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Road tankers for refrigerated liquefied gas

冷冻液化气体汽车罐车

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Table of Contents

Road tankers for refrigerated liquefied gas

1 Scope

1.1 This Standard specifies the requirements for materials, design, manufacture, test methods, inspection rules, signs and marks, exit-factory documents, storage and transportation for road tankers for refrigerated liquefied gas (hereinafter referred to as tankers).

1.2 This Standard is applicable to the tanker of which the design pressure of the container in the tank is not less than 0.1 MPa, the geometric volume is not less than 1 m^3, the vacuum powder insulation or high vacuum multi-layer insulation structure is adopted, and the tank is permanently connected to the finalized chassis or semi-trailer running mechanism.

1.3 This Standard does not apply to tankers in the following ranges:

a) The material of the tank is non-ferrous metal or non-metal;

b) Tankers filled with refrigerated liquefied gas medium with standard boiling point lower than -196°C;

c) Tankers filled with toxic medium;

d) Tankers with special requirements for national defense and military equipment.

1.4 Defined scope

1.4.1 The scope of tankers to which this Standard applies includes tank bodies, pipelines, safety accessories, instruments, loading-unloading accessories, and finalized chassis or semi-trailer running gears, supports, operation boxes, self-superchargers, etc.

1.4.2 The scope of tankers is defined as follows:

a) The beveled end face of the first circumferential joint of the welded connection between the tank and the pipeline;

b) The first threaded joint end face of the tank and the pipeline and safety accessories threaded connection, and the first flange sealing surface of the flange connection;

c) The end cover of the opening part of the tank and its fasteners;

d) The connection welds between the tank and non-pressure components.

1.4.3 Pipeline includes all pipes and fittings connected to the tank.

geometric volume of the inner container.

3.11 specified filling rate

When the tanker is filled, the ratio of the liquid volume to the geometric volume of the inner container when the filling liquid reaches the maximum liquid level specified in the design.

3.12 reference steel

A benchmark steel of which the set lower limit of the standard tensile strength (R_m) is 370 MPa, and the elongation after break (A) is 27%.

3.13 sealing-off vacuum degree

The vacuum degree when the vacuum interlayer pressure is relatively stable at room temperature after the tank is vacuumed and sealed.

4 Qualification and responsibilities

4.1 Qualification

4.1.1 The design, manufacture, inspection and acceptance of tankers shall not only comply with the provisions of this Standard, but also comply with the relevant laws, regulations and safety technical specifications promulgated by the state.

4.1.2 The designer and manufacturer of tankers shall obtain the corresponding special equipment design and manufacture license according to the provisions of TSG R0005.

4.1.3 In addition to holding the corresponding special equipment manufacturing license, the manufacturer of tankers shall also obtain the corresponding product manufacturing qualification in accordance with the regulations of the competent department of the automobile industry under the State Council.

4.2 Responsibilities

4.2.1 User or design client

The user or the design client shall submit the tanker design conditions to the design unit in formal written form. Design conditions include at least the following:

a) Main standards and safety technical specifications that shall be followed in design and manufacture.

b) Working conditions, including ambient temperature, working temperature range, working pressure range, loading-unloading conditions and methods, loading-unloading pressure, additional load, road conditions, etc.;

c) Filling medium, including the number, name, category, composition, physical and chemical properties, hazardous characteristics, harmful impurity content of the medium, and the corrosion rate of the medium to the tank material, etc.;

d) Geometric volume or effective volume of the inner packaging;

e) Expected tanker age and sandwich vacuum age;

f) Required maintenance time;

g) Number of pressure cycles corresponding to fluctuating pressure;

h) Model and necessary technical parameters of the finalized chassis or tractor;

i) Other necessary conditions required for design (such as tank material selection, anti-corrosion, surface treatment and special tests, etc.).

4.2.2 Designer

4.2.2.1 The designer shall complete the vehicle design based on the contents of the risk assessment report, and shall be responsible for the correctness and completeness of the design documents.

4.2.2.2 The management and use of the special seal for design shall meet the requirements of TSG R0005.

4.2.2.3 The designer shall keep all the design documents within the design service life of the tanker.

4.2.3 Manufacturer

4.2.3.1 The tanker shall be manufactured as the whole vehicle. The manufacturer is responsible for the manufacturing quality of the tanker.

4.2.3.2 The manufacturer shall manufacture according to the requirements of the design documents. When the original design document needs to be modified, it shall obtain the written certification document agreeing to the modification from the original designer, and make detailed records of the modified parts.

4.2.3.3 The manufacturer shall formulate a quality plan before manufacturing. Its content includes at least the tanker manufacturing process control points, inspection items and qualification requirements.

4.2.3.4 During the manufacturing process and after completion, the inspection department of the manufacturer shall conduct various inspections and tests in accordance with the provisions of this Standard, design drawings and design documents, and quality plans, issue corresponding reports, and be responsible for the correctness and completeness of the reports.

tanker manufacturer. The content of the material quality certificate shall be complete and clear. And print traceable information signs and quality inspection stamps.

5.1.6 When the manufacturer obtains tank materials from non-material manufacturers, it shall obtain the original material quality certificate provided by the material manufacturer or a copy stamped with the official seal of the material operator and the seal of the person in charge.

5.1.7 The manufacturer shall be responsible for the authenticity and consistency of the quality certificates of the obtained materials and purchased parts.

5.2 Tank material

5.2.1 The material selected for the tank shall comply with the provisions of GB/T 150.2 and the corresponding national standards and industry standards. When selecting materials for tank pressure components, the use conditions of materials (such as design temperature, design pressure, medium characteristics and operating characteristics, etc.), material properties (mechanical properties, process properties, chemical properties and physical properties), tank manufacturing process and economic rationality shall be considered.

5.2.2 The use of foreign brand materials or new materials shall comply with the relevant regulations of TSG R0005.

5.2.3 Inner container

5.2.3.1 The material of the pressure components of the inner container shall comply with the relevant material standards and design drawings.

5.2.3.2 The steel used for the pressure components of the inner container shall generally be made of austenitic stainless-steel.

5.2.3.3 The mechanical properties of materials used for inner containers shall meet the following requirements:

a) The steel used for the pressure components of the inner container shall have good plasticity. The standard value of yield strength (or 0.2% of the specified plastic elongation strength) at room temperature shall not be greater than 460 MPa. The upper limit standard value of tensile strength shall not be greater than 725 MPa.

b) The ratio of room temperature yield strength (or 0.2% specified plastic elongation strength) to room temperature tensile strength in the material quality certificate shall not be greater than 0.85.

c) The elongation after fracture of the steel plate shall not be less than $10000/R_m$ (%). The elongation after fracture of the austenitic stainless-steel shall not be less than 40%. The elongation index after fracture of specimens of different sizes shall be converted according to GB/T 17600. The converted indicators shall comply with

the provisions of this article.

5.2.4 Shell

5.2.4.1 Smelting method

5.2.4.1.1 The steel used for the shell shall be killed steel.

5.2.4.1.2 The low-temperature steel plates and low-temperature steel forgings whose design temperature is below -20°C shall also adopt the external refining process.

5.2.4.2 Chemical composition (melting analysis)

5.2.4.2.1 For low-alloy steel materials used for welding, the carbon content is not greater than 0.250%, the phosphorus content is not greater than 0.035%, and the sulfur content is not greater than 0.035%.

5.2.4.2.2 For low-alloy steel products (steel plates and steel forgings), the phosphorus and sulfur content shall meet the following requirements:

a) The phosphorus content is not more than 0.030%. The sulfur content is not more than 0.020%.

b) For steel with a design temperature lower than -20°C and the lower limit of the standard tensile strength not greater than 540MPa, the phosphorus content is not greater than 0.025%, and the sulfur content is not greater than 0.012%.

5.2.4.3 Mechanical properties

5.2.4.3.1 For the low-alloy steel used for the shell, the standard value of the yield strength at room temperature shall not exceed 460 MPa, and the standard value of the upper limit of the tensile strength shall not exceed 725 MPa. It shall be able to adapt to the environmental conditions encountered by the tanker during transportation and use. It shall meet the requirements of the design drawings.

5.2.4.3.2 For the low-alloy steel used for the shell, the ratio of the yield strength to the tensile strength at room temperature in the material quality certificate shall not be greater than 0.85.

5.2.4.3.3 The impact test of low-alloy steel plates and steel forgings for shells shall meet the following requirements:

a) The impact test temperature shall be in accordance with the requirements of the design documents.

b) The minimum value of the Charpy impact absorbed energy (KV_2) of the V-notch specimen shall meet the requirements in Table 1.

c) When the impact absorption energy index in the steel standard is higher than that

5.2.6.1 Stainless-steel forgings for inner containers shall meet the requirements of NB/T 47010. The level of forgings shall not be lower than Level III.

5.2.6.2 The low-alloy steel forgings and stainless-steel forgings for shells shall comply with the regulations in NB/T 47009 and NB/T 47010, respectively. The level of forgings in contact with the medium in the tank shall not be lower than level III. The levels of other forgings are not to be lower than Level II.

5.2.7 Steel pipes and fittings

5.2.7.1 The materials used for steel pipes shall comply with the provisions of GB/T 150.2 and design drawings, and shall comply with the provisions of GB/T 13296 or GB/T 14976.

5.2.7.2 Pipe fittings shall comply with the relevant standards. When steel forgings are used for pipe fittings, they shall comply with the provisions in 5.2.6.

5.2.7.3 When the pipe fittings are formed by cold forming, the measured value of ferrite after forming shall not exceed 15%.

5.2.8 Thermal insulation material

5.2.8.1 Expanded perlite (pearlite) for vacuum powder insulation shall meet the following requirements:

a) Particle size: 0.1 mm ~ 1.2 mm.

b) Bulk density: 30 kg/m^3 ~ 60 kg/m^3.

c) Moisture content: not more than 0.3% (mass ratio).

d) Thermal conductivity (average value at normal pressure and temperature 77 K ~ 310 K): no more than 0.03 W/ (m · K).

5.2.8.2 The light blocking agent shall have good chemical stability.

5.2.8.3 The high-vacuum multi-layer heat insulation material shall comply with the provisions of GB/T 31480. It shall be made of degreased fiber cloth or degreased fiber paper with small thermal conductivity and low outgassing rate.

5.2.9 Adsorbent materials

5.2.9.1 SA Molecular sieves shall meet the requirements of GB/T 13550. 13X molecular sieve shall meet the requirements of HG/T 2690.

5.2.9.2 The oxidized handle shall comply with the provisions of YS/T 599.

5.2.10 Welding consumables

5.2.10.1 The welding consumables used for the tank shall meet the requirements of NB/T 47018.1 ~ 47018.4. There are clear and firm signs.

5.2.10.2 The selection of welding materials shall consider the matching of the mechanical properties of the welded joints and the base metal of the tank. The tensile strength of the weld metal shall not be lower than the lower limit specified in the base metal standard. The impact absorbed energy of low-alloy steel welding materials meets the requirements in Table 1. When necessary, its performance shall not be lower than the corresponding requirements of the base metal.

5.2.10.3 Welding consumables shall undergo welding procedure qualification according to the requirements of NB/T 47014. They can be used only after passing the assessment.

5.2.11 Sandwich support material

5.2.11.1 Non-metallic support materials shall be selected as low thermal conductivity, low surface outgassing rate under vacuum and good low temperature impact toughness as possible. The use temperature shall be within the allowable use temperature range of the material.

5.2.11.2 Metal support materials shall be selected with low thermal conductivity and good low temperature impact toughness. The operating temperature shall be within the allowable operating temperature range of the material and meet the standard requirements of the corresponding material.

5.2.12 Other

5.2.12.1 Outsourced parts shall comply with the relevant national standards or industry standards. They shall have quality certification documents or product certificates.

5.2.12.2 The finalized chassis shall use the finalized products approved by the State Council's automobile authority. There are corresponding technical information and quality certification documents. When choosing an imported automobile chassis, it shall comply with the relevant regulations of the national competent department. There are corresponding technical information and quality certification documents.

5.2.12.3 The semi-trailer running mechanism shall meet the requirements of GB/T 23336, and have corresponding technical information and quality certification documents.

5.2.12.4 Portable fire extinguishers shall meet the requirements of GB 4351 and be within the period of validity.

5.2.12.5 Imported valves and other pressure piping components shall also comply with the relevant regulations of the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China.

5.2.12.6 Fasteners shall comply with the relevant national standards or industry

the outer end surface of the pipeline, safety accessories, instruments and loading-unloading accessories in the length direction of the tank shall not be less than 150 mm.

6.1.8 The pipeline joints, loading-unloading valves, overpressure relief devices, emergency shut-off devices, instruments and other accessories of the tanker shall be reasonably arranged and relatively centralized, so as to facilitate operation, inspection and maintenance. Set in the operation box for protection as possible. Pipelines, valves, etc. shall be clearly marked to indicate their purpose.

6.1.9 The operation box of the tanker shall have enough space for operation. The connection is firm. The settings meet the vehicle requirements.

6.1.10 When the self-supercharger is installed on the tanker, it shall be installed in a safe and reliable place.

6.1.11 The quantity, position and light color of the external lighting and signaling devices of the tanker shall comply with the provisions of GB 4785.

6.1.12 At least one portable fire extinguisher of not less than 4 kg shall be equipped on both sides of the tanker, which shall be securely fixed, easy to pick and place.

6.1.13 Single vehicles and semi-trailer tractors shall be equipped with speed limiting devices, satellite positioning devices with driving recording functions, retarders or other auxiliary braking systems.

6.1.14 The front turning radius and rear clearance radius of the semi-trailer shall meet the requirements of GB/T 20070.

6.1.15 The semi-trailer running mechanism shall comply with the provisions of GB/T 23336.

6.1.16 The towing pin of the semi-trailer shall comply with the provisions of GB/T 4606 or GB/T 4607.

6.1.17 The axle and suspension device of the semi-trailer shall comply with the provisions of GB/T 23336.

6.1.18 The layout of the semi-trailer support device shall not affect the steering of the tractor. Semi-trailer support device shall meet the requirements of QC/T 310. The ground clearance in driving state shall not be less than 320 mm.

6.1.19 Tankers filled with flammable and explosive medium shall comply with the following regulations:

a) The exhaust spark arrester of the tanker shall be arranged in the area before the front face of the tank and not higher than the upper plane of the vehicle longitudinal beam. The exhaust spark arrester shall meet the requirements of GB 13365.

b) The structure and safety technical requirements of the tank and its additional equipment shall comply with the relevant provisions of GB 21668 and GB 20300.

6.1.20 The design service life of the tank shall not be less than 10 years.

6.2 Design documents

6.2.1 The design documents of the tanker shall at least include the following documents:

a) Risk assessment report, including main failure modes and risk control in design, manufacture and use stages. The basic content shall meet the requirements of Annex B.

b) Design instructions, including the main physical and chemical properties of the filling medium (number, name, category, saturated vapor pressure and density corresponding to the working temperature, etc.). Hazardous characteristics, limited components of mixed medium and limited content requirements of harmful impurities. Compatibility with tank materials, etc. Description of the selection of design codes and standards. Description of the principles for determining the main design structure. Explanation of the principles for determining the main design parameters. Description of material selection. Description of the selection of safety accessories. Instructions for the selection of instruments and handling accessories. Description of selection of main purchased components (such as finalized chassis or running gear, etc.).

c) Design calculations, including calculations of tank strength, stiffness, external pressure stability, volume, heat transfer, safe discharge capacity, discharge capacity of overpressure relief devices, and strength of internal and external support structures, etc. Stress check of the connection between the tank and the walking mechanism or the finalized chassis. Axle load distribution for tankers. Calculation of roll stability and center of gravity. When necessary, it also includes the analysis and calculation of the structural strength and stress of the tanker.

d) Design drawings, including general drawings, tank and component drawings, piping systems and flow charts, etc.

e) Manufacturing technical conditions, including main manufacturing process requirements, inspection and test methods, etc.

f) Instructions for use, including main technical performance parameters, applicable medium, safety accessories, specifications and connection methods of instruments and loading-unloading accessories, operating instructions, precautions for use, necessary warning requirements and emergency measures, etc.

6.2.2 General design drawings, tank drawings, risk assessment reports and design calculations shall be signed by 3-levels -- design, check and review; and approved by

a) Material designations, specifications, standards and requirements of main pressure components;

b) Main design parameters, including design temperature, design pressure, minimum design metal temperature, corrosion allowance, medium density, rated filling rate, maximum allowable filling volume, filling medium and its hazard, geometric volume of inner container and vacuum interlayer, welding joint coefficient, etc. If the medium has a tendency of stress corrosion, the limited content of the corrosive medium shall also be indicated;

c) Calculated thickness, nominal thickness and minimum formed thickness of the cylinder and head of the inner container and the outer shell;

d) Non-destructive testing requirements;

e) Heat treatment requirements (if necessary);

f) Pressure proof test requirements;

g) Tank vacuum insulation type, vacuum performance index, vacuum insulation performance index, vacuum design service life, etc.;

h) Anti-corrosion requirements (if necessary);

i) Design service life of the tank (the fatigue tank shall indicate the number of cycles).

6.3 Connection between tank and finalized chassis

6.3.1 The layout of the upper part of the tanker shall avoid concentrated load on the finalized chassis frame.

6.3.2 When the finalized chassis frame needs to be lengthened, the material used for the lengthened part shall consider the weldability with the original frame material.

6.3.3 Drilling or welding in the stress concentration area of the tanker frame shall be avoided. When the side plane of the frame is drilled, the edge of the hole shall be at least 25 mm above the upper and lower planes.

6.3.4 The longitudinal center plane of the tank shall coincide with the longitudinal center plane of the finalized chassis. Its allowable deviation is not more than 6 mm. The connection between the tank and the finalized chassis shall be reasonable and firm.

6.4 Connection between tank and semi-trailer running gear

6.4.1 Semi-trailers can be divided into two types: semi-load-bearing and load-bearing according to the stress on the tank and the connection method.

6.4.2 The semi-trailer frame shall be checked for structural strength.

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