SURETANK LTD.

Vertical Helifuel Offshore Tanks Technical Manual

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Abstract

The purpose of this manual is to establish a minimum understanding of vertical tank design as outlined in the following pages and to assist in the understanding of the Suretank design and manufacture process.

It is the absolute responsibility of the operator to ensure that the tank container complies with regulations or material requirements specific of the cargo, to the method of carriage or to the route over which the container is transported.

It is also the user's responsibility to ensure that the container complies with all applicable conventions, laws, regulations and government requirements.

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Section 1

Introduction

Vertical Chemical Offshore Tanks

1.1 General Description

To be read in conjunction with G.A. ST-3170 rev. C.

Unit is primarily designed, manufactured and certified under EN12079 & DNV 2.7-1.

Additionally, the unit described is a portable tank container, designed, manufactured and certified under tank instruction T4 of IMDG & ADR/RID.

The pressure vessel construction code is ASME VIII Div. 1.

The material of construction is 316/316L stainless steel.

The tank shell is 4 mm and the dished ends are 4 mm.

All tank and part attachments to tank are manufactured from stainless steel.

All bolts and fasteners are stainless steel.

Frame material:	Carbon steel EN10219	S275 J2H	– primary structure
		S235 JR	– secondary structure

Design temperature range: - 20º C to + 70º C

1.2 Specification for Standard Vertical Offshore Tank

Under section 4.2.5.2.6 of the IMDG Code, portable tank instructions specify the provisions applicable to a portable tank when used for the transport of specific substances. Portable tank instructions T1 to T22 specify the applicable minimum test pressure, the minimum shell thickness (in mm reference steel), and the pressure relief and bottom-opening provisions.

This tank is designed according to a T-4 portable tank and is available in the following dimensions:

1.3 Equipment Overview

G.A. ST-3170 Rev. C

Design Considerations

This unit is designed under strict design criteria. These include but are not limited to the following:

1) Offshore Regulations
2) Pressure Vessel Codes
3) IMDG Container Codes
4) Transport Regulations
5) Specific Data Sheets
6) Specifications

Together with sound engineering principles, these form the basis of design.

Pressure

Tank designed to T4 (under IMDG code) are as follows:

Maximum Allowable Working Pressure	1.77 bar
Hydrostatic Test Pressure	2.65 bar
Relief Valve Set Pressure	2.2 bar
External Design Pressure	0.21 bar
Relief Valve Set Vacuum	0.21 bar

Temperature

Minimum Design Temperature	-20ºC
Maximum Design Temperature	+70ºC

The vessel and frame material are based on the above operational temperature range.

Weight and Capacity

Maximum Gross Weight	4,500 kg
Tare Weight	1,790 kg
Actual Capacity	2,900 Litres +/-2%

Ullage

The maximum ullage requirement for a given product is controlled by the appropriate regulations.

For certain dangerous liquids definitive filling limits are specified. These rates are 97%, 95% or 90% according to the classification of the cargo or its vapour pressure, or whether the cargo is heated in transit.

To calculate the maximum safe load:

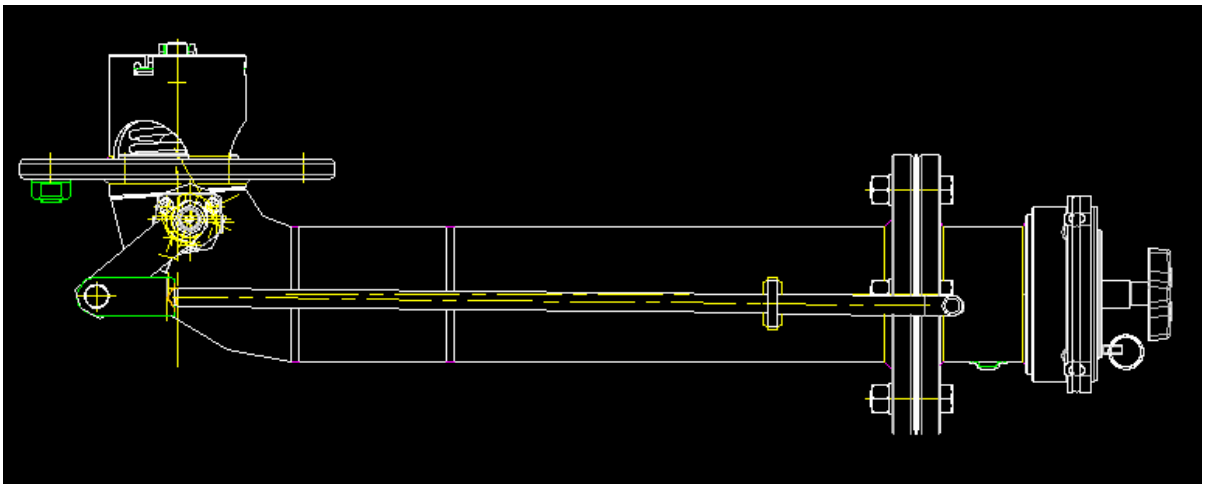
$$V = \frac{A \times C}{100\ (1 + Et)}$$

Where
V = Volume of liquid to be loaded (gallons/litres)
C = Capacity of tank (gallons/litres)
A = Fill percentage required
E = Cubical expansion co-efficient of liquid
t = Rise in temperature of cargo during containment

This calculation neglects the volumetric expansion of the vessel due to the rise in temperature. For all normal purposes this calculation will be adequate. For certain dangerous liquids definitive filling limits are specified by regulation.

Valve Configuration

As previously mentioned, this unit conforms to a UN portable tank type T4. As well as dictating pressure settings, it also determines whether bottom opening provisions are allowed. In this instance bottom openings are allowed, but it must be designed as per the requirements of the IMDG Code section 6.7.2.6.3. It shall be a 3-closure valve system. First closure being a 3" emergency footvalve operable via a lever adjacent to the valve, second closure is a 105mm Self sealing Coupling, while the final closure is simply a Cap. (FV 290/5375A).



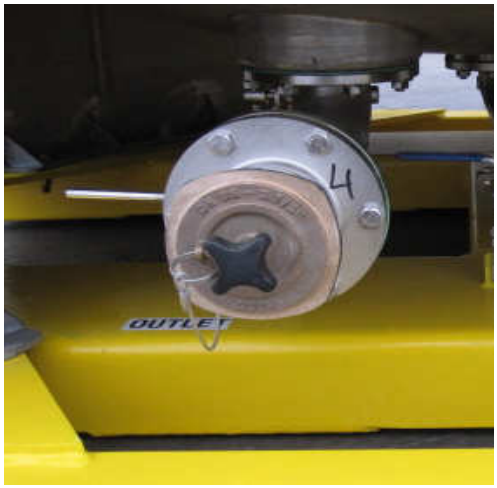


Fig 1.2 - Bottom Outlet

Section 2

Standard Tank Features

Standard Tank Features

2.1 Bottom Outlet Valve

This unit is equipped with a Fort Vale bottom outlet assembly, comprising of a 3” Emergency Footvalve, extension pipe, 105mm Self Sealing Coupling and Cap. (FV290/5375A).

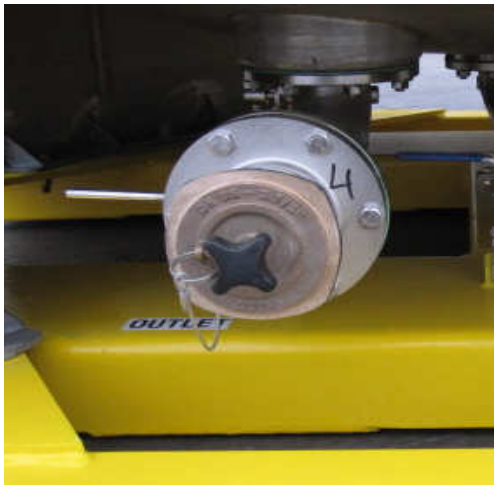


Fig 2.1 – Bottom Discharge Assembly

IMPORTANT: Connect hose first in order to minimise spillage.

In order to facilitate discharge, the emergency footvalve must be opened by pulling forward on the manual lever , (located L.H.S.) of valve.

A Female Coupling connection must be connected to the 105mm Self sealing Coupling in order to open the valve Outlet.

The cap should be removed during discharge and connection should be made to the vessel via the Coupling.

To facilitate / aid discharge, the operator may:

- Open the manlid on the top of the tank to prevent vacuum build-up. The vacuum relief valve is not intended for this use.

The exact means of discharge is very much dependant on the set-up available and is beyond the scope of this manual. For more information see section 6.4. An earthing point is provided adjacent to outlet to prevent static discharge when dealing with flammable cargo, which could cause fire/explosion.

2.2 Sample Valve

1 x 1.5” Footvalve complete with extension pipe, ¾” ball valve, 90^{o} bend and cap, c/w Remote Closure provision. (Fort Vale part number: 338/2960), or Perolo equivalent.

As per CAP 437 requirements a stainless steel sample point is fitted at the lowest point of the tank. A 1.5” foot-valve is fitted in the sample line, an extension pipe, and a ¾” ball valve terminating with a captive dust cap & chain. The sample point is designed to allow adequate space and height for a sample jar to be used.

2.3 Inspection Hatch.

1 x 170mm 3 point fastening (Fort-Vale part number. 14I/3100125W).

2.4 Pressure-Vacuum Relief Valve

As per the requirements of the IMDG code, a pressure relief valve is fitted to the top of the tank. It consists of a 2½" BSP (65mm nominal bore), fitted with both pressure and vacuum relief facilities. The whole unit is encircled with fireproof gauze (1). In the event of an emergency the wire gauze prevents flammable contents from catching fire in the case of fire engulfment.

This valve is designed to relieve pressure in the tank at a setting of 4.4 bar. It is specifically designed to offer large enough relieving air flow capacity in the case of complete fire engulfment (IMDG Code section 6.7.2.12.2). The valve is an independent safety device and should not be connected or relied upon, within the process for performing other relieving or regulating functions.

The relief valve is also fitted with a vacuum relieving spring set at 0.21 bar. Once more, this is an independent safety device and should not be used or relied upon for any other function. It is merely designed to function in the event of an over-vacuum situation.

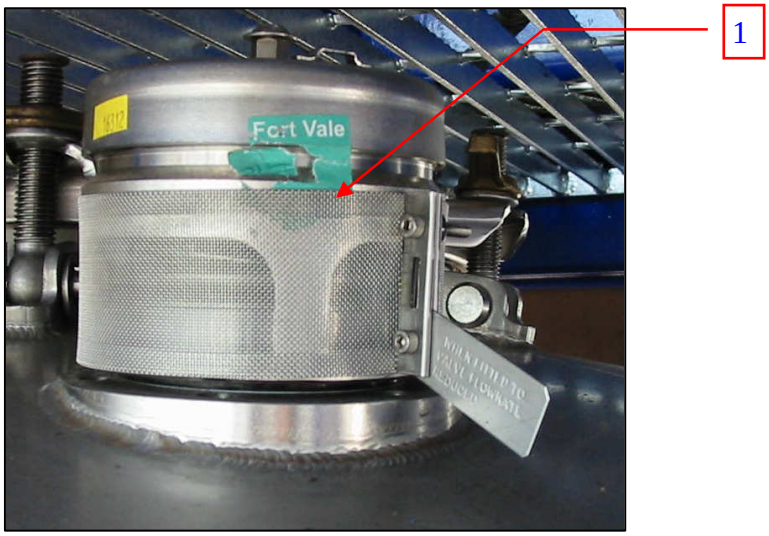


Fig 2.4

2.5 Manlid

The manlid fitted to this unit is a Fort Vale 500mm lid (Fort Vale part number: 721/0000P), complete with 6 swing bolts and a hinging mechanism. The lid is designed to enable access into the tank for inspection, repairs, cleaning, etc. It may also be used as a top filling access point.

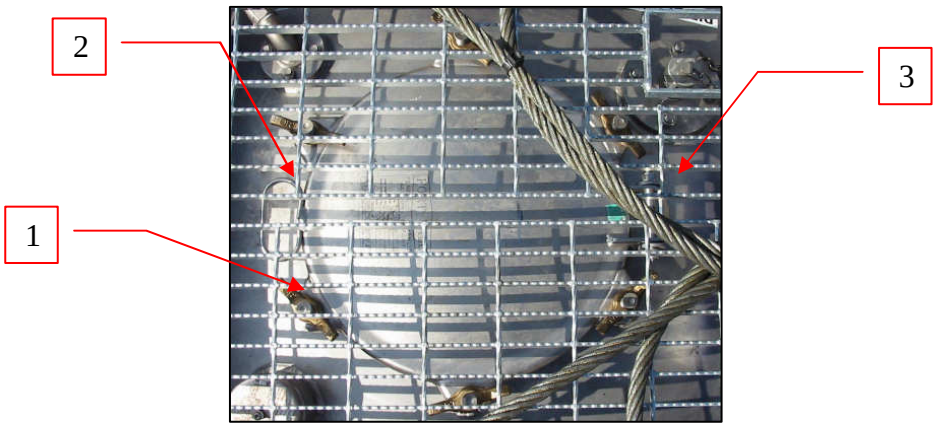


Fig 2.5 – Manlid

The lid is opened by loosening the wing nuts (1) on each of the 6 swing bolts and allowing the bolt to rotate away from the lid and lie flat on the vessel. The lid may then be raised using the handle (2) and allowed to rotate open through the hinge (3). The lid has its own stop at approximately 135 degrees of opening. The hermetic (vapour tight) seal with the vessel is enabled using a nitrile rubber square-section seal, fitted into the groove of the manlid. Care should be taken when opening the manlid due to internal pressure build-up during transport.

The manlid is closed by replacing the cover on the neckring and securely tightening all 6 swing-bolts. Tighten swing-bolts with a hammer or a special wrench. They should be tightened evenly so as to avoid creating torsion.

Note: An open manlid is outside frame dimensions. Care must be taken to ensure that it is kept closed at all times during transport as it may collide with overhead electrical wiring when in railway transit and cause damage.

2.6 Dipstick and Dipstick Access

The tank is fitted with a stainless steel dipstick to gauge the level of contents in the vessel. The vessel is accessed through the Inspection Hatch. The dipstick is placed into this Inspection Hatch and is lowered into the vessel as far as possible. Upon removing the dipstick, the level of the vessel may be compared to a scale calibrated and marked in 100L increments on the side of the dipstick. The dipstick is housed Internally within the Inspection hatch.

2.6 Walkway and Ladder

Access to the top of the tank is provided by the frame that acts as a ladder for access to the fittings. On top of the unit there is a mild steel galvanised walkway which is bolted to the frame on the top of the tank and secured using stainless steel m-clips (see fig 2.6 below). The walkway is designed to adequately cover all exposed fittings and thereby prevent straps or chains snagging as per DNV 2.7-1/EN 12079.

Access to the fittings is enabled via a mild steel galvanised grating top-lid, hinged, and designed to lie at approx 120° in fully open position

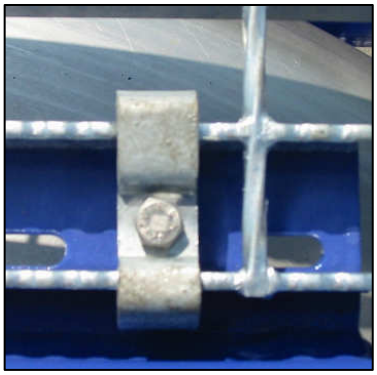


Fig 2.6 – Walkway Clips

2.7 Signwriting & Nameplates

All valves and fittings are marked to indicate their function and how they may be opened and closed. Mandatory decals are also fitted for information regarding serial number, capacity, weight, container type, approvals, etc.
In addition, further safety decals are provided to assist in warning operator of potential hazards.

Fig 2.7 – Capacity and Weight Decals


Fig 2.8 – Overhead Wires Decal

In addition to the decals, all data relating to the tank is recorded on the relevant data plate. This unit contains 2 data plates.

1. Offshore Data Plate (1)……..In accordance with IMDG, ADR/RID.
2. DNV Inspection Plate (2)……In accordance with EN12079/DNV 2.7-1

Fig. 2.9

The IMDG offshore plate provides information of the manufacturer and owner and detailed design parameters of the unit. It contains particular information on the offshore type approval details and provides for a record of future interval inspections.

The Inspection plate provides details relating to the Offshore Container, i.e. the MGW of the unit, the maximum sling angle and a record of inspections.

2.8 Frame External Finish and Vessel Internal & External Finish

The tank is finished as follows:

Frame External Finish -	Frames shot blasted to Swedish standard SA 2 ½. Prime with 1 coat of zinc rich epoxy to a nominal d.f.t. of 75 microns. Intermediate coat of micaceous iron oxide (Intercure 200) to a nominal d.f.t. of 125 microns. Finish with 1 topcoat of 2-pack polyurethane enamel to a nominal d.f.t. of 50 microns. Colour: Shell No. 4.
Vessel Internal Finish -	All welds as laid, except bottom outlet pad ground flush and polished smooth. Chemically cleaned and degreased.
Vessel Ext Finish -	Chemically cleaned and degreased; welds as laid.

2.9 Tubular Document Box

The S/S document box comes as standard on all units and is an ideal method of carrying the appropriate transport, shipping, certification or any other pertinent documentation associated with the unit.

Fig. 2.10

2.10 Safety Features

Earthing Plates

The build-up of static electricity poses a large threat to chemical tanks which carry flammable or explosive product. For this reason, earthing plates are fitted to all units as a precautionary measure. (See fig. 2.11 below).

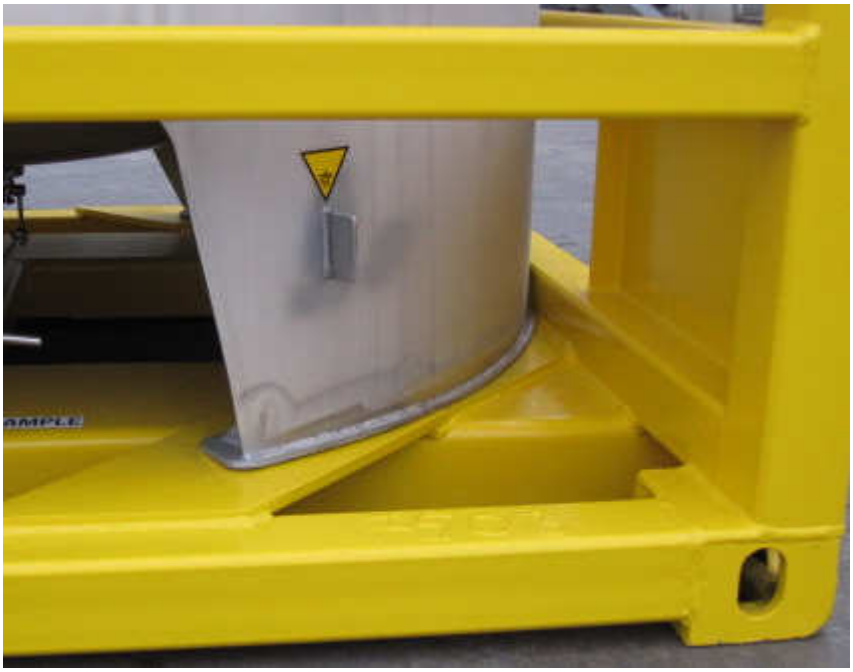


Fig. 2.11

Note: Caution must be taken when repainting the tanks so that the earthing plates are not painted over as this will inhibit their function of removing any static electricity and hence reducing the risk of fire.

PRV, PV Safety Relief Valve & Wire Gauze

As per the requirements of the IMDG code, a pressure relief valve is fitted to the top of the tank. It consists of a 2½" BSP fitted with both pressure and vacuum relief facilities. The whole unit is encircled with a flame arrestor to suit a 2½" Super Maxi Highflow pressure vacuum relief valve. This wire gauze is fitted in order to prevent the passage of flames into the tank.

Decals

Safety decals are provided to assist in warning operator of potential hazards. Mandatory decals are also fitted for information regarding serial number, capacity, weight, container type, approvals, etc.

Section 3

Optional Tank Features

3. Optional Tank Features

Some additional features are available for this tank type; however, they are not included in the standard tank design.

3.1 Float Dial Level Gauge

Suretank direct reading contents gauge are designed for mounting directly onto the side of a tank to provide a continuous reading of product contents. Each gauge incorporates a magnetic coupling through the gauge body from the wet side to the pointer, which eliminates the possibility of fluid leakage into the gauge dial chamber. The dial chamber is completely sealed and is supplied with a dry nitrogen purge to prevent condensation or ice formation for low operational temperatures.

Wetted parts are all stainless steel providing good resistance to chemical corrosion. Standard gauges are designed for use with product densities of 1.0 kg/l. Gauges with counter balance weights are available for use with lower product densities. Each gauge is custom built and calibrated to suit individual tank dimensions and design. Dial markings are available in fractions, percentage or engineering units. (See fig. 3.1 below)

Features:

- Constant Reading of Contents
- Robust Construction
- Leak Proof
- Dry Gas Purged Dial Chamber
- Designed for Environmental Extremes

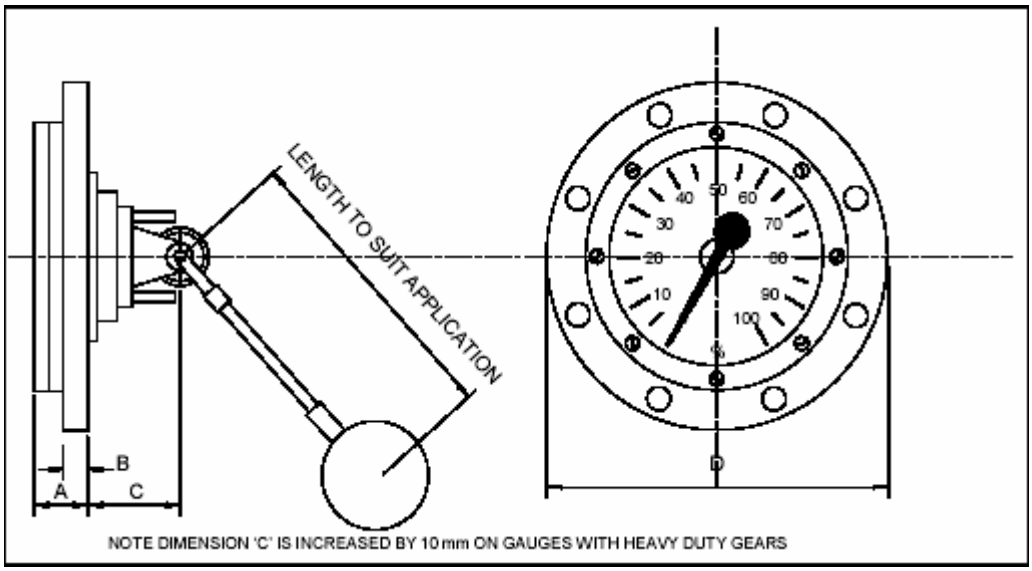


Fig. 3.1

3.2 Magnetic Level Gauge

The magnetic level gauge is designed so that the liquid being measured is enclosed within a sealed chamber. A stainless steel, titanium or plastic float fitted with a permanent omni-directional magnet moves freely inside the chamber and actuates the magnetic wafers within the indicator. As the float rises or falls with the liquid level each wafer rotates 180º and so presents a contrasting colour. Those wafers above the float show white, whilst those level and below show red – the indicator then presents a clearly defined and accurate level of the liquid in the chamber.

The Magnetic Level Gauge can be mounted in various orientations, typically onto the side of the vessel. Connections are direct to the bottom and top of the tank. (See fig. 3.2A & 3.2B below)

Fig. 3.2.A

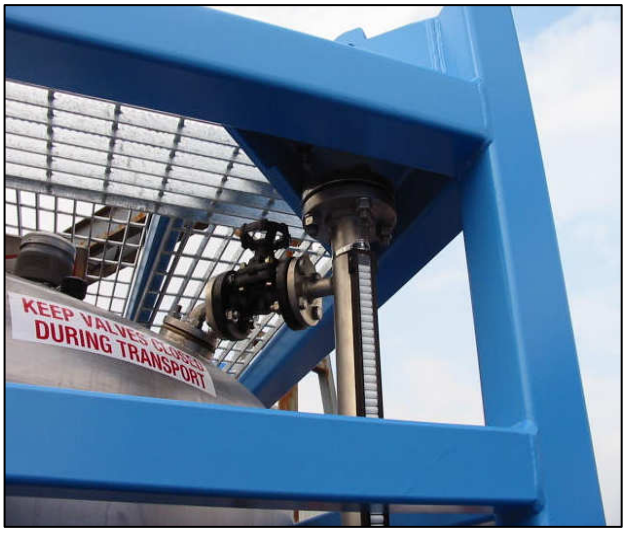


Fig. 3.2.B

3.3 Fall Arrestor

During offshore conditions climbing onto the top of the tank can be extremely dangerous. A fall arrestor and accompanying harness, for the operator, can limit the risk of falls.

Fig 3.3

3.4 Spare Connections

Spare connections can be supplied for the provision of future ancillaries such as level gauges, dipsticks, etc…

3.5 Approvals

The standard approvals are:

IMDG
DNV 2.7-1
EN 12079
ADR/RID

Optional approvals include:

UIC
TIR
CSC
USDOT

ASME U-STAMP
PED

Section 4

Maintenance

4. Maintenance

Introduction:

Inspection should be carried out in compliance with all international and national laws regarding safety, the workplace, inspection and working conditions.

Entry into tank vessel should be undertaken only after compliance with all of the prerequisites required or recommended by the health and safety authorities having jurisdiction over both the location of the tank and the tank itself.

Do not enter any tank vessel which does not possess a valid certificate of cleanliness and valid entry permit. Persons wishing to enter a tank vessel must take adequate precautions prior to entry to ensure their personal safety.

4.1 Mandatory Inspections and Tests for Containers Carrying Dangerous Goods

The shell and other items of equipment of the unit shall be inspected and tested before being put into service for the first time (initial inspection and test) and thereafter at not more than 5 year intervals (5 year periodic inspection and test) with an intermediate periodic inspection and test (2.5 year periodic inspection and test) midway between the 5 year periodic inspection and test. An exceptional inspection and test shall be performed regardless of the last periodic inspection and test, where deemed necessary.

4.1.1 Initial Inspection

The initial inspection and test is carried out at the manufacturer's premises. It includes a check of the design characteristics, an internal and external examination of the tank and its fittings and a pressure test in accordance with the IMDG code. A leak proof test and a test of the satisfactory operation of all the service equipment are also performed. When the shell and all its fittings have been separately pressure-tested, they are subjected to a leak proof test together.

4.1.2 5 Year Periodic Inspection and Test

This test shall include an internal and external examination and as a general rule, a hydrostatic test. When the shell and the equipment have been separately pressure-tested, they are subjected to a leak proof test together.

Any heating equipment will be subject to inspection and tests including pressure tests on heating coils or ducts during the 5-year periodic inspection.

4.1.3 2.5 Year Periodic Inspection and Test

This test shall include an internal and external examination of the portable tank and its fittings, a leak proof test and a test of the satisfactory operation of all service equipment.

4.1.4 Exceptional Inspection and Test

This test is necessary when the tank shows evidence of damaged or corroded areas, leakage or other conditions that indicate a deficiency that could affect the integrity of the tank. The extent of the test shall depend on the amount of damage or deterioration of the tank. It shall include at the very least a 2.5 year inspection and test.

All 4 tests detailed above shall be performed or witnessed by an expert approved by the competent authority or its authorised body. The date of the inspection shall be recorded on the nameplate. In all cases where cutting, burning or welding operations on the shell have been carried out, the work shall be to the approval of the competent authority or its authorised body, taking into account the pressure vessel code used for the construction of the shell. A pressure test to the original 6 bar shall be performed after the work is complete.

4.2 Internal and external examinations shall ensure that:

- The shell is inspected for pitting, corrosion or abrasions, dents, distortions, defects in welds or any other conditions, including leakage that might render the unit unsafe for transport.
- The piping, valves and gaskets are inspected for corroded areas, defects or any other conditions including leakage that might render the unit unsafe for filling, discharge or transport.
- Swingbolts for tightening manhole covers are operative and there is no leakage at cover or gasket.
- Missing or loose bolts or nuts on any flanged connection or blank flange are replaced or tightened.
- All emergency devices and valves are free from corrosion, distortion and any damage or defect that could prevent their normal operation. Self-closing foot valve shall be operated to demonstrate proper operation.
- Required markings on the tank are legible and in accordance with the regulations.
- The framework, the supports and the lifting equipment of the tank are in satisfactory condition.

Important:
This unit may not be filled and offered for transport after the date of expiry of the last 5 year or 2.5 year inspection and test. However, if the unit was filled prior to the date of expiry of the last inspection and test, it may be transported for a period not to exceed 3 months beyond this date of expiry. In addition, this unit may be transported after the date of expiry of the last inspection and test, if after emptying but before cleaning, for purposes of performing the next required test or inspection prior to refilling and unless otherwise approved by the competent authority, for a period not to exceed 6 months beyond the date of expiry, in order to allow the return of dangerous goods for proper disposal or recycling. Reference to this exception should be included in the transport documentation.

4.3 Periodic Examination, Tests & Repairs for Offshore Containers

It is the responsibility of the owner to retain the current offshore certification for the unit, arrange for periodic inspection, record substantial repairs, modifications or changes in identification, etc., and maintain adequate records to ensure the traceability of equipment.

All periodic examinations and tests shall be carried out by an inspection body meeting the requirements of EN 12079/DNV 2.7-1 (Annex 2).

Containers shall be periodically examined and tested in accordance with the schedule listed in the following table:

Schedule of Examination and Testing

Time or Interval	**Test / Examination**			
	Lifting Test	Non-Destructive Examination of Padeyes	Thorough Visual Examination	Suffix to be marked on offshore plate **
Initial Certification	Yes	Yes	Yes	T
At Intervals not exceeding 12 months	At discretion of Inspection Body	At discretion of Inspection Body	Yes	T or VN or V
At intervals not exceeding 5 years	At discretion of Inspection Body	Yes	Yes	T or VN or V
After substantial repair or alteration *	Yes	Yes	Yes	T

* A repair which in the opinion of an inspection body, affects the primary elements of the offshore container, or elements which contribute directly to its structural integrity.

** T - Proof-load test, non destructive examination and visual examination.

VN - Visual examination and non-destructive examination.

V - Visual examination only

Note: For the exact detail of the lift test, non-destructive examination and visual examinations please refer to EN 12079/DNV 2.7-1 section 4.6.3, 5.2.3/5.2.4 & 5.4.

Important:
It is the owner's responsibility to ensure that this unit is maintained in accordance with the above standard. If the user or any of his agents detects any structural damage or corrosion which may affect the load bearing integrity of the unit, they shall immediately contact the owner to make arrangements for repairs to be carried out. Adequate arrangements shall be made for the safe transportation of the damaged container to the location agreed by the owner. The container shall not be used until it is repaired and inspected by an inspection body.

Repairs of the load bearing structure shall be carried out in accordance with the requirements for design and manufacture of container set out in EN12079/DNV 2.7-1. The repairer shall ensure the quality of these procedures and facilities by a certified quality assurance system at least in accordance with EN ISO 9002. The owner shall provide the inspection body with full details of repairs which have been carried out. After completion of repairs, the unit shall be inspected and where relevant, tested by the inspection body. Any modification will require re-certification of the container by a certifying body.

4.4 Tank Cleaning

Cleaning is a complex and specialised task to be undertaken only by trained personnel. If the unit contains residue from hazardous cargo, it must only be cleaned by approved cleaning facilities.

There are several tank cleaning techniques including the following:

- Cold water wash
- Hot water wash
- Steam cleaning
- Solvent wash
- Caustic wash
- Acidic wash
- Detergent wash

Cleaning is a standard requirement unless a similar or compatible product is to be loaded soon after discharging the previous cargo. It should be carried out without delay to prevent drying out or hardening of residue or contamination of residues with air or moisture which may cause chemical changes, resulting in serious corrosion to the tank shell material. Cleaning is particularly important when the previous cargo is toxic or is likely to react with another product.

Disposal of chemical residues can often be more expensive than the cleaning operation itself. Operators should always ensure that the tank is properly emptied by the consignee. Care should be taken to ensure that disposal of residues takes place in an environmentally friendly matter.

Before accepting any cargo for transport, the operator of this unit is advised to obtain all possible information concerning the recommended method of cleaning and determine whether it is possible to dispose of certain product residues at cleaning stations near the point of discharge. Always check with the local authorities that there are no local regulations which may prohibit the cleaning of tanks which have carried a particular cargo.

After discharge, the tank will contain residues which, depending upon the individual hazard may require to be disposed of by:

- Filtering
- Incineration
- Settlement
- Dumping

or as demanded by the local authority.

Modern cleaning methods reduce the exposure of personnel by the use of branched jets or spinners inserted into the tank. Certain cargos may require a special cleaning medium such as detergent, caustic, emulsifier, solvent or patent pickling chemical such as acid detergent. Hardened residues may have to be removed by high pressure water jet. Steaming with Xylene or Toluene will assist in removing dried resins. Sonic equipment is sometimes used to speed up the cleaning process.

Consideration of the effect of the cleaning method on the tank shell material is important. Many products release free chlorides if heated or contaminated with water or other chemicals. The resulting corrosion is fast and often irreparable.

Chemical testing for cleanliness can be done but is normally only provided on demand. Visual inspection of a tank is not necessarily undertaken. An inspection society cleanliness certificate is not always a guarantee that a tank is sufficiently clean for the next product to be loaded. Sterilisation and deodorisation are sometimes required as an addition to the normal cleaning process. Stripping and cleaning of valves is not normally undertaken unless specifically requested.

Bearing the above comments in mind, the following cleaning procedure is offered as a guideline to the operator of this unit.

1. It is advisable to remove cargo residue as soon as possible after discharge.
   Prolonged presence of residue of many products, especially if contaminated with water, can seriously damage the stainless steel tank surface.

2. It is essential to identify the previous cargo in order to establish the method of removing and disposing of the residue.

3. Ensure that the cleaning materials and procedure are compatible with the previous cargo as well as the tank and its fittings.

4. Check local regulations regarding cleaning and disposal of cargo residues.

5. The residue of the majority of cargos is often removed by steam cleaning but in many cases this can cause residue to harden or cause them to become corrosive to stainless steel. Expert opinion should always be sought where the correct cleaning procedure is not known.

6. Cleaning stations do not normally strip and clean equipment such as syphon tubes, level gauge chambers, valves, so instructions should be given to ensure that items are free from contamination.

7. Always vent the tank during steam cleaning. Check the maximum operating temperature on the data plate. Do not close all openings before the tank has cooled as a partial vacuum would develop which may cause the tank to collapse.

8. Stubborn stains or cargo residue may be removed by abrading with nylon pads, e.g. Scotchbrite. No other form of abrasive material may be used inside the tanks without expert advice. Chemicals are available to easily remove most stains. These chemicals have the additional advantage of improving the resistance of stainless steel to corrosion.

9. Condensation of water vapour within the tank can cause trace elements from the cleansing compound to become corrosive. Always ensure a tank is dry after cleaning and never store the tank with the valves and manlid open.

10. After cleaning, a competent inspector should issue a cleaning certificate declaring the tank free of all previous cargo and contamination. After certain cargos, a gas free certificate will also be required.

11. The exterior of the tank should also be cleaned to prevent damage to the tank. Any spillage or residue of hazardous cargo must be removed to comply with international regulations. All markings must be clearly legible.

12. Remove redundant labels. It is illegal to allow a tank to be transported with incorrect hazard labels.

13. The ladder and walkway should be kept free of cargo and dirt to ensure the safety of personnel.

14. Finally, a word of caution, never enter a tank or touch cargo residue unless there is a signed permit from an authorised person allowing entry and confirming that the tank is clean or the last cargo was harmless.
15. Often cleaning operations involve “person-in-tank” work. There needs to be procedures in place to establish that the atmosphere inside the tank is safe to breath e.g. using oxygen meters, other meters detecting flammable or harmful vapour, Draeger tubes etc.

16. When checking the atmosphere inside a tank, the possibility of the presence of a pocket of unsuitable vapours should not be discounted. Remember, the vapours are more often than not heavier than air, may be colourless and odourless.

17. If necessary, workers should be protected and given a sustaining independent air supply.

18. Tanks risk implosion if they are not allowed to cool before closing them down.

19. Cleaning certificates that attest to the thorough cleaning of a tank greater than forty-eight hours previously should not be accepted.

Warning: There are numerous examples of deaths of workers inside tanks due to an oxygen starved atmosphere.

4.5 Routine Maintenance and Checks

4.5.1 Cleaning

Check that the tank interior is clean, free of particles, stains and taint from previous cargos. Check exterior for cargo contamination or excessive road dirt. Check for presence of foreign labels. For further information on cleaning, refer to the previous section of this manual.

4.5.2 Framework

Check for cracks, dent, distortions, holes, splits, improper repairs and damage to welds. Check that distortions have not damaged the tank shell.

4.5.3 Walkway

Check for cracks, dents, distortions, holes, splits, improper repairs and damage to welds that would render the walkway unsafe. Check all fastenings are present and tight.

4.5.4 Paintwork

Check general condition for areas of damage or corrosion. Check for areas of damage caused by cargo contamination.

4.5.5 Manway

Inspection

- Check for damage and correct operation.
- Check that the seal has not deteriorated and is free of contamination.
- Check bolts and hinge pins are stainless steel.
- Check hand nuts are of a non-corrosive metal.
- Check the dipstick for legibility and security.
- Check customs sealing requirements are met.
- Check neckring and manlid for damage, pitting, corrosion and contamination.
- Check neckring for damage, distortion and burrs.
- Check weld to tank for cracking.
- Check manlid for damage, distortion, indentations and cracks to welds.
- Check manlid hinge for distortion and cracks.
- Check seal for excessive deformation, contamination, cracking and deterioration.
- Check pivot pins of swing bolts are secure with the fixing screw fitted inwards for customs requirements.
- Check threads of swing bolts are free of damage or corrosion.
- Bolts should have light lubrication.
- Check hand nuts for ease of operation and nuts are held

Repairs

- Crack to hinge welds should be ground out and re-welded using appropriate stainless steel filler material.
- Hand Nuts: Seized hand nuts should be removed to re-tap the thread and to run a die nut over the bolt thread. Where the hand nut cannot be freed, cut the nut to facilitate removal.
  Re-cut the bolt threads and fit a new hand nut.
- Manlid: Distorted or dinted manlids should be straightened where possible. Where excessive damage has occurred, fit a replacement.
- Cleanliness: Contaminated fittings and manway well must be cleaned

Note: Any hot work carried out on the vessel invalidates the mill certificate.

4.5.6 Dipstick

Inspection

- Check dipstick and stainless steel pipe are free of corrosion, pitting and contamination.
- Check material is stainless steel of the same grade as the tank type.
- Check dipstick markings are legible.
- If replacement of dipstick is necessary, contact Suretank for details.

4.5.7 Safety Relief Valve

Inspection

- Check for damage and correct operation.
- Check gaskets and seals are undamaged and are of the correct material.
- Check for cleanliness
- Check flame-trap for damage and security.
- Check customs sealing requirements are met.

Cleaning

- Remove PV valve from tank.
- Remove plastic plug from top of valve and push down the vacuum pressure plate with a suitable rod to facilitate cleaning of the pressure plate from the inside bottom of the valve.
- Using the pressure plate lifting tool or otherwise, lift the pressure plate off the seating to facilitate cleaning through the valve case.
- Test the valve in accordance with the following procedure:

Testing

- Prepare test rig as in the diagram below.

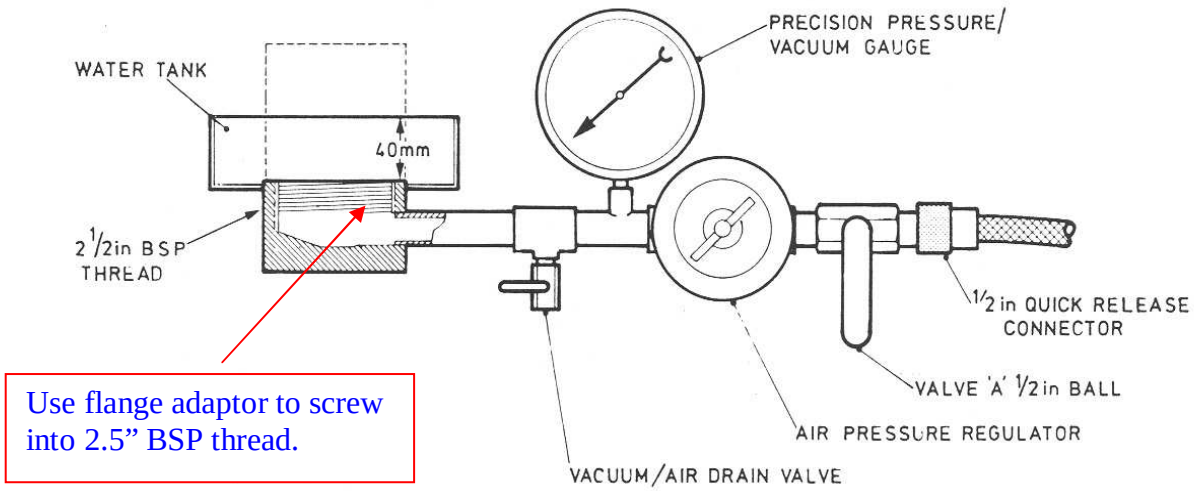


Fig 4.1 – Test-Rig for Relief Valves

- Position valve in the test rig and fill water bath with soapy water to cover the valve outlets.
- Raise pressure to operating pressure (4 bar) and check for leakage.
- Increase pressure in the rig slowly until air bubbles start to appear from the pressure plate seal.
- This is the "start-to-discharge" pressure. Check gauge reading and record.
- Reduce pressure in the rig slowly until the air leakage stops. This is the "re-set" pressure. Check gauge reading and record.
- Drain water from the water bath.
- Release pressure via the venting valve.
- Substitute a vacuum supply for the pressure supply or alternatively use the deadweight tester.
- Increase vacuum slowly until valve relieves. Check gauge reading and record.
- Confirm results conform to below :

Start-to-discharge pressure	Re-Set Pressure	Vacuum setting
4.4 bar (tolerance as marked on valve)	3.96 bar (Can't be less than 10% below "start-to-discharge" pressure)	6" Hg (tolerance as marked on the valve)

- Defective valves should be repaired by approved depots only. In some circumstances it may be expedient to fit new or refurbished valves and return the original valve to an approved depot for remedial work.

Section 5

Safety

5.0 Safety

5.1 General Safety Procedures

There are general safety considerations to be considered when planning to undertake operations associated with this unit:

- Is the tank located at the correct storage area?
- Is it a danger to other operations?
- Is it too close to platform edge?
- Are contents compatible with adjacent material?
- Are all fittings and labels accessible and visible?
- Is the master link accessible?
- Is it necessary to double stack?
- Can the contents be sampled and measured?
- Is there a health & safety data sheet available for the tank contents?
- Is there a danger of radiant heat from a flame?
- Has the tank been checked for loose items?
- Are there any visible signs of mechanical damage?
- Is the tank load within the stowage area weight limit?

5.2 Preparation for Dispatch Onshore / Offshore

The following check should be carried out as a minimum when working with tanks and their contents:

A. Check the condition of the frame and ensure that there are no signs of excessive corrosion or deformation.
B. Ensure that the tank is not overloaded. Please refer to section 1.3 of this manual for important data on this subject.
C. In the case of tank having cargo in it, ensure there are no signs of leakage.
D. Check that all certification is full in date, and has sufficient test period remaining so as to prevent certification expiring when offshore.
E. Ensure that any old hazard and supply labelling has been removed and affix all new relevant hazard and supply labelling.
F. Check all valve assemblies for damage and security ensuring end caps are in place.
G. Check that manlid is securely closed.
H. Check the lifting equipment for any signs of damage.
I. Check the grating for any sign of damage or for loose fittings.
J. Check the top surfaces for any potential dropped objects.

5.3 Accessing the top of tank

Access/climbing on top of a chemical tank should only be undertaken as a last resort AND IS NOT RECOMMENDED.

However, should this become absolutely necessary, access should be gained by using the tank's built in ladder.

Note: All tanks should have a fully enclosed grated or plated top and where not in place then access to the top of the tank should be avoided and only carried out following a risk assessment and if the activity is accompanied by a watchperson.

Suitable height safety arrangements in line with Working at Heights Regulation must be in place should access to the top of a tank be necessary.

While this unit has been designed to comply with all appropriate approvals, there are still unavoidable hazards as follows:

A. The process of going from ladder to top of tank requires 100% awareness. It will be necessary to grab hold of the top member of the frame or the walkway, in order to pull oneself up.
B. While on top of tank, there are hazards above the padeyes as access needs to be provided for slings. Stand on walkway at all times and do not attempt to stand on any part of the vessel.
C. Working at heights is a common safety hazard and all appropriate precautions should be taken.

5.4 Discharge

A. Ensure all hose connections are made prior to opening the internal valve.
B. Care should be taken in opening vent valve on top as there may be pressure in the tank.
C. Ensure all appropriate earthing procedures are complied with.

5.5 Lifting with Sling Set

Extreme caution should be taken in attaching shackles to padeyes and additionally hooking up master link to crane hook. Furthermore be aware that no container may be stacked on one, which has its sling set still in tact on top of the tank. If stacking is required, sling set should be removed and kept in storage.

Guidelines and safety procedures relating to offshore lifting are beyond the scope of this manual, but a good reference for these guidelines is the UKOOA safe shipping guidelines, published in November 2002.

5.6 Lifting with Forklift

The IMDG Code does not allow portable tanks with dangerous cargo to be lifted with a fork lift truck unless they are less than 3.65m long and comply with the quoted subparagraphs (see section 6.7.2.17.4).

The tanks are equipped with forklift pockets located at the base of the frame.

5.7 Safety Considerations Associated with Tank Use and Risk Assessment

Prior to undertaking any work associated with chemical tanks and their contents, personnel must consider all aspects of safety and ensure safe working practices are adhered to.

This can be effectively achieved by carrying out a Risk Assessment, which should consider as a minimum the following safety questions:

- Is a formal Risk Assessment required?
- Is the tank located at the correct stowage point or designated area?
- Is it a danger to other operations?
- Is it too close to the edge of a facility, equipment or other cargo unit?
- Has the segregation of products been considered?
- When stowed are all the valves and fittings accessible?
- How can the contents be sampled and measured?
- Is it clear what the tank contents are?
- Are the contents labelling clear and visible?
- Is the lifting sling master link accessible without climbing on top of the tank frame?
- Is there a MSDS sheet available for the tank contents?
- Is there a danger of radiant heat from a flare or other source?
- Has the tank been checked for loose items?
- Is double stacking unavoidable and if so are tanks and Stacking posts compatible?
- Is there any visible mechanical damage?
- Is the tank load within the storage area weight limit?
- Has backload product compatibility been established to ensure hazardous chemical by products have not been formed?
- Is it possible for flammable vapours to escape into the atmosphere?
- Has the tank been properly earthed by a competent person?

Section 6

Operation

Operating Conditions and Considerations

6.1 Tank Contents and Handling

Among the reasons given for climbing on top of tanks are:

- Accessing the dip tube.
- Opening the tank lid to determine level.
- Filling through the manlid.
- To operate the vacuum breaker or open the hatch to assist flow.

6.2 Sampling

Sampling of the tank contents should be carried out through the 3/4” sample valve, an off-take from the main discharge line at the base of the tank.

- Remove the cap, open the lever-operated foot valve.
- Place clean sample jar at sample valve discharge and drain off sample carefully ensuring all potential for drips/spillages/splashes are catered for in the risk assessment.
- Replace protective cap, close valves.
- Adhere to precautions identified on Health and Safety Data Sheets and the COSHH and Risk Assessments.

Note: No intervention on Air Inlet Valve or Pressure/Vacuum Breaker Valve is required for sampling.

6.3 Contents Checking

The unit also comes with a dipstick marked on one side in 100 L increments and on the other in 100 litre increments, housed Internally within inspection hatch.

The level may be read by placing the dipstick in through the access point, to a sufficient depth and accordingly, taken from the level marked on the dipstick.

6.4 Discharging

When discharging flammable product, the tank should be bonded, (earthed by a competent person) in order to prevent a build up of static electricity and subsequent danger of ignition/explosion.

- Remove drip cap from the mail discharge outlet and connect hose to the main discharge outlet valve.
- Open the lever operated foot valve and main discharge valve, (in that order), to allow the tank to discharge.

When discharging the tank, the following actions should be considered:

- Ambient temperature, viscosity and specific gravity, all may inhibit free flow.

Note: Operators should be aware of the following hazard.

Upon completion of discharging the tank contents ensure all valves are closed, end caps are refitted and secured accordingly.

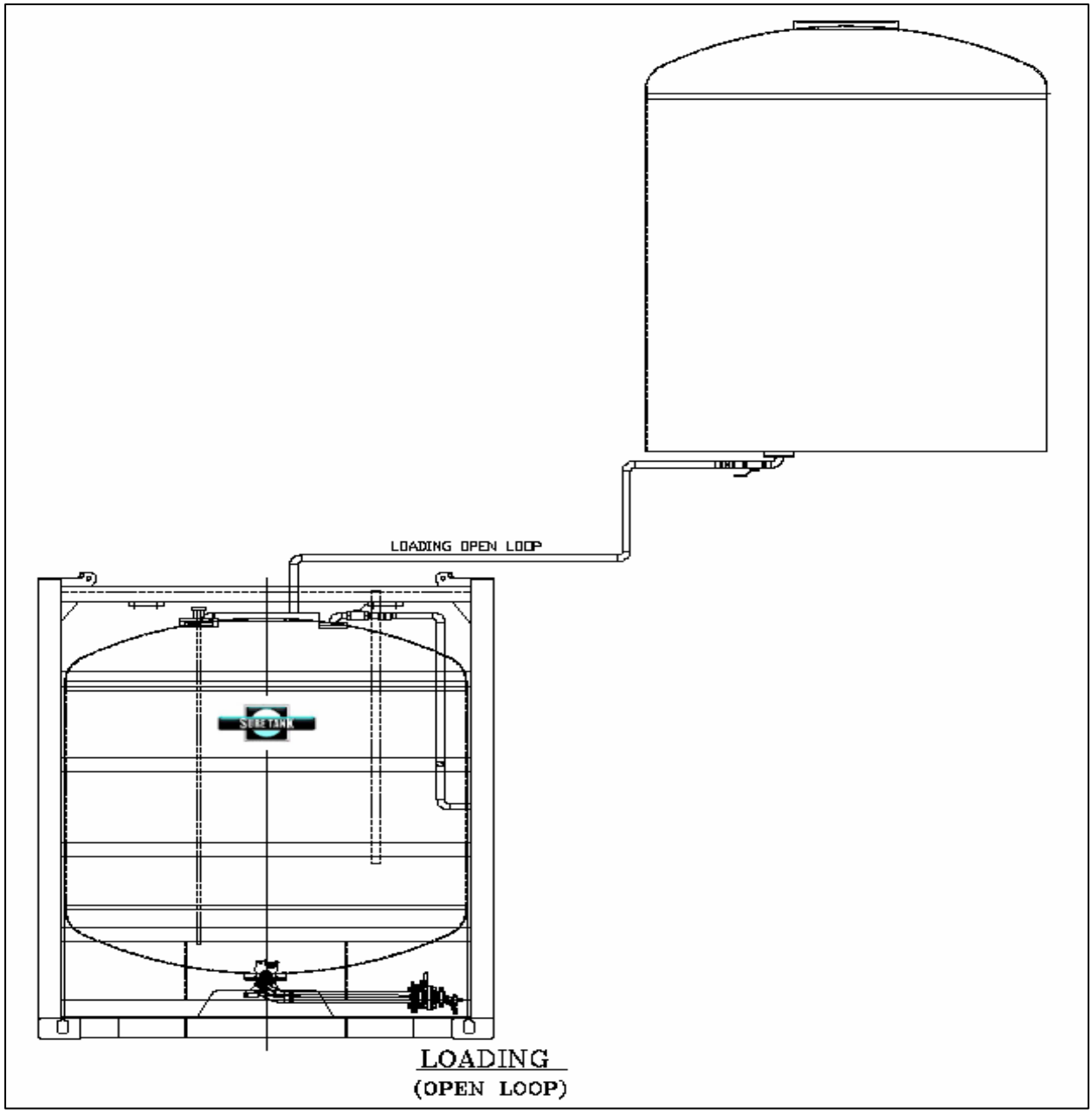
6.5 Recirculation

1. Loading – Open Loop

- Earth the container by connecting the earth plugs to the earthing spades, located on the front and rear of the bottom frame transverse member.
- Connect the hose to the Bottom Outlet on the storage tank and insert it through the manlid into the container.
- Open the airline valve on the container.
- Open the Bottom Outlet Valve of the storage tank.
- (This can be further assisted by using a pump).

Once loading is complete:

1. Close Outlet Valve and disconnect the hoses as well as the earthing spades.
2. Make sure all the openings are firmly closed.
3. Clean any areas that may be contaminated by the product.

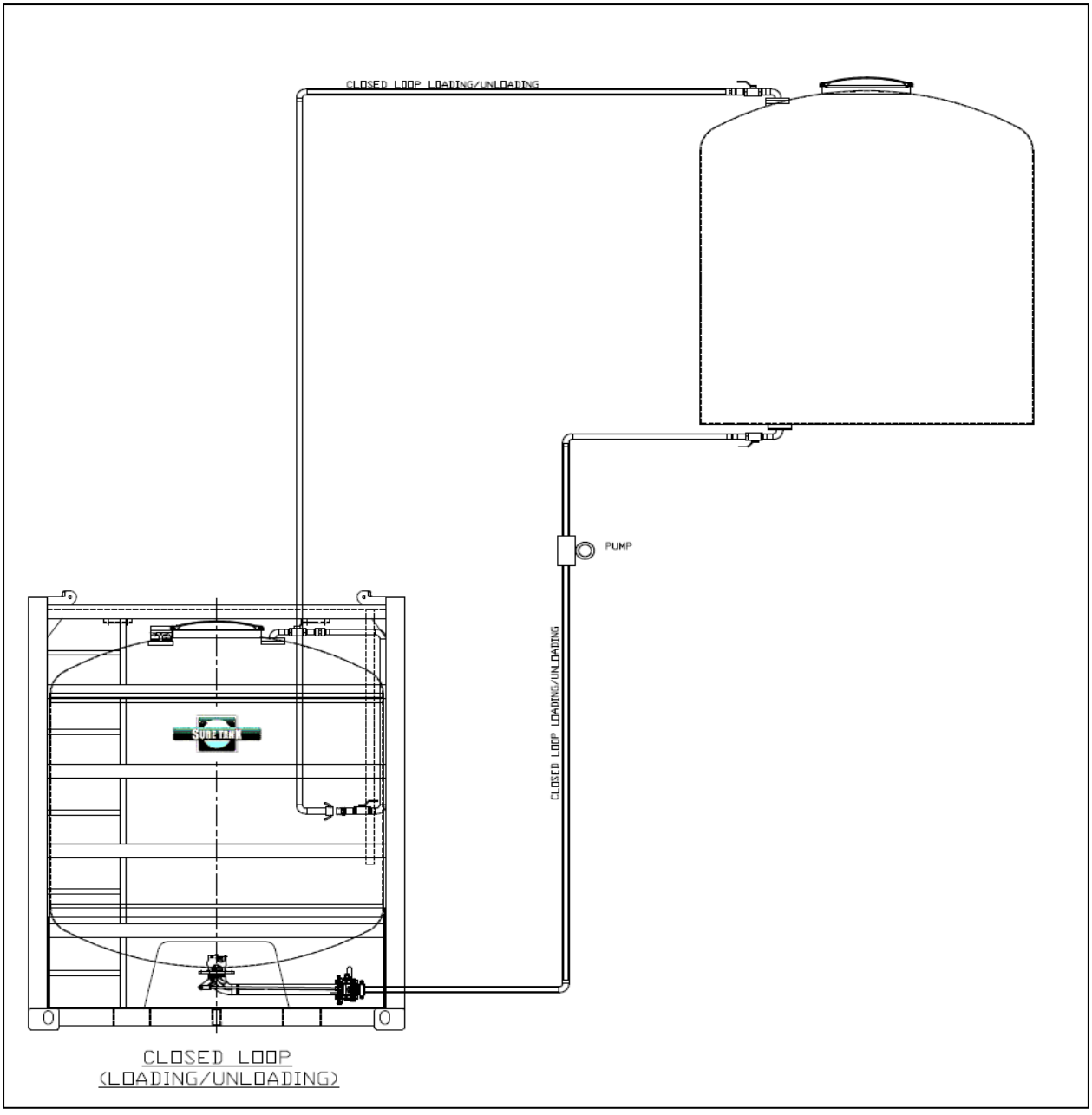


2. Loading – Closed Loop

- Earth the container by connecting the earth plugs to the earthing spades, located on the front and rear of the bottom frame transverse members.
- Connect the hose to the Bottom Outlet on the storage tank and the Bottom Outlet on the container via a pump (note: ensure pump direction is consistent with required flow direction).
- Connect a hose from the storage tank airline to the airline valve on the container.
- Open the Bottom Outlet Valve of the container followed by the storage tank Outlet valve.
- Start the pump until desired amount in transferred

Once loading is complete:

1. Close Outlet Valve and disconnect the hoses as well as the earthing spades.
2. Make sure all the openings are firmly closed.
3. Clean any areas that may be contaminated by the product.

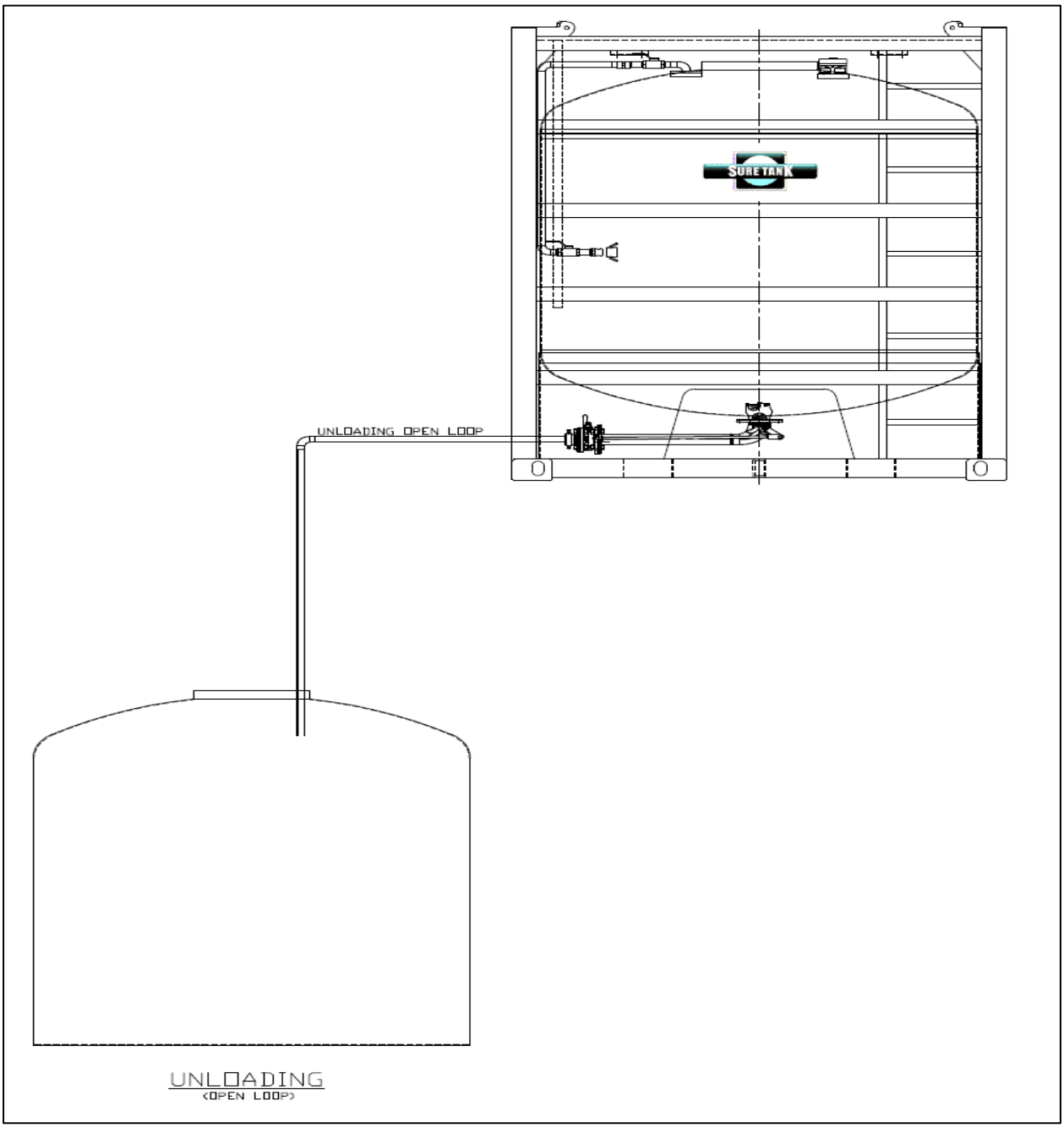


3. Unloading - Open loop

- Earth the container by connecting the earth plugs to the earthing spades, located on the front and rear of the bottom frame transverse member.
- Connect the hose to the Bottom Outlet on the container and then to the inlet of the storage tank.
- Open the airline valve on the container.
- Allow gravity take its course.
- (This can be further assisted by using a pump).

Once unloading is complete:

1. Close the Bottom Outlet of the container.
2. Disconnect the hoses.
3. Make sure all the openings are firmly closed.
4. Clean any areas that may have been contaminated by the product.

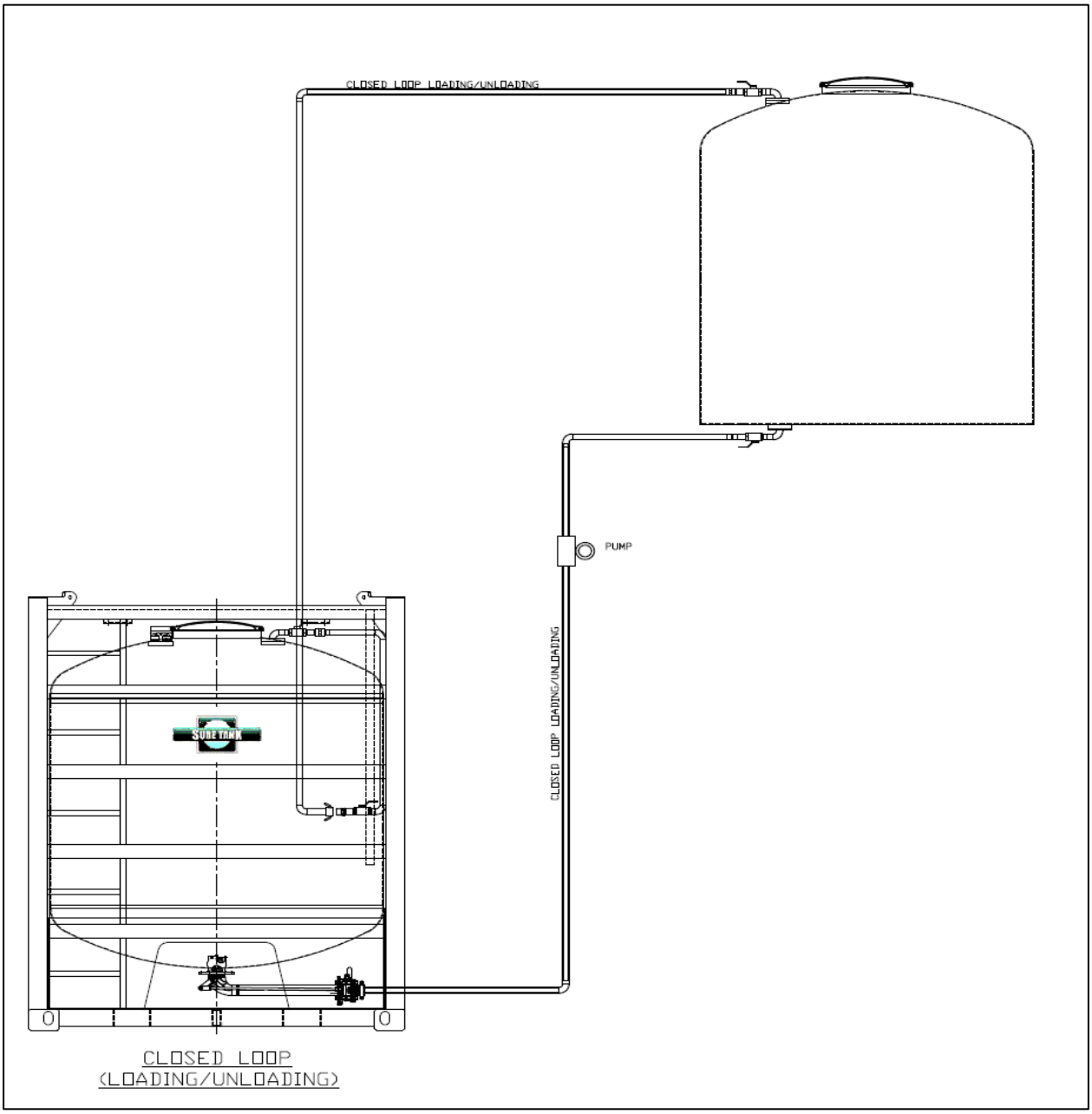


4. Unloading - Closed Loop

- Earth the container by connecting earth plugs to the earthing spades, located on the front and rear of the bottom frame transverse member.
- Connect the hose to the Bottom Outlet on the storage tank and the Bottom Outlet on the container via a pump. (note: ensure pump direction is consistent with required flow direction)
- Connect a hose from the storage tank airline to the airline valve on the container.
- Open the Bottom Outlet Valve of the container followed by the storage tank Outlet valve.
- Start the pump until desired amount in transferred.

Once unloading is complete:

1. Switch off the pressure loading.
2. Close the valves (C) or (H), then (B) and disconnect the hoses.
3. Make sure all the openings are firmly closed.



6.6 Pressure/Vacuum Relief-Valve Operation

At no time during the tank life cycle shall the pressure/vacuum relief valve be manually operated (only exception being onshore tank maintenance routine).

Any interference with this valve will affect its operational functionality and thereby compromise safety and tank integrity.

Note: The design of Chemical Tanks is primarily covered by IMDG Code.

6.7 Hooking On/Off

When in the stowed position, the tank lifting accessories should be located hanging down the outside of the tank frame (approximately 1.3m from the ground as advised by DNV2.7-1). This allows easy access to the master link, when hooking on/off the crane hook. This also avoids the necessity for climbing on top of the tank and hence compromising the safety of the operator.

Note: Particular care must be taken to ensure that the lifting accessories and crane hook does not inadvertently snag on the tank framework or ancillaries causing the possibility of premature movement of the tank.

6.8 Stacking

Double stacking of chemical tanks offshore **should be actively discouraged** and only sanctioned where it becomes absolutely essential and following the appropriate risk assessment.

Personnel should never climb on to a double-stacked chemical tank. Where deemed necessary, a thorough and robust risk assessment process with mitigating measures and actions is required.

IDEALLY THE TANKS SHOULD BE UNSTACKED.

6.9 Labelling and Documentation

All cargos, including backloaded cargos of dangerous goods shall be correctly declared, packaged and labelled, secured, documented, and segregated in accordance with the regulations and MGN 282(M) and IMDG Code plus subsequent notices issued by the Maritime and Coastguard Authority.

6.10 Lifting Details

This activity can be further divided into offshore and onshore.
For offshore lifting, the corner castings may not be used. Instead, custom-built padeyes are welded into the frame of the unit in a central location. These are designed to take 4.75 tonne shackles and capable of lifting the MGW of 4,500 Kgs. A wire rope (or chain) sling set is provided to enable this lift. The sling set consists of 4 single legs terminating on one end with a shackle, which engages with the padeye and on the other end fitted to a quad assembly and ultimately a master link which provides the central lifting point for the crane hook. The sling set is designed in order to hang over the edge of the tank to chest height (approx. 1.3m from the ground). This enables the operator to connect the sling set to the lifting device without having to climb onto the top of the tank.

6.11 Storing and Preservation Procedures

Once each container unit has been officially released by the inspector, it is ready for shipping to the customer. However, there are occasions when such units are to be stored in a location, prior to being put into service.

Some simple procedures should be adhered to while the units are being put in storage:

Transport: Transport of the units from manufacturer to storage will inevitably cause some paintwork to be removed from the framework. This can be kept to a minimum by lifting and lowering the units carefully, either with dedicated sling sets or with a forklift truck.

Note: In any case, any paintwork damage should be touched up with a suitable abrasive tool, primer and top coat immediately.

Stacking: The units are designed to stack 3 high in an empty condition (assuming slings not attached) and 2 high when full (onshore only!). However, if space is not a restriction, the stacking should be kept to a minimum, as it increases the possibility of units getting damaged and does not lend itself to ease of visual examination of stacked units. Tanks are designed for stacking so that chains or slings are not crushed or damaged.

Storage: The tank units should preferably be stored indoors. If this is not possible they can be stored outdoors, but a visual examination should be carried out on them after 3 months.

The following items should be checked after this period:

1. All paintwork is intact. No evidence of peeling, cracking or discolouration.
2. Decals firmly adhered to vessel / frame.
3. Nameplates firmly in place, with no evidence of corrosion between plate and support.
4. All seals firmly in location. No evidence of seal extrusion. (Particular attention should be paid to the manlid seal.)
5. No corrosion on the stainless steel vessel. Passivation layer should be intact. Any potential specs of corrosion should be removed with a polishing disc.
6. Free movement of all valve handles, from closed to open position.
7. Internal of tank free from any dirt, grease, contaminants, etc.
8. All nuts, bolts securely fastened. Items such as baffle plates, PV valves, ball valves, discharge assemblies, level gauge nozzles, blind flanges should be thoroughly checked for security.
9. Walkway, lid and ladder all still securely fitted to frame.

Slings: Sling sets, if fitted to each unit while in storage should be treated with a grease in order to prevent corrosion of the wire ropes. Care should be taken when using the slings, as they can damage the top of the tank if not handled correctly.
If not fitted, they should be stored neatly, preferably indoors and also treated with a grease to prevent corrosion.

References

- IMDG CODE July 2010

- DNV 2.7-1 April 2006

- “Design and Handling of Chemical Tanks”

  - Step Change in Safety

- FortVale Engineering Ltd.