



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

ENGINEERING STANDARD
FOR
STORAGE TANKS

NPCS-ES-PV-03

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PREPARED BY : PETROCHEMICAL INDUSTRIES DESIGN & ENGINEERING COMPANY (P.I.D.E.C.)



1

SCOPE

This standard as minimum directives, applies to above-ground vertical, cylindrical, closed and open-top (with or without floating roof), welded, Steel storage tanks, with pressures from 6 mbar vacuum to 170 mbar above atmospheric pressure for oil industries.

2

STANDARDS AND CODES

The latest edition of the following codes and standards are undetachable parts of this standard and shall be used with this standard, as minimum.

- API 650 Welded Steel Tanks for Oil Storage.
- API 2000 Venting Atmospheric and Low Pressure Storage Tanks.
- API 2001 Fire Protection in Refineries.
- API 2003 Recommended Practice for Protection Against Ignition Out of Static, Lightning & Stray Currents.
- API 2015 Cleaning Petroleum Storage Tanks.
- API 2550 Method for Measurement & Calibration of Upright Cylindrical Tanks.
- NFPA Vol's 1 and 8 Fire Protection Codes.
- AWWA D 100 Welded Steel Tanks for Water Storage.
- NPCS-CS-PV-02 Construction Standard for Erection of Storage Tanks.
- NPCS-MS-PV-04 Material Standard for Storage Tanks.



3 DESIGN

3.1 GENERAL

- 3.1.1 Tanks shall meet the requirements of the applicable codes as minimum. The tanks shall have an API monogrammed nameplate.
- 3.1.2 Storage tank specification data sheets shall be filled out by the manufacturer. The inspector shall fill out the appropriate blanks in this specification data sheet.
- 3.1.3 All tanks shall be designed for seismic loads based on the site conditions. The tanks must be designed either according to appendix-E of API 650 or appendix-A of AWWA D 100.
- 3.1.4 Tanks having a small design pressure to 170 mbar shall be designed according to appendix-F of API 650 and the nameplate shall indicate this.
- 3.1.5 Tanks operating at metal temperature from 90°C to 260°C shall be designed according to appendix-M of API 650. When such tanks are subjected to liquid head and temperature cycles, e.g. due to loading and unloading of the tank content, they shall meet the fatigue requirements of the same appendix.
- 3.1.6 Water tanks for private fire protection shall be designed according to NFPA 22 Vol.1. The tanks subject to freezing shall be heated according to chapter 10 of NFPA 22. Suitable connections shall be provided for such tanks.
- 3.1.7 For design and construction of foundations under the vertical steel storage tanks, appendix-B of API 650 shall be used.
- 3.1.8 External floating roofs shall be designed & constructed according to appendix-C of API 650.
- 3.1.9 Internal floating roofs shall be designed & constructed according to appendix-H of API 650.
- 3.1.10 Based on storage tank process data sheets and all relevant standards and codes, as referred in section 2, the mechanical data sheet for each tank shall be prepared.

3.2 FOUNDATION CONCERNS

- 3.2.1 As a rule uniform settlements do not affect the tank stability.

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- 3.2.2 Inclination of the tank axis increases the bending stresses in the bottom corner. For this reason the maximum value stated in the structural analysis shall not be exceeded.
- 3.2.3 Differential settlements in the bottom corner relative to an initial horizontal or inclined plane can give rise to major deformation of the tank shell, with the following consequences:
- a) In the case of the tanks with fixed roofs where the circular edge of the upper edge of the shell is preserved, outward and inward bulging of the shell occurs. Inward bulging reduces the resistance of the shell to bulging.
 - b) In the case of tanks with floating roofs loss of roundness of the upper edge of the shell can result in the roof jamming and in the destruction of the annular seal.
- 3.2.4 Because excessive sag of the bottom increases the circumferential stresses at the bottom corner, particular importance attaches to the relevant measurements. There is no problem if the permissible maximum value (relative to the bottom corner) is reached within a concentric circle, the diameter of which is half that of the shell. Should the maximum value be outside, that circle modifications to the foundation may become necessary at a value as low as about 0.8 of the maximum value.
- 3.2.5 Should major differential settlements, inclinations and inward bulging be found continuous, observation is desirable and advice should be sought from soil mechanics experts and tank manufacturers. In critical cases filling is to be discontinued.
- 3.2.6 The tank foundation is intended to prevent:
- a) Inadmissible inclination of the tank.
 - b) Inadmissible deviations from the plane of the foundation beneath the shell.
 - c) Inadmissible sag of the bottom of the tank relative to the bottom edge.
- 3.2.7 The type of foundation should take into account:
- a) The nature of the ground.