be classified according to the criteria of the applicable classes.

A5.3.3.2 A waste containing two or more constituents which are dangerous substances subject to the provisions of the IMDG Code shall be classified under the applicable class in accordance with their dangerous characteristics and properties as described below.

A5.3.3.3 The classification according to the dangerous characteristics and properties shall be carried out as follows

- determination of the physical and chemical characteristics and physiological properties by measurement: or calculation followed by classification according to the criteria of the applicable class(es); or
- if the determination is not practicable, the waste shall be classified according to the constituent presenting the predominant hazard.

A5.3.3.4 In determining the predominant hazard, the following criteria shall be taken into account:

- if one or more constituents fall within a certain class and the waste presents a hazard inherent in these constituents, the waste shall be included in that class; or
- if there are constituents falling under two or more classes, the classification of the waste shall take into account the order of precedence applicable to dangerous substances with multiple hazards.

A5.3.3.5 Wastes harmful to the marine environment only shall be transported under the class 9 entries for ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S., UN 3082, or ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S., UN 3077, with the addition of the word "WASTE". However, this is not applicable to substances which are covered by individual entries in the IMDG Code.

A5.3.3.6 Wastes not otherwise subject to the provisions of the IMDG Code but covered under the Basel Convention may be transported under the class 9 entries for ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S UN 3082 or ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S., UN 3077.

Annex 6 Filling, Discharge and Manway Lid Operation

A6.1 Filling and Discharge

A6.1.1 There are three main methods of discharging tanks

- by gravity where the cargo is allowed to flow out of the shell, this is generally the normal method for tank containers with bottom discharge assemblies.
- by the use of a pump, where the cargo is pumped out, this is generally associated with a top discharge valve,
- by introducing a pressuring medium such as air or nitrogen into the shell generally associated with top discharge.

A6.1.2 There are two methods of filling:

- by gravity, generally through the manway or top discharge valve
- by pumped or pressurised flow through the manway or top or bottom discharge valves.

A6.1.3 Each of the methods of filling or discharging will involve a means of expelling or introducing air or gas into the shell to ensure that a excessive pressure or a vacuum does not build up during the process. This can be achieved by:

- filling or discharging with the manway lid open, (not used for pressurised discharge); or
- filling or discharging with the manway lid closed. With the manway lid closed and compressed or atmospheric air being passed through the airline valve
- filling or discharging using a closed loop system for higher hazard dangerous goods where top discharge tanks are demanded by the regulations.)

A6.1.4 Airline valves – standard tank containers

A6.1.4.1 The main methods of loading are by gravity ("splash fill") and by pump. If discharging by air or nitrogen, a point on the top of the shell is needed to connect up the pressurising medium supply. A small diameter valve (typically ¾ inch to 1½ inch/ 20 mm to 38 mm) is usually provided for this purpose – the airline valve.

A6.1.4.2 During loading and discharging operations, depending on the method being used, there is always a risk of the shell becoming over pressurised and rupturing or for partial vacuum conditions to occur which could lead to implosion (see Picture A6.1) Partial vacuum conditions may also occur in the shell during cleaning operations if hot water or

Picture A6.1

steam is used and the shell not allowed to cool down to ambient temperature before it is closed.

A6.1.4.3 The air line valve may also be used as a venting valve to allow air into the tank to prevent implosion during discharge by pump. Care has to be taken if this method of preventing implosion is used to ensure that the flow of air through the valve's small diameter is sufficient, otherwise implosion can still occur.

A6.1.4.4 If discharge has taken place using a pressurising medium, the shell will remain under pressure unless steps are taken to relieve the residual pressure. Attempting to open a manway lid on a shell under pressure is an extremely dangerous practice. It may be safer to relieve the residual pressure by opening the airline valve instead, even though this is a slower process.

A6.1.4.5 Pressure gauges may be fitted to airline valves and vapour return lines on top discharge tanks. These gauges should not be confused with the tell tale gauges fitted in the void between an in series bursting disc and press relief valve.

A6.1.5 Vapour Return

A6.1.5.1 Some dangerous goods are so dangerous that either to have the tank open for filling or discharge or, for example, to vent any excess pressure in the shell from the pressurising medium to atmosphere, may be extremely dangerous as the escaping vapour may be a mixture of highly toxic or corrosive vapours and the pressurising medium. Nevertheless, the excess pressure or creation of partial vacuum conditions when loading and unloading these substances must be controlled. The solution is a closed (vapour recovery) system with more than one valve fitted which allows greater flexibility in load and discharge arrangements

A6.1.5.2 In the same area as the valve over the siphon pipe there will usually be at least two other valves – see the two valves to the right in Picture 24. They may have the same diameter or one may be larger than the other. One valve will be intended to be used either for filling with a pipe or hose temporarily bolted onto the flange once the covering plate has been removed or as a vapour return line. The second valve is intended to be used either as connection for pressure discharge or it, too, may be used as a vapour return line.

A6.1.5.3 Particularly when discharging is taking place, the tank container is in need of vapour to replace the displaced liquid or implosion may occur. On the other hand, the receiving storage tank suffers a pressure increase as the liquid level rises with consequent risk of bursting. The situation is balanced using the vapour return line to divert the unwanted vapour from the storage tank into the tank container.

A6.1.5.4 When loading or discharging top discharge tanks using close circuit systems, consideration should always be given to fitting non-return valves at suitable points in the lines. These are not normally provided on the tank containers themselves.

A6.2 Manway Lid Operating

A6.2.1 *Design*

A6,2,1,1 The number of swing bolts will vary according to the pressure rating of the shell. When loosened, they fold back on their hinge to allow the manway lid to be opened.

Picture A6.2

A6.2.1.2 Picture A6.2 shows an example of swing bolts which are tightened using nuts. The shanks and wing nut of the bolts may be made of the same metal such as stainless steel (see Picture A6.3) while other designs may have a wing nut made of a softer non-ferrous metal (see Picture A6.4).

Picture A6.3

Picture A6 4

A6.2.1.3 Compatible sealing material must be fitted into a circular recess made in the manway lid (see Picture A6.5) or in the neck ring to receive the seal.

Picture A6.5

A6.2.1.4 It is important that the manway lid sealing material is appropriate to the cargo carried, in good condition and complete. An incompatible, incomplete, poorly fitted or damaged seal (gasket) will present a severe risk of the cargo, or its vapours escaping.

A6.2.2 Opening the Manway Lid:

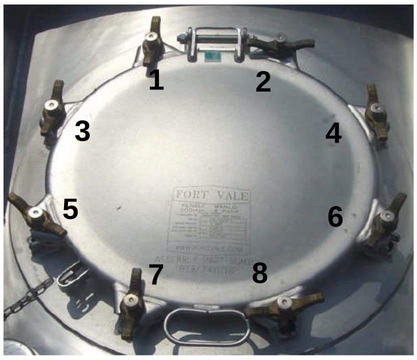
A6.2.2.1 Great care must be taken by whoever is opening manway lids in case the tank container is under pressure. Pressure may, for example, remain inside a tank after discharge because it has not been fully depressurised after emptying. Pressure may also be present due to volatile vapours or because a so-called “nitrogen blanket” has been used to inert the ullage space (liquid tanks) or gas phase (gas tanks). This warning applies to tank containers intended for both dangerous goods and non-regulated goods, including beer tanks – see 9.3.4

Caution: All pressure must be released from the tank prior to opening the manway lid

A6.2.2.2 The following steps should be taken when opening manway lids:

- Loosen the hand nuts on the swing bolts by rotating the hand nuts anti-clockwise, keeping the swing bolts upright and located in their receiving bracket. Start with the hand nuts closet to the hinge and proceed in the order shown in Picture A6 5.

  Do not swing the swing bolts away from their receiving bracket.



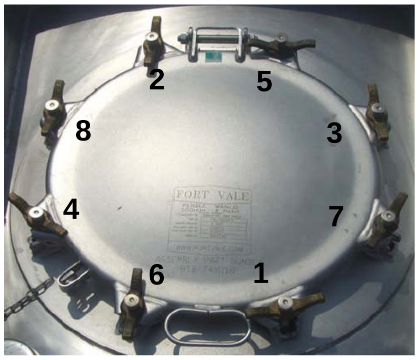
Picture A6.5

- Wait for full evacuation of any residual pressure that might have remained into the tank.
- Pull the manway lid handle firmly upwards in order to release the gasket and then let it back.
- Complete the unscrewing of the swing bolts, then swing them away from their receiving bracket in the same order as shown in Picture A6.5
- Open the manway lid by rotating it around its horizontal spindle (hinge).

A6.2.3 Closing the Manway Lids

A6.2.3.1 The following steps should be taken when closing manway lids:

- Check the gasket and gasket receiving surface for cleanliness and remove any dirt or grit.
- Position the coverlid gasket in front of the neck ring sealing surface
- Close the manway lid
- Swing the swing bolts to the upright position and position them in their receiving bracket
- Rotate the hand nuts clockwise in order to tighten the swing bolts. Tighten in the order shown in Picture A6.6
- Lock-tighten the swing bolts with a torque of 3 m daN in order to ensure gasket tightness



Picture A6.6

Note 1: It is_recommended that a torque wrench be used to ensure that the correct torque is applied

Note 2: Although a torque of 3 m daN should be necessary to ensure proper leak tightness, it is acceptable to apply a torque up to 10 m daN if required with no risk of damaging the swing bolts, manway lid and receiving brackets.

A6.2.4 ***In Service***

It is possible that the seal will be compacted during transport; this could be caused by vibration or the properties of the seal material. Should this happen then there is a risk that the seal will be broken thus increasing the risk of the cargo or its vapours escaping. If this should happen then the swing bolts should be re-tightened.

A6.2.5 ***Maintenance***

A6.2.5.1 Once per year the manway lid mechanism and dimensions should be checked as follow:

- Manway lid and neck ring thicknesses

  The actual thickness shall remain over the minimum calculation thickness after potential corrosion. The values shown below are typical:

  Minimum manway lid thickness: 4.4 mm (5 mm at time of delivery)

  Minimum neckring thickness: 7.5 mm (8 mm at time of delivery)

- Welding visual check

  No crack should show on swing bolts bracket attachments, fillets and on the circular weld between collar and neckring

- Seal tightness check

  Replace gasket if necessary

- Swing bolt threads check

  Replace the swing bolts if the threads are scratched or elongated

- Pressure test inspection

  According to tank standards requirements

A6.3 Safety

A6.3.1 All valves, ports and access lids must be properly closed once filling has been completed.

A6.3.2 Manway lids are a major cause of leaks due to improper fitting of the seal, incorrectly tightening swing bolts or swing bolts that have loosened during transport. The structure of a tank container can survive a drop from height, but if it lands upside down and the manway lid is not tightened correctly there will be a serious risk of the cargo escaping.

A6.3.3 If there is any doubt about the integrity of any closure then the shipper should be informed immediately.