INSTALLATION, OPERATION & MAINTENANCE

PROCEDURE

FOR PRESSURE VESSEL

Contents

1. Scope:

Pressure vessels marked by Dana Tank A/S.

2. Purpose:

The purpose of this procedure is to provide guidelines regarding the handling, installation, and use of Dana Tank Pressure vessels to preserve human safety and the integrity of the equipment. All installation, handling and user operations must abide by the standards and regulations currently in force at the site where the VESSEL is to be installed and shall be backed by technical projects and reports issued by duly certified professionals. All operations shall be carried out by qualified skilled personnel as per site requirement.

3. Identification of vessel

The data that identify the vessel are located on the name plate, which shows its capacity, pressure ratings and operating temperature range. The data on the plate may include the following:

- Serial number: Serial number is the unique identification number for each vessel
- Fluid Code: 1 dangerous and 2 is non dangerous fluid group as per PED 2014/68/EU.
- Volume (V): The total volume of the vessel per Litter
- TS: (minimum and Maximum design temperature in °C)
- PS: (minimum and maximum design pressure in Bar)
- PT: Test pressure in Bar gauge
- Code or design standard
- The year of built
- Manufacturer address

4. Condition of use

The maximum conditions of use are determined by the data on the name plate:
It is the user's responsibility to provide the necessary means to maintain the equipment within those conditions. Thickness ratings are minimum design values. This data must be considered as they represent the equipment's service condition limits. Any use under different conditions or for contents other than those specified for the vessel in question may entail a hazard for persons or objects in the vicinity.

IMPORTANT NOTE

It is the user's responsibility to keep the equipment within its design limits and to give it proper maintenance.

5. Handling

Prior to the handling or installation following shall be taken into the consideration:

- Be careful not to damage the coating. Damage to the anti-corrosion coating shortens the product's service life (see "repair process" below).
- Prevent any knocks or dents...
- In case that the vessel has fitted valves or other component, make sure to not damaging during the handling or installation by the belts, chains, or other lifting tools and equipment. Damage to valves can render them useless, lead to leakage, etc.

Failure to adhere to the above points may entail repair operations becoming necessary prior to the vessel being installed.

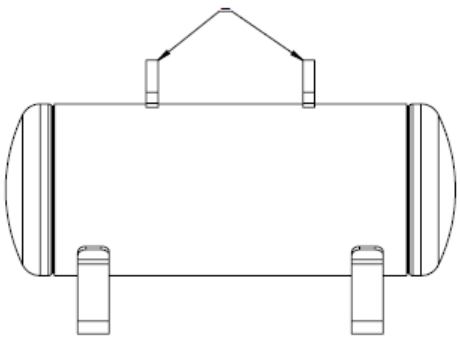
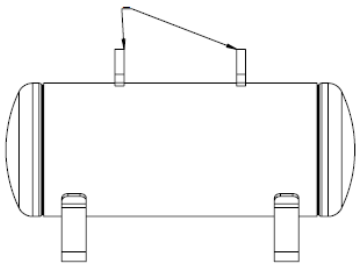
Pressure vessels should only be transported, handled, or erected when empty and free of loads. The weight of the empty vessel (tare) is shown on project specification and packing list. This is its nominal weight.

Depending on design, the vessel might be fitted with lifting aids (lugs, trunnions, eye bolts,) to make moving it when empty easier. These lifting aids should be used whenever possible.

The vessel must be hoisted using all the lifting lugs.

- The slings/chains used must never form an angle of more than 90º.
- Spreader beams are suggested, for handling and installation of larger vessel
- Lifting should be carried out in a way that distributes the weight of the vessel evenly over all the lugs.
- If the vessel has 8 lifting lugs under the apex (two at either end and four in the middle), it should be hoisted as shown in the illustrations.

Other devices that do not make use of the lugs, such as forklift trucks or girth belts around the vessel, can be used to lift the vessel providing they adhere to the relevant safety regulations. In such cases, special care must be taken to protect the vessel coating.

Correct lifting	Incorrect lifting
	

6. Installation

On-site installation of the pressure vessel must be carried out:

- by specialised personnel
- according to an installation project and lifting instructions

Installation project:

Installation project is not under responsibility of Dana-Tank. However as minimum the installation project must be included in:

- correct sizing of the vessel, in accordance with the gas flow required. Inadequate sizing will cause subsequent installation malfunctions (freezing in case of liquefied gases, etc.).
- applicable regulations (safety distances...).
- If the vessel is not supplied with the valve set already mounted, the installation project must include all the valve

Other applicable instructions:

Installation technicians must give all necessary instructions for the appropriate use and maintenance of each installation.

Check list before installation

Before installing a vessel it is recommended to check the following points:

- The vessel should be fitted with its name plate that identifies it
- Appearance of equipment for damage and rust-free condition.
- Orientation marking.
- Lifting points.
- Check that the installation's working conditions are within those for which it has been designed, indicated on the name plate (design pressure, design temperature, degree of filling, minimum thickness...).
- Check that the vessel has no water inside, by briefly opening the purge valve (located on the vessel's bottom apex).
- Check that the vessel has not been damaged during transport or installation (no dents, damaged valves...)
- Check that the vessel coating is in good condition. Especially in the case of vessels that are to be installed underground.
- Close all the openings.

Foundation:

Foundation shall be checked for the following items, before starting the installation:

- Dimensions
- Positions (centre marking) and height (level marking).
- Disorders in concrete such as cracks, abnormal concentration of aggregates, porous state, surface condition etc
- Dimensions and cleanliness of anchor box, if applicable.
- Surface of foundation shall be conditioned for proper seating and bonding of the grouting material with foundation.

- Foreign matters such as oil, grease, dirt, dust, loose concrete etc. shall be completely removed from the surface.
- Size and location of anchor bolts embedded in the concrete shall be checked against the drawings and inspect, for any damage or rust on the threaded parts.
- The threaded part of the anchor bolts shall be cleaned properly and greased or machine oil for smooth running of nuts over the threads. The following conditions shall be followed regarding all anchor bolts.

Installation of Equipment

- All equipment shall be lifted slightly to examine the underside for cleanliness and its level and the acceptability for installation.
- As a rule, shims shall be placed on liner plates fixed on the concrete foundation at near sides of the anchor bolts for leveling the equipment.
- During installation work, special care shall be taken so as not to damage anchor bolts and equipment. Equipment shall be lowered slowly and vertically.
- If Teflon sheet is not provided on the top of sliding plates, the sliding surface shall be cleaned and plastered with grease.
- Final adjustment between equipment base and linear plate shall be done, by using plate (shims).
- As a rule, welded lifting lugs used in the installation shall be left in place.

7. Alignment

General

All installed equipment shall be aligned for plumbing and level. Vertical vessels shall be aligned for plumbing and satisfy requirements in para. 5.3.2. Horizontal vessels and exchangers shall be aligned for levelling and satisfy requirements in para. 5.3.3. Hydraulic jack shall be used for lifting and fine adjustments.

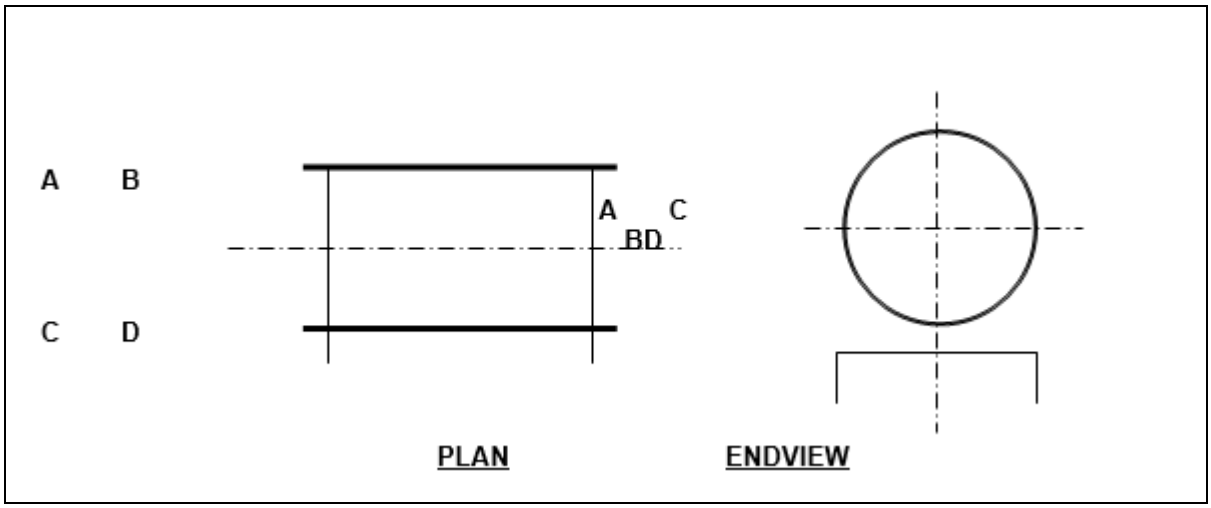
Plumbing

- Plumbing shall be checked by viewing from two directions 90 deg. apart with a theodolite. Checking of very tall equipment shall be done early in the morning.
- Out of plumb of the equipment shall not exceed 1.0 mm per 1.0 m subjected to a maximum of 25 mm for entire height, unless otherwise specified in the equipment specification.
- After alignment is finished and the lock nuts of the anchor bolts are tightened firmly, the shims shall be tack-welded to each other, and shim plates should be set inside the outer edge of the equipment to avoid pinking and cracking of grout.

Levelling

The alignment for level shall be made using a spirit level or a theodolite at four points on the centreline marked on the equipment in the shop. The level shall be aligned in the direction of AB or CD and AC or BD at the centreline on the equipment.

After levelling is finished and the lock nuts of the anchor bolts are tightened firmly, the shims and wedges shall be tack-welded to each other, and shim plates should be set inside the outer edge of the equipment to avoid pinking and cracking of grout.



Grouting:

Grouting shall be accomplished in accordance with the on-site requirements and procedure.

Final Fixing of Anchor Bolts

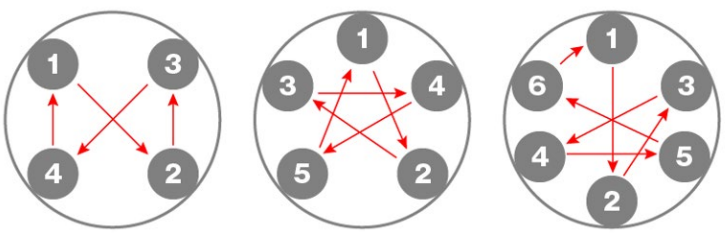
- After grouting has set and hardened, the nuts of the sliding and anchor bolts shall be loosened to allow for thermal expansion and re-tightened.
- The above requirement shall be applied to horizontal vessels.

Tightening:

All 8.8 bolts shall be tightened as per following guideline unless otherwise specified in general arrangement of the pressure vessel drawings

M5	4 Nm
M6	7 Nm
M8	18 Nm
M10	35 Nm
M12	62 Nm
M16	154 Nm
M18	220 Nm
M20	310 Nm
M22	422 Nm
M24	536 Nm

Recommended tightening sequence



8. Maintenance and Inspection

Maintenance shall be performed according to the site procedure for the maintenance of the equipment and shall be carried out in condition of maximum safety. The inspection must be performed by certified professionals only as they can identify the weak areas of a pressure vessel. The inspection must be conducted in adherence to established industry standards.

The periodic tests indicated in the regulations shall be carried out to check the general state of the vessel and equipment. A sight inspection of the vessel and the equipment shall be carried out when a new pressure test is required.

This inspection is performed when the pressure vessel is empty and not in operation. Internal inspection is mainly conducted to identify wear and tear, and corrosion around components such as vessel connections, welded nozzles and seams, and areas near to welds, external controls, or fittings etc.

Vessels are subject to corrosive processes. It is essential to carry out preventive maintenance on all defects that are detected.

If the vessel is insulated, and working at low temperatures, the risk of external condensation and related corrosion is possible. In these cases, periodic inspections are recommended.

Apart from statutory tests (pressure testing...), it is also recommended the following tests are carried out periodically (frequency to be defined by the head of the installation, depending on the number of times vessel is to be filled):

- Tightness of equipment (with a manometer at the appropriate scale, gas detectors or soapy water).
- State of vessel surface, free of rust spots.
- Check that the earth connection is correct.

9. Storage and transportation

Storage of a pressure vessel depends on the material and applied surface treatment of the vessel.

If a carbon steel vessel is uncoated, under-roof storage is recommended, as open-sky storage will initiate corrosion of the vessel, shortening the vessel's lifetime.

Coated, galvanized or stainless-steel vessels may be stored under open sky, providing the location of storage is suitable. Under roof storage is however, recommended for all vessels.

Prior to storage or transportation, the inside of the vessel must be inspected, and drained for any humidity/ fluids, and dirt. After inspection, all openings, flanges etc. must be sealed off.

In case of open-sky storage, additional corrosion protection of the vessel and vessel parts, flanges, nozzles, is recommended.

Prior to installation, the vessel shall undergo the same inspection as stated under point *6. Installation* in this instruction.

In case of long-term storage, a yearly inspection of the vessel is recommended, to accommodate any damages to surface treatment and other parts of the vessel.

Prior to transportation of the vessel, the inside should be inspected, and drained for any humidity/ fluids, and dirt. After inspection, all openings, flanges etc. must be sealed off, prior to transportation.

Prior to installation, the vessel shall undergo the same inspection as stated under point *6. Installation* in this instruction.

Dana Tank cannot be held liable for any damages to the vessel, parts or its finishing, as a result of incorrect handling, storage, or transportation.

10.Repair of pressure vessel

In the event of damage to the vessel coating that protects it from weathering, after mask off the area to be repaired, it should be repaired in accordance with the coating specification stated in the general arrangement drawing.

 WARNING

If considerable corrosion has occurred, with a reduction in plate thickness, check that this thickness is, in all areas, greater than that indicated on the name plate or drawing.

 WARNING

Welding, flame cutting and other hot processes, resulting in local heating of the materials, are strictly prohibited on the vessel, as this will have an impact on the structural integrity of the vessel. Not complying with this, might lead to serious failure of the vessel.