

DEP SPECIFICATION

**UNFIRED PRESSURE VESSELS
(AMENDMENTS/SUPPLEMENTS TO EN 13445)**

DEP 31.22.11.32-Gen.

February 2012

DESIGN AND ENGINEERING PRACTICE

DEM1



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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the construction of welded metallic pressure vessels designed according to European Standard EN 13445:2009 for an internal gauge pressure of 0.5 bar (7.25 psi) or greater, or designed for external pressure or if specified by the Principal. This DEP also applies to pressure vessels that are components of packaged equipment units.

This DEP, accompanied by a completed data sheet (and, where necessary, additional technical notes), is used for purchasing pressure vessels in accordance with EN 13445.

This DEP is based on EN 13445:2009. Part III of this DEP amends, supplements and deletes various clauses of EN 13445:2009. Part III follows the clause numbering of EN 13445:2009 for easy reference.

All clauses of EN 13445:2009 not modified by this DEP Specification remain valid as written.

The following are excluded from the scope of this DEP:

- Pressure vessels fabricated by brazing.
- Pressure vessels or pressure vessel parts fabricated by casting.
- Pressure vessels constructed in accordance with other codes such as PD 5500, ASME VIII and GB150.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2011; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
EEA	European Economic Area
fluid group	See EN CR 13445-7
hazard category	See EN CR 13445-7
hydrogen service	Service in which the hydrogen partial pressure is greater than 7 bar (abs) (100 psia) at any temperature or any pressure at a temperature above 230°C (450°F). Ref. API RP 941, Figure 1.
PED	Pressure Equipment Directive (97/23/EC)
PWHT	Post Weld Heat Treatment; aimed at reducing hardness and residual stresses in welds
very toxic substance	Substances that are hazardous for the environment or human health, as specified in DEP 01.00.01.30-Gen. (which also references databases of "toxic" substances).

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (Part IV).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2011. The following are the main, non-editorial changes.

Old section	New section	Change
N/A	2.5.14	Added a paragraph referencing the appropriate Shell DEP's with requirements associated with overpressure protection.
2.2	2.2	Revised SHALL [PS] to shall for testing group 1
2.3.3	2.3.3	Revised SHALL [PS] to shall
2.5.1	2.5.1	Deleted reference to DEP 39.01.10.11-Gen. And DEP 39.01.10.12-Gen.
2.5.1	2.5.1	Revised SHALL [PS] to shall
4.3.4	4.3.4	Deleted reference to DEP 30.10.02.31-Gen (already covered by 2.5.1)
2.5.1	2.5.1	Revised SHALL [PS] to shall for sour services in Upstream

Old section	New section	Change
2.5.1	2.5.1	Revised SHALL [PS] to shall for wet H2S services in Downstream
2.5.1	2.5.1	Revised the margin for maximum operating conditions in hydrogen to 15 deg C and 1.8 bar (was 28 deg C and 1.7 bar)
N/A	2.5.7	Added a clause prohibiting the use of ERW pipe for pressure retaining components
N/A	2.5.10	Added a clause prohibiting the use of sheet gaskets in very toxic services
2.5.1	2.5.1	Revised SHALL [PS] to shall for bolting materials
4.2.5	4.2.5	Revised SHALL [PS] to shall
N/A	2.5.2	Added a sentence referencing the LDT, and a reference to DEP 30.10.02.31
N/A	2.5.2	Added requirements associated with design for full vacuum
2.5.3	2.5.3	Increased the length to diameter ratio from 10 to 15
2.5.4	2.5.4	Revised SHALL [PS] to shall
2.5.5	2.5.5	Revised SHALL [PS] to shall
2.5.6.2	2.5.6.2	Revised SHALL [PS] to shall
2.5.7	2.5.7	Revised SHALL [PS] to shall
N/A	2.5.13	Added a clause referencing DEP 34.00.01.10-Gen.
2.5.8	2.5.8	Revised three SHALL [PS]'s to shall's
N/A	2.5.7	Added a clause with minimum thickness requirements for nozzle necks
Part III, Section 9	Part III, Section 9	Revised SHALL [PS] to shall
9.4.5.2	9.4.5.2	Revised SHALL [PS] to shall
2.5.9	2.5.9	Revised SHALL [PS] to shall
5.3.3	5.3.3	Revised SHALL [PS] to shall
2.5.10	2.5.10	Revised SHALL [PS] to shall
2.5.12	2.5.12	Revised SHALL [PS] to shall
Part III, Section 12	Part III, Section 12	Revised SHALL [PS] to shall
4.2.1	4.2.1	Revised SHALL [PS] to shall
5.7.4	5.7.4	Revised SHALL [PS] to shall
Part III, Section 6.1	Part III, Section 6.1	Revised SHALL [PS] to shall
N/A	Part III, Section 6.4.4	Added requirements for inspection of cold-formed heads
Part III, Section 6.6.3	Part III, Section 6.6.3	Revised SHALL [PS] to shall

Old section	New section	Change
Part III, Section 13	Part III, Section 13	Revised SHALL [PS] to shall
Part III, Section 9.4.5	Part III, Section 9.4.5	Revised SHALL [PS] to shall
Part III, Section 10.2.3.4.1	Part III, Section 10.2.3.4.1	Add requirements for pneumatic testing
Append. 1	Append. 1	Revised five SHALL [PS]s to shalls
Append. 3, para. 1	Append. 3, para. 1	Revised SHALL [PS] to shall
Append. 3, para. 2.2	Append. 3, para. 2.2	Revised SHALL [PS] to shall
Append. 3, para. 2.3	Append. 3, para. 2.3	Revised SHALL [PS] to shall

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

PART II GENERAL INFORMATION AND SHELL DESIGN REQUIREMENTS

2.1 GENERAL

This DEP, accompanied by a completed data sheet (and, where necessary, additional technical notes), shall be used for purchasing pressure vessels in accordance with EN 13445.

Part III of this DEP is written as amendments and supplements to EN 13445:2009. Wherever reference is made to EN 13445, it shall be understood to mean EN 13445:2009 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of EN 13445 has been used throughout Part III of this DEP.

Clauses in EN 13445:2009 that are not mentioned in this DEP shall remain valid as written.

In the event of conflict between documents relating to the enquiry or order, the following hierarchy of documents shall apply:

First level:	Purchase order and variations thereto;
Second level:	Data/requisition sheets and drawings referred to where explicit deviations from this DEP are indicated. In all other cases, any discrepancy between the data/requisition sheets and this DEP shall be brought to the attention of the Principal; NOTE: The data/requisition sheet(s) for pressure vessels is DEP 31.22.00.94-Gen.
Third level:	This DEP.

2.2 TESTING GROUPS

The Principal may specify the testing group (see EN 13445-5, Table 6.6.1-1) on the data requisition sheet. If not specified, the Manufacturer/Supplier is free to choose the testing group based on economic grounds.

NOTE: Testing Groups should not be confused with Hazard Categories; extensive guidance on hazard categories is provided in EN CR 13445-7.

Testing group 1 shall be selected if one or more of the following conditions apply:

- a) hydrogen service;
- b) very toxic substances;
- c) liquefied gas;
- d) Cr-Mo steels and other ferritic alloy steels, and carbon steels having a tensile strength greater than 510 N/mm² (74 ksi);
- e) vessels operating in cyclic service;
- f) vessels which operate in the creep range of the materials of construction.

Testing groups 2 or 3 can be selected as appropriate.

Testing group 4 SHALL [PS] not be applied unless permitted by the Principal.

Under the PED, the Principal is responsible for providing the Manufacturer/Supplier with a specification of the normal and transient/adverse conditions under which the vessel is to operate. Moreover, the owner is obliged to participate in and/or provide information for a hazard analysis. The input provided by the Principal shall be restricted to information that is directly relevant to the vessel's integrity.

For vessels intended to be used outside the EEA, the Principal may appoint a third party inspection agency.

As part of the quotation, the Manufacturer/Supplier shall inform the Principal of the contents of a typical operating manual. This summary shall at least address all actions and inspection intervals that may interfere with process operations.

2.3 QUALITY ASSURANCE

2.3.1 General

Pressure vessels shall be purchased only from Manufacturers/Suppliers accepted by the Principal.

2.3.2 Surveillance

Surveillance requirements shall be established for each pressure vessel constructed in accordance with this DEP. The requirements shall be established by the Principal, or by the Contractor with the approval of the Principal.

The Manufacturer/Supplier shall submit the Inspection and Test Plan (ITP) to the Contractor for review and approval. Surveillance requirements identified by the Principal or the Contractor shall be incorporated into the Manufacturer's/Supplier's ITP.

ITPs for Construction Class 1 pressure vessels shall be reviewed and approved by the Principal.

2.3.3 Positive material identification (PMI)

The Manufacturer/Supplier shall perform PMI in accordance with DEP 31.10.00.10-Gen.

2.4 DRAWINGS AND FINAL DATA

2.4.1 General drawings

The general arrangement, assembly or outline drawing(s) shall contain the following information:

- a) Design Code, edition year, addenda year
- b) Hazard category
- c) References to supplementary drawings, standards and specifications
- d) Nozzle ref/mark, size, rating, reinforcing pads and locations, reference datum for dimensions, fixed end/point of supports
- e) Operating and design pressures and temperatures of all services for which the vessel is designed including number of cycles if designed for fatigue
- f) Allowable nozzle loads
- g) Environmental data
- h) Wind speed
- i) Earthquake data
- j) Blast loadings
- k) Corrosion allowances for shell, heads, nozzles, manways, and all supports and other accessories
- l) PWHT requirements
- m) Minimum Design Metal Temperature(s) (MDMT) with coincident Pressure(s)
- n) Field pressure test pressure at top of vessel
- o) Shop pressure test pressure and orientation of vessel
- p) Weights; shipping, operating, water full with all internals, Centre of Gravity

2.4.2 Fabrication drawing(s)

The detailed fabrication drawing(s) shall contain the following information:

- a) Full dimensions of all parts and sub-assemblies shown including necessary tolerances and any finishing requirements
- b) Complete identification of materials, including bolting and gaskets
- c) Complete identification of internal materials supplied by fabricator, including gaskets.
- d) Location of all circumferential and longitudinal joints
- e) Details of weld preparations and welding procedure numbers
- f) Heat treatment details, including temperature of PWHT, time at temperature
- g) General remarks on fabrication, assembly and testing as appropriate
- h) Extent and location of all nondestructive examination (NDE)
- i) Cleaning, surface preparation, painting and marking requirements
- j) Nozzle schedule including the mark number, quantity, size, rating, facing, and type. Nozzle orientation and elevation shall be provided. The mark number shall match that shown on equipment data sheet.

2.5 SHELL DESIGN REQUIREMENTS

The Contractor (or Principal) normally specifies the requirements and choices made from this section on the data/requisition sheets.

The Manufacturer/Supplier can then refer to (Part III) for the detailed technical specification.

2.5.1 Materials

Materials selection shall be in accordance with DEP 30.10.02.11-Gen., including the additional requirements specified in the Notes therein. The selected materials standard (and the aforementioned Notes) shall be indicated on the data/requisition sheets.

For low temperature services DEP 30.10.02.31-Gen. SHALL [PS] apply.

Material selection for pressure vessels in H₂S containing environments (sour service) in Upstream applications shall be in accordance with DEP 30.10.02.15-Gen.

Material selection and fabrication requirements for pressure vessels in wet H₂S service in Downstream applications shall be in accordance with DEP 30.10.02.17-Gen.

Duplex and Super-Duplex materials shall be in accordance with DEP 30.10.02.35-EPE or its successor.

A materials/corrosion engineer shall advise whether additional requirements shall be specified for stainless steel materials exposed to chloride ions in concentrations which could cause stress corrosion cracking. This can be due to external atmospheric exposure or to internal high-chloride environments. More guidance on chloride stress corrosion cracking is given in DEP 39.01.10.11-Gen. and DEP 39.01.10.12-Gen.

Materials selection for hydrogen service (Part 1, 1.3.2) SHALL [PS] be in accordance with API RP 941. The maximum operating conditions (temperature and hydrogen partial pressure) SHALL [PS] be at least 15°C (27°F) below and 1.7 bar (25 psi) to the left of the applicable material curve of API RP 941, Figure 1. This requirement also applies to the carbon and low alloy pressure boundary material of vessels built with a stainless steel corrosion resistant cladding or overlay.

Bolting materials shall be selected from DEP 30.10.02.11-Gen. in combination with, DEP 30.10.02.31-Gen., DEP 39.01.10.11-Gen. or DEP 39.01.10.12-Gen., (as applicable), unless otherwise approved by the Principal.

2.5.2 Design pressure and temperature

The definition and determination of temperature and pressure levels, including design pressure and design temperature, shall be in accordance with DEP 01.00.01.30-Gen.

The lower design temperature (LDT) shall be specified as the minimum metal temperature (MMT) as defined by DEP 01.00.01.30-Gen. In addition, consideration for the prevention of brittle fracture shall be made in accordance with the requirements of DEP 30.10.02.31-Gen.

The pressure vessel SHALL [PS] be designed for Full Vacuum if any of the following conditions apply:

- a) If the process is such that vacuum conditions can occur.
- b) If the vessel normally operates under vacuum. Vessels that operate at less than full vacuum [i.e., absolute pressure between 0 kPa and 100 kPa (0 psi and 14.7 psi)] shall be evaluated for design at full vacuum.
- c) Vessels in steam or steam condensate systems that are not open to the atmosphere.

For flanges and bolts, the design temperature shall be as in the following table:

Design temperature	% of vessel design temperature	
Flanges	Uninsulated	Insulated
Lap-joint flanges	85	100
Other flanges	90	100
Bolts for Flanges	80	100

2.5.3 Wind load

Wind loads shall be determined in accordance with local codes or EN 1991-1-4, refer to DEP 34.00.01.30-Gen. The wind pressure either at the top of the equipment or, for equipment with an overall height over 30 m (100 ft) and/or having a length to diameter ratio larger than 15, at different specific elevations shall be stated on the data/requisition sheets. The calculation of the stated wind pressure shall take into account the applicable correction factor for the aspect ratio of the equipment.

Equipment having an overall height to diameter ratio larger than 15 may be prone to vortex shedding, and the following SHALL [PS] be considered:

- Piping and platforms shall be distributed around the circumference of the equipment, especially within the top third part of the equipment, to prevent vortices being formed;
- If the above is not possible (e.g., only one overhead line and only rest platforms every 6 m (20 ft)), and if the eddy shedding frequency is within 70% of the natural frequency of the equipment, three wind deflectors shall be installed with a width of $\frac{1}{10}$ of the equipment diameter, evenly spaced in circumference and having a pitch of 5 times the diameter of the equipment, within the top third part of the equipment.

Alternatively, dynamic damping devices may be considered.

2.5.4 Fatigue analysis

The Principal shall specify the required fatigue service lifetime and all operating data necessary for the Manufacturer/Supplier to perform the analysis. If a vessel is intended to be used in a service where more than one set of operating parameters (pressure and temperature) is envisaged (e.g., catalyst regeneration, batch processes, etc.), the data shall include this information and shall state the duration of each envisaged operating mode. The Manufacturer/Supplier is responsible for performing the fatigue analysis if required by EN 13445:2009.

2.5.5 Creep analysis

If a vessel is operating above 380°C (715°F) for ferritic steels and 500°C (930°F) for austenitic stainless steels (see 18.4.3), a creep analysis shall be performed.

If cyclic service is a consideration along with operation in the time dependent temperature range, Annex B of EN 13445:2009 shall be used for analysis method.

The Principal shall specify the required service lifetime and all operating data, necessary to perform the analysis. If a vessel is intended to be used in a service where more than one set of operating parameters (pressure and temperature) is envisaged, the data shall include this information and shall state the duration of each envisaged operating mode and indicate if creep monitoring will be applied.

2.5.6 Corrosion allowance and cladding/lining

2.5.6.1 Corrosion allowance

The minimum corrosion allowance for vessels shall be as follows, unless otherwise specified by the Principal:

Service	Material	Corrosion allowance
General process	carbon steel and low-alloy steel	3 mm (0.12 in)
Non-corrosive or very mildly corrosive (e.g. steam, dry compressed air, LPG, LNG and dry natural gas)	carbon steel and fine grain carbon steel	1 mm (0.04 in)
Service in which the operating temperature is always below 0°C (32°F)	fine grain carbon steel, 3.5% Ni steel and 9% Ni steel	1 mm (0.04 in)
	aluminium and stainless (duplex) steel	none

The corrosion allowance for removable internals shall be as follows:

Item	Corrosion allowance
Stainless steel internals	none
Heavily-loaded components (catalyst grids, etc.) in non-clad equipment made from carbon or low-alloy steel	50% of the corrosion allowance specified for the vessel shall be applied to each surface of the internal

2.5.6.2 Cladding/lining

A chemical analysis of the welded overlay material shall be made at one of the following depths:

- 2.5 mm (0.10 in) for cladding applied as corrosion protection, or
- 1.5 mm (0.06 in) for cladding applied only for product purity.

The chemical composition shall comply with the specification for the material alloy of the cladding.

Loose linings shall not be used.

For the requirements for process equipment with internal chemical-resistant brick lining, see DEP 30.48.60.13-Gen. For dense refractory concrete linings, see DEP 64.24.32.30-Gen. For the requirements for glass-lined process equipment, see DEP 30.48.70.30-Gen.

2.5.7 Shells, nozzles, openings and branch connections

If shell courses have different thicknesses, the inside diameter shall be constant unless otherwise specified by the Principal.

The minimum distance between the weld toe of two longitudinal seams in one course shall be 200 mm (8 in) or five times the wall thickness, whichever is the larger. The minimum distance between the weld toe of staggered longitudinal seams of two adjacent courses shall be 200 mm (8 in) or five times the wall thickness, whichever is the greater. However, where this cannot be achieved, the last 300 mm (12 in) of the adjacent longitudinal seams shall be subjected to 100% examination in accordance with (6.3) or (6.4) as applicable.

Continuous liquid outlets on columns and vessels shall each be provided with a vortex breaker, see Standard Drawing S 10.010, and in the following cases internally extended vortex breakers may be used:

- in fouling service;
- for the hydrocarbon liquid outlets of separators where the liquid is separated from water or aqueous solutions, except where this would give rise to corrosion problems in the bottom.

Vortex breakers should not be used if exposed to rapid thermal loading.

External nozzle loadings shall be specified on the data/requisition sheets. If nozzle loadings are not known or stated in the specification, the interface loadings in (Appendix 7) shall be assumed.

Electric Resistance Welded (ERW) pipe or tube shall not be used for pressure retaining parts such as shells or nozzle necks.

Nozzle necks SHALL [PS] be a minimum thickness of Schedule Standard Pipe plus corrosion allowance with the following exceptions:

- a) Carbon steel or low alloy nozzles DN 80 (NPS 3) or less SHALL [PS] be minimum schedule 160 when the operating temperature of the vessel is between 0°C (32°F) and 175°C (350°F) and when the vessel and nozzle are externally insulated. However, this requirement may be waived to use Schedule Standard Pipe plus corrosion allowance when the vessel and nozzle have Thermal Spray Aluminium (TSA) under-insulation coating applied in accordance with DEP 30.48.40.31-Gen.
- b) Austenitic stainless steel or other high alloy nozzles DN 80 (NPS 3) or less shall be minimum schedule 80S.

2.5.8 Vessel supports

Supports shall be designed so that the metal temperature of the part of the support resting on concrete will not exceed 100°C (212°F). For vessels with operating temperatures below ambient, this temperature shall be such that no condensation will occur under normal operating conditions. The mechanical design shall provide for insulation sealing, adequate surface protection and prevention of liquid collecting areas.

All vessels shall be provided with at least 2 earthing bosses in accordance with Standard Drawing S 68.004 located on diagonal opposite sides.

Cylindrical, vertical vessels shall be supported by a skirt in accordance with Standard Drawing S 20.001, and shall meet the following requirements:

- a) The skirt shall be continuously welded to the shell of the vessel, in accordance with either Standard Drawing S20.001 or other appropriate design, subject to the approval of the Principal.
- b) For vessels of stainless steel or high alloy material, with a design temperature of

230°C (450°F) or more and low temperature carbon steel, the skirt material attached to the vessel shall be of the same material group and similar coefficient of thermal expansion. The length of this section of the skirt shall be no less than $2\sqrt{Rt}$ where R is skirt radius and t is skirt thickness. The remainder of the skirt may be carbon steel.

- c) Flanges SHALL [PS] not be installed inside skirt areas.
- d) The Manufacturer/Supplier shall supply a template of the base plate bolt holes when so specified by the Principal. Template shall be clearly marked with 0° orientation and stating which way is up.

If specified or approved by the Principal, vessels normally supported by skirts may be supported by lugs if:

- The vessel is not in cryogenic service; and
- The lugs are attached to pads that are of the same material group as the pressure plate.

Spherical vessels shall be supported by legs.

Small, cylindrical, vertical vessels ($D \leq 1500$ mm (60 in)) can be supported by legs, generally four (4) in number or half skirts according to standard drawing S 22.005, if:

- i. The design temperature is not greater than 230°C (450°F), and;
- ii. The h/D ratio is no greater than 5, where h is the distance from the base of the support to the top tangent line of the vessel, and;
- iii. The vessel is not in cyclic service.
- iv. The legs are attached to pads that are of the same material group as the pressure plate. See (2.5.8 b).
- v. Vessel is not subject to blast loading.

Horizontal vessels shall be supported by two saddle-type supports unless analysis indicates otherwise, with the agreement of the Principal. The supports shall be continuously welded and shall comply with Standard Drawing S 22.001 or S 22.002. If a sliding saddle is required, it shall comply with Standard Drawing S 22.003.

2.5.9 Lifting trunnions and other attachments

All vertical vessels shall be provided with lifting trunnions, attached by full penetration welds, or lifting lugs as specified on the data/requisition sheets. The tail end of vertical vessels that have a mass greater than 20 tonnes (44,100 lb) shall be provided with a tailing lug (or lugs).

Lifting lugs and trunnions for on-shore equipment SHALL [PS] be designed for a total load as follows:

- For vessels ≤ 100 t (220,500 lb), 1.5 times the lifted weight of the equipment.
- For vessels > 100 t (220,500 lb), 1.35 times the lifted weight of the equipment.

Lifting lugs and trunnions on vessels liable to be lifted from an offshore barge shall be designed for a total load of 3 times the lifted weight. If vessels are dressed up, all lifting attachments shall be designed for the dressed weight. When tail lugs are fitted, the base ring and internal strengthening members shall be designed for the most severe lifting condition. All lifting lugs shall be NDT'ed before lift.

For lifting trunnions for vertical vessels, see Standard Drawing S 10.115. Lifting trunnions shall be removed from insulated vessels after erection.

Cleats for ladders and platforms, insulation support rings and clips for steam tracing shall be fabricated in trapezium form to avoid corrosion under insulation. See Standard Drawings S 20.003, S 28.012, S 28.013 and S 28.014.