

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 314

**Design and construction of large LNG storage tanks
(double walled metallic type)**

04	05/2015	Organisation change – January 2015
03	10/2009	Update of reference documents
02	10/2005	Addition of “EP” root to GS identification
01	10/2003	Change of Group name and logo
00	03/2001	First issue
Rev.	Date	Purpose of the revision

Owning entity: DSO/TEC

Managing entity: DSO/TEC/PVV

Document update realised by
standards coordination
Reorganisation 2015

General Specification		GS EP PVV 314
Design and construction of large LNG storage tanks (double walled metallic type)		
Rev.: 04	Effective date: 05/2015	Page: 2 of 21

Contents

1. Scope	4
2. Reference documents	4
3. Tank configuration	5
3.1 Outer tank	6
3.2 Inner tank and suspended roof	6
3.3 Tank dimensions	6
3.4 Tank foundation	6
3.5 Insulation	6
3.6 Nozzles and appurtenances	6
3.7 Control and safety equipment	7
4. Design conditions	7
4.1 Allowable design stresses	7
4.2 Shell thickness	7
4.3 Hydrostatic test design condition	7
4.4 Attachments to inner tank	7
4.5 Design stress of shell bottom attachment to annular plates	8
4.6 Design load combinations	8
4.7 Minimum thicknesses	8
5. Tank materials	9
5.1 Carbon steel supplementary requirements	9
5.2 9% nickel steel supplementary requirements - Qualification of materials	9
5.3 Material selection	10
6. Fabrication	10
6.1 Examination of materials	11
6.2 Shop fabrication	11
6.3 Packaging	11
6.4 Site erection	12
6.5 Welding procedures and qualification tests	12
6.6 Welders qualification	12

6.7	Production tests	12
6.8	Welding repair.....	13
6.9	Arc strikes on primary components	13
6.10	Tolerances	13
7.	Inspection and tests.....	13
7.1	Extent of tests	13
7.2	Acceptance standards.....	14
7.3	Hydrostatic test	14
8.	Foundations.....	14
9.	Insulation	15
9.1	Bottom insulation	15
9.2	Shell insulation.....	15
9.3	Roof insulation	16
10.	Nozzles and appurtenances	16
10.1	Nozzles	16
10.2	Access equipment.....	16
11.	Control and safety equipment.....	17
11.1	General.....	17
11.2	Temperature and density control.....	17
11.3	Level control	17
11.4	Pressure control and safety.....	17
11.5	Heating/Foundation system.....	18
12.	Cleaning and painting.....	19
12.1	Final painting	19

General Specification		GS EP PVV 314
Design and construction of large LNG storage tanks (double walled metallic type)		
Rev.: 04	Effective date: 05/2015	Page: 4 of 21

1. Scope

This Specification, together with referenced documents, covers the requirements for design, material supply, fabrication, inspection, test and painting of single containment, double-walled metallic LNG storage tanks.

Requirements for civil works (foundations, supporting areas and drainage system) for fire-fighting equipment, for pre commissioning and commissioning procedures, are excluded from this Specification.

Design and materials not specifically covered by this Specification may be proposed by Contractor and shall be submitted to the Company approval.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

Any conflicting requirements between this specification and any other relevant document must be reported to the Company for decision. In any case, and notwithstanding the final decision of the Company, the most stringent requirement is always first meant to govern.

Design and construction of large LNG storage tanks (double walled metallic type)

Rev.: 04

Effective date: 05/2015

Page: 5 of 21

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ASTM A553	Standard Specification for Pressure Vessel Plates. Alloy Steel, Quenched and Tempered 8 and 9% Nickel
BS 7448-1	Fracture Mechanics Toughness Tests - Part 1: Method for Determination of K _{Ic} , Critical CTOD and Critical J Values of Metallic Materials
BS 7910	Guide to methods for assessing the acceptability of flaws in metallic structures
API STD 620	Recommended Rules for Design and Construction of Large, Welded, Low-pressure Storage Tanks
API STD 650	Welded Steel Tanks for Oil Storage
NFPA 59A	Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG)
ASME Section V	Non-destructive Examination
ASME Section VIII	Pressure Vessels
ASME Section IX	Welding and Brazing Qualifications
ASME Section II	Material Specifications
ASME Section II Part A	Ferrous Materials
ASME Section II Part C	Welding Rods, Electrodes and Filler Metal

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP PVV 611	Welding of pressure containing piping and equipment

3. Tank configuration

Tanks shall be of double-walled metallic type:

General Specification		GS EP PVV 314
Design and construction of large LNG storage tanks (double walled metallic type)		
Rev.: 04	Effective date: 05/2015	Page: 6 of 21

3.1 Outer tank

The outer tank shall be designed to enclose the tank insulation and to contain the vapour phase of the tank at the design pressure. It shall be made of carbon steel and shall consist of:

- Flat bottom
- Cylindrical wall
- Outer dome roof.

3.2 Inner tank and suspended roof

The inner tank shall be designed to contain the stored liquid and shall consist of:

- 9% Ni steel flat bottom
- 9% Ni steel cylindrical wall
- A flat deck, made of aluminium or 9% Ni steel, suspended from outer dome roof by suitable rods, loosely fit to the tank wall to allow vertical and horizontal movement, shall support the roof insulation.

3.3 Tank dimensions

They shall be determined by the Contractor in compliance with the design conditions specified for workable and total stored volume, stress and maximum thickness requirements for inner shell, hydraulic test conditions, loads allowable by bottom insulation and foundation, and insulation requirements.

3.4 Tank foundation

The type of tank foundation shall be determined according to the results of soil investigations.

In case of tank supported by a slab at grade (concrete or compacted earth), prevention of soil freezing shall be insured by an electrical heating system installed in the slab.

In case of tank supported by an above grade reinforced concrete slab laid on piles, prevention of soil freezing will be obtained by natural venting between grade and slab.

3.5 Insulation

The tank insulation shall consist in:

- A bottom insulation installed on the outer tank bottom and supporting the loads of tank and stored product
- A shell insulation of loose perlite and associated device to avoid excess of compressive strength on the inner tank by perlite settlement due to inner tank movement during cool down and warm up cycles
- A roof insulation laid on the suspended deck.

3.6 Nozzles and appurtenances

Each tank shall be fitted with all nozzles and accessories necessary for normal operation, commissioning and decommissioning procedures and maintenance.

General Specification		GS EP PVV 314
Design and construction of large LNG storage tanks (double walled metallic type)		
Rev.: 04	Effective date: 05/2015	Page: 7 of 21

All connections to or from the inner tank shall be installed through the outer tank roof and suspended roof, or through the tank bottom.

3.7 Control and safety equipment

Control and safety equipment of tanks shall be designed to allow remote operation and control.

Control and safety equipment shall be designed and installed in accordance with Standards and Codes as listed in Chapter 2, and in accordance with Instrument Specifications.

4. Design conditions

The tank shall be designed in accordance with [API STD 620](#), Appendix Q.

Contractor shall insure that each important tank element shall have proven operating experience in similar size and conditions.

4.1 Allowable design stresses

These stresses shall comply with the [API STD 620](#). The allowable stresses specified by the table Q 3.3 of the [API STD 620](#) are based on strength of weld metal. Other values may be considered if yield and tensile strength of weld metal are certified, based on welding procedure qualification, at higher values than those stated by the Code. The Contractor shall supply data on previous experiences to support its statement. Final decisions shall be submitted to the Company approval.

The resultant stresses from combination of loads shall not exceed the allowable stresses specified above at any point of the tank. Furthermore, for parts of the tank not subject to hydrostatic test and parts not over-stressed during hydrostatic test, allowable stresses shall be calculated by applying the safety factor of 5 to the minimum guaranteed tensile strength (instead of 3 as for the other parts of the tank shell).

Maximum allowable design stress during hydrostatic test shall be limited to 0.90 of the yield strength on which the design stresses have been based.

No course shall have a thickness greater than the thickness of the course placed below.

4.2 Shell thickness

Shell plate thickness for inner tank shall not exceed 32 mm.

4.3 Hydrostatic test design condition

The inner tank shall be tested by filling with water to the maximum height compatible with thickness and stress calculations. Minimum filling height shall be 90% of the design liquid level.

4.4 Attachments to inner tank

Attachments to the inner tank shell, including stiffeners, shall be by full penetration fillet welds.

Attachment welds shall not be located within 150 mm of any main seam.