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NB

ENERGY INDUSTRY STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

NB/T 47003.2-2022

Replacing NB/T 47003.2-2009

Atmospheric pressure vessels - Part 2: Silos for solid materials

常压容器 第2部分：固体料仓

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Foreword

This document was issued on 4 November 2022 by the National Energy Administration of the PRC and takes effect on 4 May 2023.

It is a NB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

It is classified under ICS 23.020.10, Chinese classification J 74.

It replaces NB/T 47003.2-2009, which is superseded.

This document has been drafted in accordance with the rules given in GB/T 1.1-2020, Directives for standardization - Part 1: Rules for the structure and drafting of standardizing documents.

NB/T 47003, Atmospheric pressure vessels, is divided into two parts: Part 1, Steel welded atmospheric pressure vessels; Part 2, Silos for solid materials.

This document constitutes Part 2 of NB/T 47003, Atmospheric pressure vessels.

This document replaces NB/T 47003.2-2009, Silos for solid materials. In addition to structural adjustments and editorial changes, the following main technical changes have been made with respect to NB/T 47003.2-2009:

a) the range of application of the design pressure of silos for solid materials has been changed (see 1.2; 1.2 of the 2009 edition);

b) the responsibilities of the user or of the party commissioning the design have been added (see 4.2.1);

c) the safety factors for carbon steel, low alloy steel and high alloy steel have been changed: the safety factor applied to the lower limit of the standard tensile strength of the steel has been adjusted from 2.4 to 2.3 (see 4.6; 4.8 of the 2009 edition);

d) the pressure test has been deleted (see 4.8 of the 2009 edition) and the tightness test and the water filling test have been added (see 4.10);

e) the steel grades of steel materials and the allowable stresses of section steel have been added (see Clause 5; Clause 5 of the 2009 edition);

f) aluminium plate (see 5.7), aluminium tube (see 5.8), aluminium extruded bar (see 5.9), aluminium hot extruded profile (see 5.10) and aluminium alloy forgings (see 5.11) have been added;

g) the overpressure coefficient of the material load has been added (see 6.1);

h) the use coefficient I for seismic calculation has been deleted (see 6.4 of the 2009 edition);

i) the calculation method for the wind load has been changed (see 6.5; 6.5 of the 2009 edition);

j) the calculation of the material load on the conical part of the silo shell has been changed (see 6.11; 6.10 of the 2009 edition);

k) the stability check of the cylindrical part of the silo shell has been added (see 6.15);

l) Annex B, Calculation of the horizontal pressure on the cylindrical shell of an eccentrically discharged silo, has been added (see Annex B).

This document was proposed by and is under the jurisdiction of the National Technical Committee on Boilers and Pressure Vessels of Standardization Administration of China (SAC/TC 262).

The drafting organizations of this document are: Gansu Lanke Petrochemical High-tech Equipment Co., Ltd.; China Kunlun Contracting and Engineering Corporation; SINOPEC Engineering Incorporation; SINOPEC Shanghai Engineering Company Limited; China Special Equipment Inspection and Research Institute; Hefei Municipal Administration for Market Regulation; Ningbo Special Equipment Inspection and Research Institute; Shanghai Lanbin Petrochemical Equipment Co., Ltd.; Lanzhou Petroleum and Chemical Equipment Inspection Institute of the Machinery Industry Co., Ltd.; China Huanqiu Contracting and Engineering Co., Ltd. Beijing Branch; Beijing Yanhua Engineering Construction Co., Ltd.

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The successive editions of this document and of the documents it replaces are: JB 2880-1981; JB/T 4735-1997; NB/T 47003.2-2009.

1 Scope

NB/T 47003.2-2022 is Part 2 of the Chinese standard for atmospheric pressure vessels and covers silos for solid materials, replacing the 2009 edition. A silo is not a tank with powder in it: stored solids arch and rathole, they exert pressures that depend on whether the contents are filling or discharging, and the switch to flow can load the transition of a hopper far beyond anything the static head would suggest. The standard is built on that. It sets the scope and the defined terms, then the material properties that govern design - bulk density, angle of internal friction, wall friction angle and flow function - and how they are determined. Loads follow: the filling and discharge pressures on the vertical wall and on the hopper, the patch loads from eccentric discharge, and the combination with wind, snow, seismic and thermal actions. Design rules then cover the cylindrical shell and its buckling under axial compression, the conical and pyramidal hoppers and the transition ring or skirt where the hoop tension concentrates, the roof and its openings, the supporting structure and the skirt or leg arrangement, and the discharge outlet with its gate and flow-promoting devices. Materials, wall thickness and corrosion and abrasion allowances are specified, followed by fabrication and welding, dimensional tolerances, inspection and testing, marking and the documentation supplied on delivery. It applies to welded steel silos for the Chinese energy and process industries.

1.1 This document specifies the requirements for the design, fabrication, inspection and acceptance of silos for solid materials (hereinafter referred to as silos).

1.2 This document applies to steel and aluminium welded vertical cylindrical silos used to store granular or powdery loose solid materials, within the following range of application:

a) the inside diameter of the silo shell is not greater than 20 m;

b) the volume is not less than 15 cubic metres;

c) the design positive pressure is not greater than 20 kPa and the design negative pressure is not lower than -5 kPa;

d) the design temperature range is in accordance with the service temperature range permitted for the metallic material of the silo shell;

e) the ratio of the height H to the inside diameter Di is not greater than 5.

1.3 This document does not apply to the following silos:

a) silos directly buried underground;

b) silos containing materials whose degree of toxic hazard is extreme or high;

c) hoppers that are frequently moved;

d) groups of silos connected in a row by an operating platform.

1.4 Boundary of the silo. The scope defined in this document covers the silo shell and the parts connected with it to form an integral whole, delimited within the following boundaries.

a) For the connection between the silo and external piping: 1) the end face of the groove of the first circumferential joint of a welded connection; 2) the end face of the first threaded joint of a threaded connection; 3) the sealing face of the first flange of a flanged connection; 4) the first sealing face of a special connector or of a pipe fitting connection.

b) The closure elements of the openings of the silo, such as nozzles, manholes and handholes, the formed heads, the flat covers and their connecting fasteners.

c) The support elements of the silo, the reinforcing elements of the openings, the pads and other attachments, together with their welds to the shell.

d) The safety accessories and instruments directly mounted on the silo.

2 Normative references

The following documents contain provisions which, through normative reference in this text, constitute indispensable provisions of this document. For dated references, only the edition corresponding to that date applies to this document; for undated references, the latest edition (including all amendments) applies to this document.

GB/T 150.1 Pressure vessels - Part 1: General requirements

GB/T 150.2 Pressure vessels - Part 2: Materials

GB/T 150.3 Pressure vessels - Part 3: Design

GB/T 150.4 Pressure vessels - Part 4: Fabrication, inspection and testing, and acceptance

GB/T 699 Quality carbon structural steels

GB/T 700-2006 Carbon structural steels

GB/T 713 Steel plates for boilers and pressure vessels

GB/T 983 Stainless steel covered electrodes

GB/T 985.1 Recommended joint preparation for gas welding, manual metal arc welding, gas shielded arc welding and beam welding