Safety - Operation

Operating the tank safely

The safety of operatives, the general public and the environment depends upon the responsible operation of tank containers during loading, discharge, storage and transport. It is essential to ensure the following before loading or dispatching a tank container.

The tank is the correct type and in the proper mechanical condition

Ensure that the tank container being used is suitable and approved for the carriage of the cargo concerned and has been well maintained, inspected and tested in accordance with the regulations. It should also have successfully completed Pre-trip inspection.

click to view pre-trip inspection

The tank is labelled

The correct identification and hazard warning labels must be attached in their appropriate positions on the container. Labels which are no longer applicable must be removed.

The tank is filled correctly

The ullage (free space in loaded tank) must comply with the regulations.

click to view ullage claculations

Suitable equipment is available

The loading or discharge equipment (hoses, couplings, gauges, pumps, compressors etc) are in good order and suitable for the product to be handled.

The tank interior and exterior is suitably clean

Ensure that any residue from previous cargoes is removed or is compatible with the product to be loaded. The exterior of the tank, especially the labels and markings, must not be contaminated or obscured with cargo spillage.

The gross weight is not exceeded

The gross weight of the vehicle when loaded must not exceed the weight limitations imposed by regulation.

All operations are competently supervised

The personnel in charge of loading or discharge must be in possession of written instructions detailing the safety requirements and emergency procedures in relation to the handling of the cargo and must have been trained to the required level of competency.

The gas or air supply is clean

Ensure that any gas / air supply used for loading, discharge or blanketing will not contaminate the cargo.

Product handling

The manufacturer of the product can be contacted for advice and information on the appropriate safety standards. Required protective clothing may consist of part or all of the following depending on the hazard.

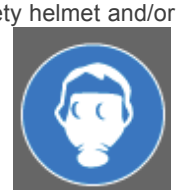
Body protection, apron, trousers or suit

Boots, clogs or overshoes

Gloves

Eye protection, visor or glasses

Safety helmet and/or hood



Vapour mask or breathing apparatus

The protective clothing must be resistant to the type of product being handled

Tankspan strongly advise the operator to carry out a pre-trip inspection before the tank is filled with cargo. It is also in the operator's interest to arrange for intermediate external inspections at selected ports and depots to report and pinpoint the cause of any damage to tank containers in transit. The following minimum inspection procedure is provided for the operator's guidance. The inspection as described is advisory only and it may be found that different procedures are necessary depending on the cargo and on the circumstances under which the tank is used. It is in the operator's own interest to maintain the tank container in perfect operational order. Apart from the consideration of possible legal repercussions following an incident involving badly maintained tanks, effective preventive maintenance minimises non-productive time and repair costs.

All defects should be reported to the engineer in charge of repair and maintenance. If further investigation or tests are required these should only be carried out by a qualified personnel trained in the maintenance and repair of the items considered defective. Any damage should only be repaired by approved and competent repairers who are aware of the special techniques and exacting standards required. In the case of major damage to the frame or any damage to the tank shell always consult Tankspan before proceeding with repair.

An increase in cargo temperature due to higher ambient temperature or cargo heating will result in cargo expansion and an increase in vapour pressure. If the tank is overfilled, product could escape through the relief valve. If the loading temperature is known and the highest temperature the cargo will reach either naturally or by heating is also known, it is a simple matter to calculate the maximum safe load necessary to avoid discharge through the pressure relief valve.

For hazardous cargo transportation certain maximum filling ratios are recommended by the IMDG Code. These filling ratios are variously 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 or litres)
C = Capacity of tank (gallons or 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 (refer to the IMDG code).

Hazardous Cargoes

Hazardous materials are classified according to the nature of the hazard involved. The most widely accepted system is that promulgated by the United Nations and which is incorporated in the International Maritime Dangerous Goods Code (IMDG) and provides the foregoing classificarions for tank containers.

Class 1 Explosives

1.1 Substances and articles which have a mass explosion hazard (a mass explosion is one which affects virtually the entire load almost instantaneously)

1.2 Substances and articles which have a projection hazard but not a mass explosion hazard

1.3 Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard

1.4 Substances and articles which present no significant hazard

1.5 very insensitive substances which have a mass explosion hazard

Class 2 Gases

Compressed: liquefied or dissolved under pressure or liquefied by refrigeration

2.1 Inflammable* gases

2.2 Non-inflammable gases

2.3 Poisonous gases**

* 'inflammable' has the same meaning as flammable
** Poisonous gases which are also inflammable should be segregated as Class 2.1 gases.

Class 3 Inflammable Liquids

3.1 Low flashpoint group of liquids having a flashpoint below - 18 deg C (0 deg F), closed cup test

3.2 Intermediate flashpoint group of liquids having a flashpoint of - 18 deg C (0 deg F) up to, but not including 23 deg C (73 deg F), closed cup test

3.3 High flashpoint group of liquids having a flashpoint of 23 deg C (73 deg F) up to, and including, 61 deg C (141 deg F), closed cup test

Class 4 Inflammable solids or substances

4.1 Inflammable solids

4.2 Substances liable to spontaneous combustion

4.3 Substances emitting inflammable gases when wet
(Certain inflammable solids, when molten, may be carried in tank containers. An example is molten sulphur which is in hazard Class 4.1)

Class 5 Oxidising substances (agents) and organic peroxides

5.1 Oxidising substances (agents)

5.2 Organic peroxides
(These are similar to oxidising substances but are additionally extremely unstable and heat sensitive in that an explosive reaction can occur if exposed to heat or if contaminated by reducing agents. Because of the facility to control temperature in transit, tank containers are an effective means of transporting organic peroxides).

Class 6 Poisonous (toxic) and infectious substances

6.1 Poisonous (toxic) substances

6.2 Infectious substances

(The majority of toxic substances require a Type 1 tank. For certain products a bottom opening is prohibited and a bursting disc may be required in series with the pressure relief device).

Class 1 Explosives

Class 2 Gases

Class 3 Inflammable Liquids

Class 4 Inflammable solids or substances

Class 5 Oxidising substances (agents) and organic peroxides

Class 6 Poisonous (toxic) and infectious substances

Class 7 Radioactive

Class 7 Radioactive substances

Class 8 Corrosives

(The majority of corrosive substances require a Type 1 tank. For certain products a bottom opening is prohibited and a bursting disc may be required in series with the pressure relief device).

Class 9 Miscellaneous dangerous substances

This is an abbreviated summary. The UN 'Orange Book' or the IMDG code should be consulted for full information.

substances

Class 8 Corrosives

Class 9 Miscellaneous dangerous substances

Safety - Dangers

COMMON DANGERS

Tankspan tanks are extremely safe for all modes of transport, and provide secure and robust cargo containment in transit. The greatest risk of cargo spillage or damage to the tank or its fittings occurs during loading and discharge. Here are some common dangers to be avoided.

Flash Spill

Cause
Opening manhole or hose connection when tank is pressurised. May result in 'flash spill' of product and lid or cover being thrown.

Precaution
Examine pressure gauge if fitted and relieve any pressure before opening manlid or hose connection by carefully opening the air-line valve or cap. Take care not to vent off dangerous vapours into the atmosphere.


Flash Spill

Asphyxiation/Poisoning

Cause
Entering tank with oxygen depleted or contaminated atmosphere. May cause poisoning or asphyxiation.

Precaution
Check cleaning certificate and last cargo. Check tank atmosphere with appropriate analyser before entry. If necessary, carry out gas-freeing procedure. A second person should be stationed outside the manhole with a lifeline to the person in the tank.


Asphyxiation/poisoning

Hose Whiplash

Cause
Disconnection of hose when the tank is pressurised. Could cause injury to operatives.

Precaution
Ensure that tank and hose are de-pressurised before disconnection.


Hose Whiplash

Chemical Reaction/Product Contamination

Cause
Tank and fittings not efficiently cleaned of previous product. Product loaded in uncleaned tank. Incorrect cleaning agent used. May result in contamination of new cargo violent chemical reaction, crusting/ congealing of residues in tank and fittings, or damage to tank lining.

Precaution
Ascertain previous product carried. Check cleanliness of tank outlet valve chamber and other fittings in contact with cargo before loading. Check cleaning agent compatibility before use.


Chemical Reaction

Accidental Cargo Discharge

Cause
Careless opening of outlet valve or disconnection of hose from tank containing cargo or leakage via incorrect fittings or hoses. May result in a chemical reaction, toxic or inflammable fumes or other potential dangers to personnel and equipment

Precaution
Check if cargo is present before opening valves or disconnecting fittings. Check that hoses and fittings are correct for a particular tank.


Accidental cargo Discharge

Overpressure


Overpressure

Cause
Excessive operating pressure. Could result in rupture of hoses or tank or release of cargo through the pressure relief valves, with possible risk of injury and spillage.

Precaution
Note the maximum working pressure marked on the tank and ensure that it is not exceeded.


Excessive Steam Pressure

Excessive Steam Pressure

Cause
Excessive pressure introduced into heating system. May damage tank or rupture hose causing failure or escape of cargo.

Precaution
Do not exceed the maximum working pressure of the heating system marked on the tank.


Vacuum Collapse

Vacuum Collapse (Implosion)

Cause
Vacuum created in tank during pumping out, or as a result of tank cooling after system cleaning, or after discharge of heated cargo. Could result in damage to tank shell.

Precaution
Ensure that tank is vented (via manhole or air-line) during cargo discharge or after steam cleaning, or discharge of heated cargo. If a vacuum valve is fitted check that it operates freely. NOTE: Special precautions should be taken when handling hazardous cargo to guard against venting of harmful vapours.


Hose Kinked or Flattened

Hoses Kinked or Flattened

Cause
Hose unable to pass air or liquid. Could cause over-pressure or vacuum collapse.

Precaution
Hoses should be inspected before use and correctly laid out before fitting. Wheeled equipment should be prevented from entering area where hoses are crossing the ground.


Heat Damage

Heat Damage To Empty Tank

Cause
Heating tank prior to cargo loading, exceeding maximum design temperature of shell. Could cause deformation/ damage to shell and fittings.

Precaution
Limit pre-heating temperatures such that the shell or heater tubes do not exceed tha maximum product temperature indicated on the data plate. Care should be taken not to overheat small quantities of cargo, especially cargo residue.


Cargo Vapour Explosion

Cargo Vapour Explosion

Cause
Naked light or electrical spark in presence of cargo vapours during loading/ discharge or in presence of cargo leakage. May cause fire or explosion.

Precaution
Strictly observe the 'no naked light' rulings in the vicinity of tanks. Ensure good earth connection has been made to the tank during loading/discharge. Check tools and clothing (especially boots) for spark risk.


Tank Overheating

Tank Overheating

Cause
Exceeding operating temperature, may damage tank shell, insulation, and fittings.

Precaution
Do not exceed the maximum operating temperature indicated on the tank. Check that the thermometer is in working order.

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Safety- Handling

Loaded Tanks

Loaded tank containers may ONLY be lifted by a TOP SPREADER attached either to a sidelift truck, a gantry crane or container-handling vehicle such as a straddle carrier.

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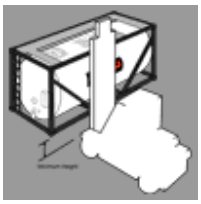
Extreme caution must be exercised when handling loaded containers by a sidelift truck fitted with a top lift attachment, as the change in the centre of gravity due to cargo surge may result in instability of the vehicle. The tank container should be moved when suspended at the lowest practical height.



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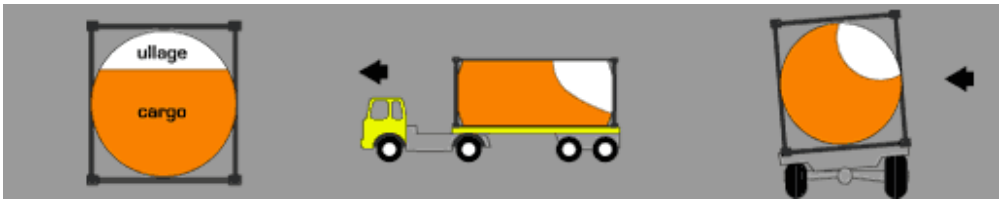
Ullage

Transporting by Road, Rail and Sea
Only vehicles constructed or specifically adapted for the carriage of ISO containers should be used.
Excessive cargo surge can affect vehicle stability. The maximum ullage permitted for a given product is controlled by the appropriate regulations.



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Empty Tanks

In addition to the handling techniques for loaded tanks, empty tank containers may be lifted by side connecting the two top corners, provided that the lower transverse support frame contact the bottom corner castings or the corner post.

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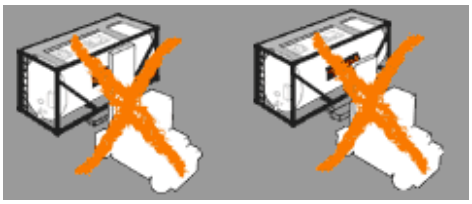
Malpractice

On no account should a tank container be lifted by equipment contacting the tank shell, or any part of the frame other than the corner castings or corner post.



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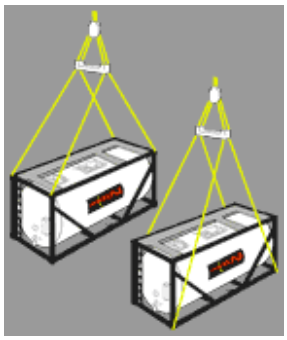
On No account should lifting forks or tines of a conventional forklift truck be used on any tank container. Contact between lifting equipment and the tank shell or its insulation may result in serious damage to the tank and the escape of cargo.

While ISO standards do not permit containers to be lifted by angled slings from the top corner castings, most Tankspan tanks are designed and tested to be lifted from both the top and bottom corner castings. When lifting from the top castings the angle of the slings should not be less than 50 degrees to the horizontal. When connecting to the bottom corner castings the slings must be not less than 45 degrees.
Care must be taken to ensure that the slings do not touch the tank during lifting. For safe and efficient handling of containers a properly designed spreader is always to be recommended.



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Road, Rail and Ship

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. Up to a maximum 20% ullage is normally observed for non-classified products.

Safety- Cleaning

General

Tank cleaning is standard requirement and should be carried out by specialist cleaning facilities.
Before accepting any cargo for transport, the operator should obtain information concerning the recommended method of cleaning and determine whether it is possible to clean and dispose residues at the destination. Environmental regulations might restrict the cleaning of certain cargoes. Operators should ensure that the tank is fully discharged by the consignee and that responsibility for the disposal of excess cargo is confirmed.
Cleaning is principally carried out by the use of rotating pressurised hot (or cold) water jets, commonly referred to as a spinner head, lowered into the tank through the manlid. Additives such as detergents, solvents and caustics are introduced through the spinner as required. Consideration of the effect of the cleaning method on the tank shell material is important. Many products release free chloride if heated. Steam vapour cleaning systems are also in common use. Preheating the tank is used for certain cargoes to facilitate cleaning. The heat from high temperature cleaning processes naturally dry the tank, but to speed the process hot air blowers are recommended. Dismantling and cleaning of valves and syphon tubes is not always undertaken unless specifically requested. Sterilisation and removal of stains are sometimes required, as an addition to the standard cleaning process.
Tests for cleanliness are normally carried out when specified. An independent inspector may be employed to ensure a tank is cleaned to the required specification and should issue a certificate of cleanliness.

Standard Procedures

1. Make arrangements for cleaning prior to discharge of the cargo, agree specification and costs.

2. Identify the last cargo

3. Establish the cleaning procedure and environmental regulations regarding cleaning and disposal of residues and vapours.

4. Ensure that discharge procedures are confirmed with the consignee and transporter and that the tank is fully discharged.

5. Determine the next cargo to be loaded in order to specify any special instructions at the time of cleaning.

6. Cleaning of valves and top outlet syphon tubes and renewal of gaskets or seals should be specified as required.

7. Stubborn stains or cargo film might need to be removed by polishing with nylon pads. No other form of abrasive material should be inside the tank without expert advise.

8. Dry the tank on completion of cleaning.

9. Ensure inspection is completed and that the tank is cleaned to the specified quality. The cleaning station should issue a cleanliness receipt confirming the cleaning process carried out. An independent surveyor should be employed where a Cleanliness or Safety Certificate is required.

10. Remove all redundant labels

11. The exterior of the tank should be cleaned to remove any cargo residue and to ensure that mandatory markings are legible. The ladder and the walkway should be kept clean to ensure safety of personnel.

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Safety- Gas Blanketing

Purging The Tank

Two methods of purging the tank of atmospheric air are available to the tank user depending upon the equipment available.

Method One – By pressure

1. Close manlid and valves

2. Connect nitrogen supply to airline, or bottom outlet.

3. Inject nitrogen until pressure in tank is 1.5 bar (21psi)

4. Release pressure in tank through top outlet. (if top outlet is used to inject nitrogen, or if there is no top outlet, the pressure should be released by opening the airline or bottom outlet. The tank now contains 40% air and the amount of nitrogen used is 1.5 times the volume of the tank.

Repeat steps 3 and 4 if necessary:

- After 2 purges the air content is 16%. Oxygen content 4%. Nitrogen consumed 3 volumes.
- After 3 purges the air content is 6%. Oxygen content 1.5%. Nitrogen consumed 4.5 volumes.
- After 4 purges the air content is 2.5%. Oxygen content 0.5%. Nitrogen consumed 6 volumes.

5. Close all valves on tank

Method Two – Mixing and Venting

1. Close manlid

2. Connect nitrogen supply to top outlet or bottom outlet.

3. Open outlet not used in steps 2 above. (If top outlet is not fitted, open airline connection).

4. Inject nitrogen until number of air changes required have been completed using a flow meter to measure the nitrogen used.

- After 1 volume change the air content is 37%. Oxygen content 10%. Nitrogen consumed 1 volume.
- After 2 volume changes the air content is 13%. Oxygen content 3%. Nitrogen consumed 2 volumes.
- After 3 volume changes the air content is 5%. Oxygen content 3%. Nitrogen consumed 3 volumes.
- After 4 volume changes the air content is 2%. Oxygen content 0.4%. Nitrogen consumed 4 volumes.

Note: The effectiveness of this method depends upon the thorough mixing of the air in the tank with the incoming nitrogen. In practice it is not possible to achieve the theoretical percentages shown above and it is recommended that an oxygen analyser is used to confirm that the air content is sufficiently reduced.

5. Close all valves on tank

Loading Under A Nitrogen Blanket

Loading under a nitrogen blanket.
Read in conjunction with the appropriate loading section with particular attention to the ‘before’ and ‘after’ instructions.

1. Purge the tank.

2. Connect the product loading hose to the top or bottom hose connection

3. Pressurise hose.

4. Open valves and commence loading.

5. As the cargo fills the tank the nitrogen pressure will rise

6. when the nitrogen pressure required for the cargo to be carried is reached, commence bleeding off the excess pressure by slightly cracking open the airline valve.

7. The product quality must be metered at the pump or bulk storage location. When the complete cargo is loaded, close the tank inlet valve or valves.

8. Check that the correct nitrogen pressure has been maintained.

9. Drain and remove the hose.

10. Replace all blanketing plates and dust caps.

Gas blanketing and loading under a nitrogen blanket

With certain products, the empty space in the tank container during loading and discharge and the ullage space during transit is filled with an inert gas, usually nitrogen. For pressure loading and discharge, inert gas is used for the propellant medium by which the pressure is supplied. Before loading it is normally necessary to purge the tank of atmospheric air.

Safety Note: Inert gases are normally non-toxic, but inhalation in confined spaces can cause asphyxiation. Tanks which have been purged of air should be fitted with a temporary seal and marked to indicate that the tank contains inert gas.

Preparing the Tank

Products carried under a gas blanket require the normal pre-trip checks to ensure that the tank container is suitable for the purpose. There should be an additional pressure check for tightness of all valves and fittings to ensure that no loss of inert gas will occure during transportation

Safety- Heating

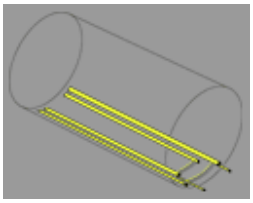
Steam Heating

Tanks equipped for steam heating have a series of steam channels on the outside of the lower half of the tank, and on some designs, around the tank circumference. These channels provide up to ten square metres of heating area with a heat input roughly equivalent to 100 kW at a pressure of 2 bar (31 psi). Steam heating is the most efficient means of heating the tank cargo.

The steam channels terminate at the rear of the tank and are closed by threaded dustcaps.

The inlet and outlet can be fitted with a valve and the outlet should be fitted with a steam condensate trap.

The maximum working pressure of the system is indicated on the data plate.



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Electrical Heating

Two different methods are used:

• **Immersion Tubes** which have the highest efficiency

• **External Shell** heating which provides even cargo heating and a high degree of control.

Immersion System
The immersion system consists of two 17 foot (5.2m) heating elements fitted within fully welded, pressure tested, stainless steel tubes running inside and parallel to the base of the tank shell. This system operates on either 200-280 V 3-phase or 340-480 3 phase. Power output at 440 V is 12kW.

External Heating Shell

The external shell heating system consists of a network of elements in contact with the shell over the bottom third of the circumference of the tank. These heaters are especially suitable for heat sensitive products. This system operates on either 200-280 V 3-phase or 340-480 3 phase. Power output at 440 V is 15kW.

Click here for samples
(see Mannings electrical)

General Precautions

1. Do not exceed the maximum steam working pressure. This is marked on the tank data plate. The use of excessive pressure may damage the tank shell.

2. Do not overheat the cargo. Excess heat can degrade sensitive cargoes, so it is important that the heat input is directly related to steam pressure. To avoid damage to the tank shell or cargo through excess steam pressure, it is recommended that a variable relief valve and gauge be fitted to the steam supply line.

4. Do not discharge during heating. Continue to apply heat until ALL the cargo is melted and has reached the correct temperature. Do not commence discharge until the correct temperature has been reached. This will assist the melting of solidified material, and prevent overheating and consequent damage to the cargo or tank shell.

Cargoes with a low heat-transference properties may require a long time to melt.

5. Do not attempt to force open valves

Connecting the steam supply

1. Check that the correct steam pressure has been determined, and that the cargo characteristics have been properly considered.

2. Connect the steam supply hose to the inlet BSP connection.

3. Fit a steam trap to the condensate outlet. This will allow the latent heat in the steam to be fully used, so reducing both heating time and cost.

4. Open steam supply SLOWLY. This will prevent 'water hammer' as the condensate in the saturated steam is discharged. Check all hoses and connections for leaks.

3. Prevent pressure build-up. The pressure build-up caused by cargo expansion must be relieved. If the cargo is non toxic, open the air inlet. If toxic, vent back to a storage tank.

Note: With some solidified products such as maleic anhydride the pressure increase in the lower melted portion of the cargo may not find a leakage path through the solid portion, and the pressure build-up may exceed the working pressure of the tank. In such a case it is necessary to fit steam traces on the dip tube to provide a path for the molten product through the still solid product to the top of the tank.

blocked with solid cargo. Continue to apply heat until all the cargo has melted. A steam trace at the valve outlet might be necessary.

6. Heat small quantities of cargo with extreme care, overheating may damage the cargo and tank shell.

7. Ensure that the carrier is aware of the maximum temperature to which the cargo may be heated.

8. Ensure that neither personnel nor cargo are endangered by escaping steam.

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Pitting

Pitting is another phenomenon encountered in tanks. It appears as small blemishes called "pits". If this is not dealt with quickly it can soon lead to the complete destruction of a tank. Corrosion of this kind may appear within a matter of hours, even on a tank, which has been operated perfectly successfully for many years. Corrosion is probably the main cause a tank has to be scrapped. A tank barrel can easily be ruined by careless acceptance or handling of potentially corrosive loads, even the most mild in nature. e.g. washing up liquid

Stress Corrosion.

Stress corrosion is less than completely understood phenomenon that can occur to tank shells. It can happen from the inside or the outside. Whenever metal is worked shaped, welded and fixed, as with a tank barrel onto running gear, or into a container framework, it is inevitable that the material of construction of the tank shell becomes stressed in certain areas. Where stress remains, such areas become particularly sensitive to corrosion. This form of corrosion typically appears in tank shells as thin streaks or thin cracks in the metal. Chlorine is often a major contributor to this phenomenon.

Pickling and Passivation

Once a tank shell has been completed it should be pickled and passivated. Pickling is a process whereby the interior surface is treated with a mild acid to remove blemishes from the metal. During pickling high spots will hopefully dissolve away, and pits have their edges removed so that products cannot become trapped in or around such places. A hard thin protective oxide layer is created by passivation. Stainless steel forms this protective layer naturally with the circulation of air of the surfaces.

However, natural passivation can't be assumed, so steps are taken to ensure the oxide layer is created artificially. It is most important that tank shells are correctly passivated after construction and at any time during their working lives when there has been a need to buff, grind, sand, weld, or polish where the oxide layer may have been broken. Failure to so will expose the tank shell in that particular place to an increased risk of corrosion. The importance of preserving the passive layer cannot be over emphasised.

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Possible Faults and their Remedies

Please note these are guidelines and recommendations only, and are by no means exhaustive. The personnel operating the tank are ultimately responsible for the safe operation of the tank in their care.

Accidental Cargo Discharge

Probable Cause
Careless opening of outlet valve or disconnection of hose containing cargo or leakage via incorrect fittings or hoses.

Precaution
Check if cargo is present before opening valves or disconnecting fittings. Check that hoses and fittings are correct for the tank.

Overpressure

Probable Cause
Excessive operating pressure. May result in rupture of the tank or hoses or release of cargo through the pressure-relief valves, with possible risk of spillage and injury.

Precaution
Note the maximum working pressure marked on the tank data plate and ensure that it is not exceeded. Ensure that the correct ullage space is provided to enable expansion of the cargo.

Hose Blocking

Probable Cause
Hose kinked or flattened so unable to pass air or liquid. May cause over-pressure or vacuum collapse.

Precaution
Hoses should be inspected before use and correctly laid out before filling. Hoses should be clearly marked to prevent constriction caused by objects being placed on them.

Tank Overheating

Probable Cause
Exceeding maximum operating temperature and / or the maximum working pressure of the steam heating system. May damage tank shell, insulation, fittings, and cargo.

Precaution
Do not exceed the maximum operating

Chemical Reaction/Product Contamination

Probable Cause
Tank and fittings not properly cleaned of previous cargo and / or cleaning agents. Incorrect cleaning agent used. May result in contamination of new cargo, violent chemical reaction, crusting / congealing of residue in tank and fittings or damage to the tank.

Precaution
Ascertain previous cargo carried and check Cleanliness Certificate. Check cleanliness of tank outlet valves and other fittings in contact with cargo before loading. Check cleaning agent compatibility before use.

Excessive Steam Pressure

Probable Cause
Excessive pressure introduced into heating system. May damage tank or rupture hose causing failure of heating, escape of steam, contamination or escape of cargo.

Precaution
Do not exceed the maximum working pressure of the heating system marked on the tank data plate.

Heat Damage to Empty Tank

Probable Cause
Heating tank prior to cargo loading, exceeding maximum design temperature of shell. May cause deformation of or damage to shell and fittings.

Precaution
Ensure pre-heating temperatures do not exceed the maximum design temperature indicated on the tank data plate. Care should be taken not to overheat small quantities of cargo, especially cargo residue. Verify that the thermometer is in working order.

Vacuum Collapse (implosion)

temperature marked on the tank data plate. Verify that the thermometer is in working order.

Cargo Vapour Explosion

Probable Cause
Naked light or electrical spark in presence of cargo vapours during loading / discharge or in presence of cargo leakage. May result in fire or explosion.

Precaution
Strictly observe the "no naked light" rulings in the vicinity of tanks. Ensure a good earth connection has been made to the tank prior to loading / discharge. Check tools and clothing (especially boots) for spark risk

Probable Cause
Vacuum created in tank during pumping out, or as a result of tank cooling after system cleaning, or after discharge of heated cargo. May result in damage to tank shell and injury to personnel.

Precaution
Ensure tank is vented (via manhole or air-line) during cargo discharge and after steam cleaning and discharge of heated cargo. If a vacuum valve is fitted to the pump and / or tank, check that it operates freely.

NOTE. Special precautions must be taken when handling hazardous cargo to guard against venting of harmful vapours to atmosphere.

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