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Tube trailer

长管拖车

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Tube trailer

1 Scope

1.1 This standard specifies the requirements for materials, design, manufacturing, test methods, inspection rules, sign and marking, exit-factory documents, storage and transportation of tube trailers.

1.2 This standard applies to tube trailers in which the following large-volume steel seamless gas cylinders (hereinafter referred to as gas cylinders) are permanently connected to the shaped chassis or semi-trailer running mechanism:

- a) The operating environment temperature is $-40\text{ }^{\circ}\text{C} \sim 60\text{ }^{\circ}\text{C}$;
- b) The nominal working pressure of the gas cylinder is $10\text{ MPa} \sim 30\text{ MPa}$; the nominal working pressure of the gas cylinder filled with oxygen is not more than 20 MPa ;
- c) The nominal water volume of a single gas cylinder is $1000\text{ L} \sim 4200\text{ L}$;
- d) The filling medium is natural gas, hydrogen, oxygen, air, nitrogen, argon, helium, neon, krypton and other compressed gases.

1.3 Compressed natural gas hydraulic tube trailers shall also comply with the provisions of Appendix A.

1.4 This standard does not apply to the following tube trailers:

- a) Filled with liquefied gas, dissolved gas, extremely toxic media;
- b) The gas cylinder is a filament-wound gas cylinder.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB 190 Packing symbol of dangerous goods

GB/T 567 (all parts) Rupture disc safety device

written form. The design conditions shall at least include the following contents:

- a) Working conditions, including ambient temperature, working temperature, working pressure, loading & unloading conditions and methods, loading & unloading pressure, filling frequency (times/year), possible additional loads, etc.;
- b) Filling medium, including the number of the medium (UN number or CAS number), name, category (item), components, physical and chemical properties, hazards, harmful impurity content, corresponding chemical safety data sheet (SDS) etc.;
- c) Nominal water volume and total water volume of a single cylinder;
- d) Expected service life;
- e) Finalized chassis or towing vehicle model and necessary technical parameters;
- f) Other necessary conditions required for design (such as gas cylinder surface treatment, moisture content and leakage rate detection requirements of the pressure-bearing system, etc.).

4.2.2 Design organization

4.2.2.1 The design organization shall be responsible for the design quality of the tube trailer.

4.2.2.2 The use management of special design seals shall meet the requirements of TSG R0005.

4.2.2.3 The design organization shall save all design documents, within the design service life of its product.

4.2.3 Manufacturer

4.2.3.1 The manufacturer shall be responsible for the manufacturing quality of tube trailers.

4.2.3.2 The gas cylinder manufacturer shall manufacture gas cylinders, in accordance with the design documents that have passed the gas cylinder design document appraisal and type test; it shall be responsible for its manufacturing quality.

4.2.3.3 The manufacturer shall manufacture according to the requirements of the design documents. When the original design documents need to be modified, written certification documents agreeing to the modification shall be obtained from the original design organization; meanwhile detailed records of the modified parts shall be made.

4.2.3.4 Before manufacturing tube trailers, the manufacturer shall formulate a quality plan, which includes at least pressure components such as gas cylinders and pipelines,

purchased or outsourced parts, manufacturing process control points, inspection tests, qualification requirements, etc.

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

4.2.3.6 After each tube trailer passes the inspection, the manufacturer shall issue a product certificate.

4.2.3.7 The manufacturer shall accept the supervision and inspection of the tube trailer manufacturing process by the special equipment inspection and testing authority; obtain its special equipment supervision and inspection certificate.

4.2.3.8 Tube trailers shall pass type tests and related tests by testing institutions confirmed or approved by the automotive industry authority of the State Council according to model type; obtain corresponding certification documents.

4.2.3.9 The manufacturer shall keep at least the following technical documents for reference, during the design service life of each tube trailer it manufactures:

- a) Manufacturing process drawing or manufacturing process card;
- b) Welding process documents;
- c) Records of inspection and test items specified in the standards;
- d) Check, inspection, test records during the manufacturing process and after completion;
- e) Exit-factory documents (in compliance with the provisions of Chapter 12);
- f) Original design documents.

5 Materials

5.1 General requirements

5.1.1 The selection of materials shall consider their mechanical properties, bending properties, physical properties, process properties. The materials in contact with the filling medium shall be compatible.

5.1.2 The performance, quality, specifications, markings of materials shall comply with the national standards or industry standards of the corresponding materials.

5.1.3 The materials to be welded shall have good welding performance.

5.2.1.6 Steel pipes shall be subjected to longitudinal and transverse ultrasonic testing one by one, in accordance with the provisions of NB/T 47013.3-2015. The qualified quality level shall not be lower than level I.

5.2.2 End plug

5.2.2.1 The end plug shall be forged. The forgings selected from 30CrMo and 35CrMo shall comply with the provisions of NB/T 47008-2017; their level shall not be lower than level III. The forgings selected from austenitic stainless steels such as S30403, S30408, S31603, S31608 shall comply with the provisions of NB/T 47010-2017; their level shall not be lower than level III.

5.2.2.2 The hardness of 230CrMo and 35CrMo forgings, after quenching and tempering heat treatment, shall be lower than the hardness of gas cylinders after heat treatment. The average impact energy absorption (KV_2) of its three standard impact specimens after -40 °C Charpy impact test shall not be less than 41J; the impact absorbed energy value of one specimen is allowed to be less than 41J but not less than 29J.

5.3 Pipeline

5.3.1 Loading & unloading pipelines

5.3.1.1 Pipes shall be made of austenitic stainless steel seamless steel pipes, such as S30403, S30408, S31603, S31608, etc. They shall comply with the provisions of GB/T 14976. The hydrogen filling medium shall use austenitic stainless steel seamless steel pipes, such as S31603 and S31608.

5.3.1.2 Pipe fittings shall be made of austenitic stainless steel forgings, such as S30403, S30408, S31603, S31608, etc. They shall comply with the provisions of NB/T 47010-2017. Their level shall not be lower than level III. The hydrogen filling medium shall use austenitic stainless steel forgings, such as S31603 and S31608.

5.3.2 Sewage pipe

Sewage pipes shall be made of austenitic stainless steel seamless steel pipes, such as S30403, S30408, S31603, S31608, etc. They shall comply with the provisions of GB/T 14976.

5.3.3 Drain pipe

The drain pipe shall be made of austenitic stainless steel pipes, such as S30403, S30408, S31603, S31608, etc. They shall comply with relevant standards, such as GB/T 14976 or GB/T 12771.

5.3.4 Pneumatic pipeline

Pneumatic pipelines shall be made of non-metallic materials, that meet the usage

requirements. Their nominal pressure shall not be less than 0.8 MPa and comply with the requirements of the corresponding standards. The selection of metal materials shall comply with the provisions of 5.3.3.

5.4 Frame

5.4.1 The materials used for main stress-bearing components, such as corner columns, end beams, side beams shall have good weldability, sufficient strength, toughness.

5.4.2 The materials used for the main stress-bearing components, such as corner columns, end beams, side beams shall pass the Charpy impact test at no higher than -20 °C, wherein the average impact absorbed energy (KV₂) of the three standard impact specimens shall be no less than 27J, the impact absorbed energy value of one specimen is allowed to be less than 27J but not less than 19J.

5.5 Support end plates and connectors

5.5.1 The materials used for supporting end plates and connectors shall have sufficient strength, stiffness, toughness.

5.5.2 The steel plate used to support the end plate shall comply with the provisions of the corresponding material standards. The steel plate shall pass a Charpy impact test at not higher than -20 °C, wherein the average impact absorbed energy (KV₂) of its three standard impact specimens shall not be less than 27J, the impact absorbed energy value of one specimen is allowed to be less than 27J but not less than 19J.

5.5.3 The material for the tie rod shall be 20 or 35 steel, which shall comply with the provisions of GB/T 699.

5.5.4 The flange used to fix the gas cylinder shall be made of forgings or steel plates. When selecting a steel plate, it shall be subject to a Charpy impact test at no higher than -20 °C. The average impact absorbed energy (KV₂) of its three standard impact specimens shall not be less than 27J. The impact absorbed energy value of one specimen is allowed to be less than 27J but not less than 19J. When selecting forging materials, it shall comply with the provisions of NB/T 47008; the forging level shall not be lower than level II, meanwhile it shall select the 16Mn and 35 steel.

5.5.5 The materials used for drawstrings, hoops, tie rods, etc. shall have good weldability, sufficient strength, toughness.

5.6 Sealing materials

5.6.1 The allowable operating temperature and sealing performance of the sealing material shall be able to meet the requirements for the use of tube trailers.

5.6.2 The service life of the sealing material shall meet the requirements of the regular inspection cycle of the tube trailer.

standards or industry standards; have quality certification documents or product certificates.

5.9.2 The type-finalized chassis shall be a type-finalized product, which is recognized by the automotive industry authority of the State Council. Meanwhile it shall have corresponding technical information and quality certification documents. When choosing an imported chassis, it shall comply with relevant national provisions and have corresponding technical information and quality certification documents.

5.9.3 The running mechanism of the semi-trailer shall comply with the provisions of GB/T 23336. It shall have corresponding technical documents and quality certification documents.

5.9.4 Corner fittings shall comply with the provisions of GB/T 1835. After -40 °C Charpy impact test, the average impact absorbed energy (KV_2) of the three impact specimens shall not be less than 21J; the impact energy absorbed of one of the test specimens is allowed to be less than 21J but not less than 15J.

5.9.5 Portable fire extinguishers shall comply with the provisions of GB 4351 (all parts); they shall be within the validity period.

5.9.6 The bolts and nuts, which are used to connect the supporting end plates and connecting flanges, shall be commercial level or special level fasteners. When commercial level carbon steel or low alloy steel is selected, the strength of the bolts shall not be lower than level 8.8; the strength of the nuts shall not be lower than level 8.

5.9.7 Valves and instruments shall comply with the requirements of corresponding standards.

6 Design

6.1 General requirements

6.1.1 In addition to complying with the requirements of this standard, the design of tube trailers shall also comply with relevant laws and regulations, safety technical specifications, national standards, industry standards.

6.1.2 The structural design of the tube trailer, the connection between the gas cylinder and the running mechanism or the type-finalized chassis, as well as the layout of pipelines, safety accessories, instruments, loading & unloading accessories shall be safe and reliable; meanwhile meet the usage requirements.

6.1.3 The same tube trailer shall use gas cylinders of the same material, nominal working pressure, nominal diameter, nominal water volume.

6.1.4 The outer dimensions, axle load, mass limits of tube trailers shall comply with the provisions of GB 1589. The axle load distribution shall be reasonable; the axle load and total mass shall not be greater than the allowable limits of the type-finalized chassis or semi-trailer.

6.1.5 When the tube trailer is fully loaded and in a static state, the maximum roll stability angle when tilting to the left and right sides shall comply with the provisions of GB 7258.

6.1.6 The braking device and braking performance of tube trailers shall comply with the provisions of GB 7258, GB 12676, GB/T 23336. The semi-trailer shall adopt a dual-pipe braking system.

6.1.7 The rear suspension of tube trailers shall comply with the provisions of GB 1589.

6.1.8 The side protection devices and rear lower protection devices, which are installed on tube trailers, shall comply with the provisions of GB 11567. The rear lower protective device shall have sufficient strength and rigidity, to protect the safety of gas cylinders, pipelines, safety accessories, instruments, loading & unloading accessories in the event of an accidental collision. The distance -- BETWEEN the inner side AND the vertical projection of the rearmost end of the pressure-bearing component in the length direction -- shall be not less than 150 mm.

6.1.9 The operating compartment of the tube trailer shall have sufficient operating space and shall be firmly connected. Its setting shall meet the vehicle usage requirements.

6.1.10 The number, location, light color of external lighting and signaling devices on tube trailers shall comply with the provisions of GB 4785.

6.1.11 Each side of the tube trailer shall be equipped with at least one portable fire extinguisher of no less than 4 kg, which shall be firmly installed and easy to pick up and place.

6.1.12 Type-finalized chassis and semi-trailer towing vehicles shall be equipped with speed limiting devices, satellite positioning devices with driving recording functions, retarder or other auxiliary braking systems.

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

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

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

6.1.16 The axles and suspension devices of semi-trailers shall comply with the

unloading accessories;

- h) Instructions for the selection of type-finalized chassis or semi-trailer running mechanism, corner fittings, etc.

6.2.4 The design calculation document shall at least include the following contents:

- a) Calculation of cylinder strength;
- b) Calculation of gas cylinder volume;
- c) Calculation of maximum filling capacity;
- d) Verification and calculation of bending stress of gas cylinders;
- e) Verification and calculation of bending stress of gas cylinders under dynamic load;
- f) Calculation of cylinder deflection under dynamic load;
- g) Verification and calculation of end plug thread strength;
- h) Calculation of the safety relief capacity of gas cylinders and the relief area of overpressure relief devices;
- i) Strength calculation of loading & unloading pipelines;
- j) Calculation of pipeline safety valve discharge (when necessary);
- k) Calculation of the structural strength of tie rods, support end plates, connecting flange bolts and frames under inertial force loads;
- l) Calculation of vehicle axle load distribution and roll stability.

6.2.5 Design drawings, including at least general design drawings, gas cylinder drawings, piping system drawings, necessary parts drawings, etc.

6.2.5.1 At least the following content shall be indicated on the general design drawing:

- a) Product name and model;
- b) Safety technical specifications and product standards that shall be followed in design and manufacturing
- c) Main working conditions, including working environment temperature, etc.;
- d) Main design parameters, including the nominal working pressure of the gas cylinder, operating ambient temperature, design temperature, design pressure, minimum design metal temperature of the loading & unloading pipeline, etc.;

- e) Filling medium, including the number (UN number or CAS number), name, category (item), hazards of medium, medium standard. If necessary, it shall also indicate the quality level or quality index, components, hazardous impurity content, etc.;
- f) Main characteristic parameters, including the total mass of the tube trailer, the curb mass, the nominal water volume of a single cylinder of the gas cylinder, the total water volume, etc.;
- g) The design service life of the gas cylinder (indicate the number of fatigue cycles of the gas cylinder if necessary);
- h) Chassis model or semi-trailer model, front/rear suspension, approach angle/departure angle, design speed limit, overall dimensions, wheelbase, full load axle load distribution, maximum lateral stability angle, etc.;
- i) Non-destructive testing requirements for loading & unloading pipelines;
- j) Gas cylinder's water pressure test requirements, pipeline pressure test requirements, overall leakage test requirements;
- k) Internal and external surface treatment and coating requirements of gas cylinders;
- l) Special manufacturing requirements, such as nitrogen or inert gas replacement, etc.;
- m) Models, specifications, performance parameters, connection methods of safety accessories, instruments, loading & unloading accessories, etc.;
- n) The location of product nameplates and electronic nameplates;
- o) The orientation, specifications, connection methods of the loading & unloading nozzles;
- p) Painting, marking and labeling requirements;
- q) Other requirements stipulated in the regulations or normative documents of the relevant industry authorities of the State Council.

6.2.5.2 The gas cylinder drawing shall at least include the following contents:

- a) Identification number of gas cylinder design document;
- b) Main safety technical specifications and standards;
- c) Gas cylinder body material, cylinder design wall thickness, cylinder body size, cylinder mouth thread specifications and dimensions, etc.;

- g) Operation instructions and precautions;
- h) Necessary warning statements;
- i) Maintenance requirements and emergency measures;
- j) Spare components and parts.

6.3 Medium

6.3.1 The classification, product name and number of the medium shall comply with the provisions of GB 6944 and GB 12268. The medium shall also comply with the provisions of the corresponding standards.

6.3.2 Natural gas shall comply with the following requirements:

- a) Compressed natural gas for vehicles shall comply with the provisions of GB 18047;
- b) Natural gas shall comply with the provisions of category I and category II natural gas in GB 17820-2012.

6.3.3 Hydrogen shall comply with the provisions of GB/T 3634 (all parts). Hydrogen used in fuel cell vehicles shall comply with the provisions of the corresponding standards.

6.4 Connection of gas cylinder and type-finalized chassis

6.4.1 When designing a tube truck, the layout of the upper part shall be avoided from causing concentrated loads on the type-finalized chassis frame.

6.4.2 When the type-finalized chassis frame needs to be lengthened, the weldability of the material used for the extended part shall be considered.

6.4.3 Drilling or welding in the stress concentration area of the frame shall be avoided. When drilling holes on the side planes of the frame, the edge of the hole shall be at least 25 mm away from the upper and lower planes.

6.4.4 The longitudinal center vertical plane of the bodywork part and the longitudinal center vertical plane of the type-finalized chassis shall overlap as much as possible; the allowable deviation shall not be greater than 6 mm.

6.5 Connection between gas cylinder and semi-trailer running mechanism

6.5.1 The semi-trailer frame shall be strength checked.

6.5.2 The design of tube trailers shall meet the requirements of GB/T 23336. The gas cylinders shall be checked for bending stress under additional loads.

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