TSG

TECHNICAL SPECIFICATION FOR

SAFETY OF SPECIAL EQUIPMENT

TSG R0006-2014

Supervision regulation on

safety technology for gas cylinder

气瓶安全技术监察规程

Issued on: September 05, 2014 **Implemented on: January 01, 2015**

Issued by: General Administration of Quality Supervision, Inspection and Quarantine of PRC

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1 General

1.1 Purpose

In order to ensure the safety of gas cylinders, protect the safety of people and property, promote the development of the national economy, this Regulation is hereby formulated in accordance with the “Law on Safety of Special Equipment” and “Provisions on Safety Supervision of Special Equipment”.

1.2 Scope of application

This procedure is applicable to the seamless gas cylinders, welded gas cylinders, welded insulated gas cylinders, wound gas cylinders, gas cylinders filled with fillers, gas cylinder accessories which is used at a normal ambient temperature of (-40°C ~ 60°C, note 1-1), nominal volume of 0.4 L ~ 3000 L, nominal working pressure of 0.2 MPa ~ 35 MPa (gauge pressure, the same below), has a product of pressure multiplied by volume of more than or equal to 1.0 MPa • L, contains compressed gas, high (low) pressure liquefied gas, low-temperature liquefied gas, dissolved gas, adsorbed gas, liquid with a normal boiling point of equal to or less than 60°C, mixed gas (two or more than two kinds of gases).

The materials, design, manufacture of gas cylinders for fire extinguishers, large-volume gas cylinders used for long tube trailers and tube bundle containers, or large-volume gas cylinders for electronic gas are in accordance with this Regulation.

The main gas cylinder varieties, variety codes, corresponding product standards as covered by this Regulation are as shown in Appendix A.

Note 1-1: The ambient temperature range of gas cylinders for vehicles and fire extinguishers shall be in accordance with the relevant standards.

1.3 Special provisions on the scope of application

The cylinder accessories in the scope of application in clause 1.2 of this Regulation shall, in addition to complying with this Regulation, also comply with the provisions of the “Gas cylinder appurtenances safety and technical supervision regulation” (TSG RF001). The gas cylinders for vehicles (Note 1-2)

review are approved by the AQSIQ, it allows to formally put into production and use. The product standards on which the product is manufactured and type tested shall comply with the provisions of 1.5 of this Regulation.

1.7 Identification of design document and type test

Cylinder products shall, according to the requirements of “Gas Cylinder Design Documents Appraisal Regulation” (TSG R1003) and “Regulation for Type Test of Gas Cylinders” (TSG R7002), be subjected to identification of design documents of gas cylinder products and type test. After being qualified, the design documents can be used for manufacturing. For the gas cylinder’s accessories as configured for the gas cylinder, if there is requirements in the safety technical specifications and the corresponding standards, it shall first be subjected to the type test of the accessories, then the gas cylinder.

1.8 Imported gas cylinder

The imported gas cylinders shall, in addition to complying with the relevant provisions on the inspection of import and export commodities, also meet the requirements of this clause.

1.8.1 Manufacturing license

The overseas manufacturing organization of the imported gas cylinder shall meet the requirements of 1.7 of this Regulation and obtain the corresponding manufacturing license for special equipment in China.

1.8.2 Specifications and corresponding standards for design and manufacture

All types of imported gas cylinders used in China shall meet the following requirements:

(1) Design and manufacture comply with China's safety technical specifications;

(2) For gas cylinder products without Chinese national standards, or otherwise the scope of application and technical requirements of the standards used differ from the Chinese national standards, the gas cylinder product’s standards shall be evaluated by the relevant professional technical institutions as commissioned by the AQSIQ.

1.8.3 Supervisory inspection of safety performance of imported gas cylinders

The imported gas cylinders shall be subject to the supervisory inspection of safety performance by the special equipment inspection agency (hereinafter referred to as the supervisory inspection agency) with the supervisory

(5) Organizations involved in the temporary import of gas cylinders shall establish temporary archives of imported gas cylinders.

1.9 Exported back gas cylinder

Where the exported cylinder is returned back to China for use, its manufacturing organization shall obtain the corresponding special equipment manufacturing permit in China, meanwhile meet the requirements of the standard review, identification of design documents of gas cylinder, type test of the imported gas cylinders in clause 1.5 and 1.8 of this Regulation.

1.10 Cylindered gas medium

Cylindered gas medium is divided into the following types:

(1) Compressed gas: It refers to a gas that is completely gaseous after being pressurized at -50°C, including a gas which has a critical temperature (Tc) lower than or equal to -50°C, which is also called a permanent gas;

(2) High (low) pressure liquefied gas: It refers to a gas that is partially liquid after pressurization at a temperature higher than -50°C, including high-pressure liquefied gas which has a critical temperature (Tc) of -50°C ~ 65°C, as well as low-pressure liquefied gas which has a critical temperature (Tc) of above 65°C;

(3) Low-temperature liquefied gas: It refers to a gas that is partially liquid due to cryogenic low-temperature during transportation. Those which has a critical temperature (Tc) of generally lower than or equal to -50°C are also known as cryogenic liquefied gas or refrigerated liquefied gas;

(4) Dissolved gas: It refers to the gas that dissolves in a solvent under pressure;

(5) Adsorbed gas: It refers to the gas that is adsorbed to the adsorbent under pressure.

1.11 Nominal working pressure of gas cylinder

(1) The nominal working pressure of a gas cylinder which contains compressed gas refers to the defined (charging) pressure when the gas in the cylinder reaches a completely uniform state at the reference temperature (20°C);

(2) The nominal working pressure of a gas cylinder which contains liquefied gas refers to the upper limit of the gas pressure in the cylinder at a temperature of 60°C;

(3) The nominal working pressure of a gas cylinder which contains dissolved

gas of the same characteristics (Note 1-3), according to the gas characteristics as determined based on the gas cylinder's mark. It is not allowed to modify a single gas or a mixed gas of different characteristics.

Note 1-3: Gas characteristics refer to toxic (T), oxidized (O), flammable (F), corrosive (C).

1.14 Gas cylinder's mark

The gas cylinder's mark includes a manufacturing mark and a periodic inspection mark. Manufacturing marks usually have a manufacturing stencils mark (including the mark on the nameplate), a label mark (applied on the cylinder or under a transparent protective layer), a printed mark (printed on the cylinder), a gas cylinder's color mark; etc. The periodic inspection marks generally include inspection stencils marks, label marks, inspection mark rings, inspection color codes. On the gas cylinder which is used to supply fuel to taxi, it shall have a permanent taxi identification mark (Note 1-4).

Note 1-4: For cylinders used for supplying fuel to taxi, the cylinder's manufacturing organization, installation organization or periodic inspection agency shall, after confirming the purpose of gas cylinder, make a permanent mark of "TAXI" which is representative of Taxi at the prominent position of the gas cylinder's mark (steel gas cylinders use stencils; wrapped gas cylinders use resin-covered labels).

1.14.1 Gas cylinder's manufacturing mark

1.14.1.1 Stencils marks, label marks or printed marks of gas cylinders

The manufacturing mark of the gas cylinder is the basis for identifying the gas cylinder. The arrangement and content of the marking shall comply with the provisions of Appendix B of this Regulation and corresponding standards. Among them, the manufacturing organization's code (such as letters, patterns, etc.) shall be reported to the China Gas Cylinder Standardization Organization for future reference.

The manufacturing organization shall, in accordance with the provisions of the corresponding standards, make a permanent manufacturing mark on each gas cylinder. Steel gas cylinders or aluminum alloy gas cylinders use stencils. Wrapped gas cylinders use plastic-sealed gas cylinders. Non-refillable gas cylinders are printed on cylinders. Welded insulated gas cylinders (including automotive welded insulated cylinders) and liquefied petroleum gas cylinders are identified by the embossed letter or welding-sealed nameplate.

Other products that cannot be marked by the previous method shall use the marking method which complies with the corresponding standards for gas cylinder products. The manufacturing organization shall consider the placement requirements of the information label (bar code, QR code, RF label, etc.) of gas

inspection color code of the gas cylinder shall comply with the provisions of Appendix B of this Regulation. The gas cylinder's periodic inspection agency shall stamp the inspection qualification stencils on the qualified gas cylinder or make a permanent inspection qualification mark on the gas cylinder one by one.

1.15 Supervisory management

(1) The General Administration of Quality Supervision, Inspection and Quarantine and the quality supervision departments at all levels are responsible for the safety supervision of gas cylinders and supervise the implementation of this Regulation;

(2) The design, manufacture, filling, inspection, use, etc. of gas cylinders (including gas cylinder's accessories) shall strictly implement the provisions of this Regulation;

(3) The manufacturing, filling, inspection agencies of gas cylinders shall, in accordance with the safety technical specifications and corresponding standards, promptly input relevant data on manufacturing, use registration, filling, inspection into the relevant special equipment information management system.

2 Materials

2.1 Basic requirements

(1) The selection of gas cylinder's materials shall consider the mechanical properties, chemical properties, process properties, compatibility with the medium;

(2) The selection of gas cylinder's materials shall meet the restrictive requirements of the corresponding gas cylinder product standards for materials. The gas cylinder's materials shall also meet the requirements of the corresponding material standards (Note 2-1);

(3) When selecting the metal materials which are not listed in the national standard to manufacture the main part of the gas cylinder, it shall be subject to technical review in accordance with the provisions of 1.6 of this Regulation. The review shall focus on the relevant testing of materials, the test data, the technical documents on trial production of materials (including the technical conditions on product supply), etc.;

(4) The material's manufacturing organization shall make a clear and firm stencil mark on the obvious part of the material or use other methods of marking;

(5) For the materials of overseas designations that have mature experience of use, if they are widely used domestically, they can be directly included in the corresponding standards on gas cylinder product.

2.3 Use of material and transplantation of mark

2.3.1 Basic requirements

(1) The gas cylinder's manufacturing organization shall review the material quality certificate and material mark of the incoming materials; verify and analyze the chemical composition of the metal materials which are used to make the gas cylinders according to the furnace number; carry out verification and inspection of the mechanical properties according to the batch number (except for the mechanical properties of steel pipes, steel billets, etc., which are determined by heat treatment); carry out non-destructive testing according to the relevant standards (except for seamless steel pipes which has been subjected to 100% ultrasonic non-destructive testing by steel mills) and verification inspection of low-fold organization;

(2) All inspections and tests may be used after being confirmed of complying with the provisions of this Regulation and its corresponding material standards;

(3) The materials used to manufacture the pressure components of the gas cylinders shall be subjected to mark transplantation according to relevant regulations.

2.3.2 Performance requirements

2.3.2.1 General requirements

(1) The chemical composition and mechanical properties of the cylinder material shall meet the requirements of the corresponding standards on gas cylinder products;

(2) The materials for the steel gas cylinders and steel liners shall be elemental age-resisting killed steels as smelted in electric furnaces or oxygen converters;

(3) The materials for the aluminum alloy gas cylinders and aluminum alloy liners shall have good resistance to intergranular corrosion and comply with the relevant standards;

(4) High-quality carbon steel, alloy steel or aluminum alloy billets for seamless gas cylinders shall be suitable for pressure processing;

(5) The cylinder material used for welded gas cylinders shall have good

2.3.2.3 Long tube trailer, bundle container

2.3.2.3.1 Materials for large-volume steel seamless gas cylinder

(1) In the case of brittle-inducing and stress corrosion-prone gases such as hydrogen, natural gas or methane, the actual tensile strength of the material after heat treatment shall not exceed 880 MPa, the yield ratio shall not exceed 0.86, the elongation at break (A_{50mm}) shall not be less than 20%;

(2) In case of containing other gases than those as listed in item (1) of this clause, the actual tensile strength of the material after heat treatment shall be not more than 1060 MPa, the yield ratio shall not be more than 0.90, the elongation at break (A_{50mm}) shall not be less than 16%.

2.3.2.3.2 Materials for the liner of wrapped gas cylinder

The mechanical properties after heat treatment shall comply with the requirements of relevant standards.

2.3.3 Requirements for material compatibility

(1) All metal or non-metallic materials of gas cylinder in contact with the contained gas shall be compatible with the gas they are filled with;

(2) Aluminum alloy gas cylinders shall not be used for the filling of chlorine, hydrogen bromide, carbonyl dichloride, hydrogen fluoride, methyl chloride or methyl bromide;

(3) For gas cylinders which contain carbon monoxide, it is preferably to use aluminum alloy gas cylinders or stainless-steel gas cylinders. If using the carbon steel gas cylinders, the filling organization must have measures to ensure control of the moisture and carbon dioxide content of the filled medium and ensure that the limited filling pressure at 20°C is not more than 50% of its nominal working pressure;

(4) Gas cylinders which contain fluorine or difluorinated oxygen shall be of steel seamless gas cylinders;

(5) For gas cylinders which contain medical oxygen, it is preferably to use aluminum alloy gas cylinders or stainless-steel gas cylinders.

3 Design

3.1 Thickness of cylinders

The design method used to determine the wall thickness of the gas cylinder

pressure shall generally refer to LC_{50} in Appendix C, making appropriate improvement based on the saturated vapor pressure at 60°C;

(2) The saturated vapor pressure value of the low-pressure liquefied gas at 60°C may be provided in accordance with Appendix C or the corresponding gas standard. Where it is not specified in Appendix C or the corresponding gas standard, it may use the relevant data as provided by gas manufacturing organization and officially confirmed;

(3) For gas cylinders which contain low-temperature liquefied gas, the nominal working pressure shall be determined according to the process requirements, but shall be more than or equal to 0.2 MPa and less than or equal to 3.5 MPa;

(4) For the mixed gas of low-pressure liquefied gas, it shall follow the corresponding gas standards to determine the saturated vapor pressure of the mixed gas at 60°C. For the mixed gas as composed of the compressed gas and low-pressure liquefied gas for the fire extinguishing system, the nominal working pressure shall be not less than the maximum working pressure of the fire extinguishing system at the corresponding temperature as specified in the corresponding standard;

(5) For gas cylinders which contain fluorine and difluorinated oxygen, the nominal working pressure shall be not less than 15 MPa.

3.7 Wrapped cylinder liner and wrapping material

(1) The inner liner of the high-pressure wrapped gas cylinder which contains flammable gas shall be made of metal materials such as steel or aluminum alloy; the wrapping material shall be glass fiber, aramid fiber or carbon fiber;

(2) The carrier layer of the wrapped gas cylinder shall be hoop-wrapped or fully wrapped by a single fiber. It shall not be wrapped by mixing more than two (inclusive) types of fibers.

3.8 Design service life

The manufacturing organization shall specify the design service life of the gas cylinder and indicate it on the design file of the gas cylinder and the gas cylinder's mark. The design service life of the gas cylinder shall not be less than that specified in Table 3-5. If the manufacturing organization determines the design service life beyond the provisions of Table 3-5, it shall be verified by the corresponding type test, corrosion test, or otherwise increase the design corrosion margin and verify it.

smoothly transitioned, the thickness of which shall be not less than the design thickness of the cylinder body;

(2) There is a transition between the ring shell of the concave bottom and the cylinder body. The connection between the transition section and the cylinder body is smoothly transitioned.

3.9.3 Body structure of welded gas cylinder

Steel welded gas cylinders have not more than one longitudinal weld and not more than two circumferential welds. The form of welded joint of the cylinder weld (including longitudinal and circumferential welds) shall comply with the requirements of relevant standards.

3.9.4 High-pressure gas cylinders for filling low-pressure liquefied gases

Gas cylinder's design requirements and gas cylinder's mark shall comply with the relevant standards for high-pressure gas cylinders.

3.9.5 Large-volume gas cylinders for long-tube trailers and tube-bundle containers

It shall meet the following requirements:

(1) The connection between the gas cylinder and the running gear or the container's frame shall not adopt the welded structure. It must take reliable measures to prevent the circumferential rotation and axial movement of the cylinder during use;

(2) The support and fixing device between the gas cylinders have sufficient rigidity, whilst avoiding the thermal expansion and contraction, which adversely affects the stress of the cylinder.

3.9.6 Liquefied natural gas welded insulated gas cylinders for vehicles

It shall use the large-volume cylinders as specified in clause 1.12.2 of this Regulation.

4 Manufacture

4.1 Manufacturing conditions

The gas cylinder's manufacturing organization shall obtain the corresponding special equipment manufacturing license. The manufacturing organization of medium and small-volume gas cylinders shall have a gas cylinder production line. The manufacturing organization of large-volume gas cylinders shall have independent gas cylinder's manufacturing sites and facilities.

Steel seamless gas cylinders made by tube through bottom-closing shall be subjected to process evaluation. In the bottom-closing forming process, it shall not add metals. For the tube-made gas cylinder that may be exempted of overall airtightness test of gas cylinder according to the corresponding standards, it shall, before mouth-closing, take reliable measures to carry out the bottom airtightness test.

4.4 Welding

(1) The pressure-bearing welds for the longitudinal and circumferential welds of the welded cylinder body as well as the valve seat and the cylinder body shall be automatically welded;

(2) The welding work of the gas cylinder shall be carried out in a room where the relative humidity is not more than 90% and the temperature is not lower than 0°C;

(3) The manufacturing organization shall carry out the welding procedure evaluation, formulate the welding procedure specification and the weld rework process requirements, which shall comply with the provisions of the corresponding standards;

(4) Welders engaged in gas cylinder's welding work shall pass the examination of the "Examination rules for welding operators of special equipment" (TSG Z6002) and obtain the welding qualification of the corresponding project.

4.5 Heat treatment

(1) The heat treatment of the gas cylinder shall be carried out by integral heat treatment. The heat treatment device shall ensure the uniformity of the temperature distribution in the effective heating zone;

(2) The manufacturing organization shall carry out the heat treatment process evaluation, formulate the heat treatment process specification and the repeated heat treatment process requirements, which shall comply with the provisions of the corresponding standards;

(3) For gas cylinders that require heat treatment to ensure the mechanical properties of the cylinder material, the heat treatment process shall ensure the consistency of performance of different parts of the same product;

(4) For the welded gas cylinders subject to stress-relieving heat treatment, if re-welded, it shall carry out heat treatment again.

4.6 Wrapped gas cylinder

4.6.1 Curing of fiber-wrapped gas cylinders

manufacturing organization shall also be responsible for the quality of the non-tested part;

(2) Non-destructive testing of steel seamless gas cylinders shall be subjected to the on-line ultrasonic automatic testing (except as otherwise specified in the corresponding standards). The requirements of methods and testing sensitivity shall comply with the requirements of the corresponding standards. The scope of testing shall cover all testable parts. The parts that cannot be covered shall use magnetic powder testing;

(3) Personnel engaged in non-destructive testing of gas cylinders shall be subjected to evaluation according to the requirements of relevant safety technical specifications, meanwhile obtain the corresponding qualification certificates before they can undertake non-destructive testing work corresponding to the types and grades of qualification certificates.

4.9 Inspection and testing of manufacturing quality

The inspection and testing items and requirements for the manufacture quality of gas cylinders shall comply with the requirements of the corresponding standards and meet the following requirements:

(1) Various test devices (such as X-ray digital imaging testing, hydraulic test equipment for external test method, etc.) shall meet the requirements of the corresponding standards;

(2) The hydraulic burst test shall use a test device capable of automatically collecting and recording data of the pressure-influent curve;

(3) The seamless gas cylinder (except for small-volume gas cylinders) and the metal inner liner wrapped gas cylinder shall use the external test method (also known as water jacket method) for hydraulic test. Before the test, it shall follow the requirements of relevant standards to calibrate the test system. The standard cylinder used for calibration shall be used after being calibrated. Other gas cylinders may use the internal test method to carry out hydraulic test. The hydraulic test device shall be able to automatically record cylinder number, time and test results in real time.

4.10 Exit-factory data

When the gas cylinder is exit-factory, the manufacturing organization shall issue a product certificate one by one and a batch inspection quality certificate according to the batch. The product certificate shall indicate the manufacturer's name and manufacturing license number of the cylinder and the installed cylinder valve. The content of the product certificate and the batch inspection product quality certificate shall comply with the provisions of the corresponding product standard, meanwhile it shall be signed or stamped by the

(4) The industrial non-refillable welded gas cylinder's valve is designed as a non-refillable structure. The connection between the cylinder's valve and the cylinder body is welded;

(5) The gas phase cylinder's valve as used in the liquefied petroleum gas cylinder which has a nominal volume more than 100 L should be designed as a straight valve or an angle valve with a liquid level limiting function or with an electronic anti-counterfeiting identification function. The liquid phase cylinder's valve shall be designed into a check valve.

5.2.1.2 Material of cylinder's valve

The material selection of cylinder's valve material shall consider the following factors:

(1) Under the specified operating conditions, any metallic or non-metallic valve material in contact with the gas is compatible with the gas as contained in the gas cylinder;

(2) The materials of cylinder's valve in contact with acetylene shall be copper alloy which has a copper content of less than 70% (mass ratio);

(3) The hand wheel of the valve of gas cylinder which contains flammable gas is made of flame-retardant material;

(4) Non-metallic sealing materials for the valve of gas cylinder which contains oxygen or other strong oxidizing gases are flame-retardant and aging-resistant.

5.2.2 Safe-pressure relief device

Special safe-pressure relief devices for gas cylinders include fusible alloy plug devices, rupture disc devices (or rupture discs), safety valves, rupture disc - fusible alloy plug composite devices, rupture disc - safety valve composite devices.

5.2.2.1 Principles for setting safe-pressure relief device

(1) Vehicle gas cylinders or other combustible gas cylinders, gas cylinders for respirators, gas cylinders for fire extinguishers, dissolved acetylene cylinders, welded insulated gas cylinders which contain low-temperature liquefied gases, cluster device of gas cylinder which contains liquefied gases, large-volume gas cylinders for long-tube trailers and tube-bundle containers shall be equipped with safe-pressure relief devices;

(2) For gas cylinders which contain highly toxic gases, it is forbidden to install safe-pressure relief devices;

location of safe-pressure relief devices

5.2.2.3.1 Design

(1) The design and calculation of the discharge volume and discharge area of the gas cylinder's safe-pressure relief device shall comply with the provisions of the corresponding standards. The rated discharge volume and actual discharge volume shall not be less than the safety discharge volume of the gas cylinder;

(2) The nominal burst pressure of the rupture disc device (or rupture disc) is the hydraulic test pressure of the gas cylinder;

(3) The opening pressure of the safety valve shall not be less than 75% of the gas cylinder's hydraulic test pressure or the requirements of the corresponding standard, nor shall it be more than the gas cylinder's hydraulic test pressure. The rated discharge pressure of the safety valve shall not exceed the hydraulic test pressure of the gas cylinder. The seat-return pressure of the gas cylinder is not less than the temperature-rising pressure of the gas cylinder at the maximum service temperature; meanwhile it shall meet the requirements of the corresponding standard;

(4) The operating temperature of the fusible alloy plug shall comply with the provisions of GB 8337 "Fusible plug device for gas cylinders" and relevant standards;

(5) The structure of the device shall be compatible with the use environment and conditions of use. Under normal conditions of use, it shall have good sealing performance;

(6) When the safety pressure relief device is opened, the reaction force as generated shall not adversely affect the gas cylinder;

(7) For gas cylinders which contain flammable gas, the structure and installation of the safe-pressure relief device shall be such that the discharged gas is directly discharged into the atmosphere, without being blocked or impacting on other equipment.

5.2.2.3.2 Selection of materials

(1) The material for manufacturing a safe-pressure relief device shall have uniform chemical composition and physical properties;

(2) Under the specified operating conditions, the material of any safe-pressure relief device in contact with the filled gas shall be compatible with the gas as filled in the gas cylinder;

(3) The rupture discs shall be made of pure metal sheets (such as nickel or

5.2.5 Base

Gas cylinders that cannot stand upright from the bottom of the cylinder shall be equipped with a base (except for gas cylinders with fixed brackets or assembly frames).

5.3 Requirements for manufacture and installation of cylinder's valve

5.3.1 Manufacturing license and service life of cylinder's valve

The manufacturing organization of cylinder's valve shall obtain the corresponding special equipment manufacturing license. The manufacturing organization of cylinder's valve shall ensure that its cylinder's valve product is used for at least one inspection cycle of gas cylinder. Other persons than the manufacturing organization of cylinder's valve shall neither repair nor replace the pressure parts.

5.3.2 Installation of cylinder's valve

It shall use appropriate method to install the cylinder's valve. It shall prevent any foreign objects from falling into the gas cylinder. In the course of installation, it shall use appropriate installation tools to fix the cylinder's valve onto the gas cylinder. When using a torque wrench, the torque shall meet the requirements of the corresponding standard.

5.4 Installation and maintenance of safe-pressure relief device

The installation and maintenance of the gas cylinder's safe-pressure relief device shall comply with the requirements of relevant standards. Meanwhile it shall meet the following requirements:

(1) Between the gas cylinder's safe-pressure relief device and the gas cylinder, as well as the outlet side of the safe-pressure relief device, it shall neither install the shut-off valve, nor install other parts that impede the normal operation of the device;

(2) Before the gas cylinder is filled, it shall carefully check whether the safe-pressure relief device has corrosion, damage or other external defects; whether the passage is blocked by sand, paint or dirt; whether the fusible plug is loose or coming off. When there is a problem that may cause the device to malfunction, the gas cylinder shall not be filled;

(3) It shall periodically clean, check, verify the safety valve on the gas cylinder;

(4) The rupture disc device (or rupture disc) shall be replaced periodically (except for welded insulated gas cylinders and non-refillable gas cylinders). The complete set of rupture disc devices shall be replaced in sets. The service life of the rupture disc shall comply with the relevant

station's mark on the self-owned or managed gas cylinder's body, is responsible for the daily maintenance of the gas cylinder, applying the color of the gas cylinder according to the original mark as well as the color ring mark.

6.4.2 Filling safety and management system

The gas cylinder's filling organization is responsible for the filling safety of the gas cylinder. As the organization of use of gas cylinders, the gas cylinder's filling organization shall promptly declare the periodic inspection of its own or managed cylinders; and shall be responsible for the safety publicity, education and guidance of the cylinder gas's distribution organization or gas consumers. It may use such methods as signing agreement to carry out safety management of the gas cylinder.

The gas cylinder's filling organization shall formulate corresponding safety management system and safety technical operation procedures, fill the gas cylinders in strict accordance with the corresponding standards.

The gas cylinder's filling organization shall formulate emergency plans and rescue measures for special equipment accidents (especially leakage accidents) and conduct periodic drills.

6.4.3 Files of gas cylinder

The gas cylinder's filling organization shall establish an information management database and a gas cylinder file for gas cylinder. The gas cylinder's file shall include the exit-factory data such as the product certificate and the batch inspection product quality certificate, the supervisory inspection certificate for the manufacturing of gas cylinder product, the data of registration for use of gas cylinder, the periodic inspection report of gas cylinder, etc. The gas cylinder's file shall be kept until the gas cylinder is discarded.

6.4.4 Warning label

The gas cylinder's filling organization shall paste the gas cylinder's warning label on the self-owned or managed gas cylinder. The style, production method, application of the warning label shall comply with the provisions of GB 16804 "Precautionary labels for gas cylinders".

6.4.5 Inspection and recording before and after filling

The gas cylinder's filling organization shall, in accordance with the provisions of the corresponding standards, before and after filling of the gas cylinders, arrange the person who had obtained the gas cylinder's filling operation certificate to check the gas cylinders one by one, meanwhile take the inspection records and filling records. The inspection record and filling record shall be kept for not less than 12 months. After an accident occurs in the gas cylinder, the

(1) Filling shall be carried out by means of cylinder-by-cylinder weighing. It shall prohibit the direct filling without weighing (except for gas cylinders for vehicles);

(2) It shall be equipped with a weighing instrument adapted to the number of filling fittings;

(3) The selection, specifications, verification of the weighing instrument shall comply with the relevant safety technical specifications and corresponding standards. Meanwhile the weighing instrument must be equipped with an over-installation alarm or a device that automatically cuts off the air source;

(4) The filling amount shall be re-inspected cylinder by cylinder (set the weighing instrument for re-inspection). It is strictly prohibited for excessive filling. Overfilled gas cylinders are not allowed to leave from the station and shall be disposed of in time.

6.5.4 Filling of low-temperature liquefied gas and low-temperature liquid

The filling amount shall be re-inspected cylinder by cylinder (except for welded insulated glass cylinders for vehicles). It is strictly prohibited for excessive filling. Overfilled gas cylinders are not allowed to leave from the station and shall be disposed of in time.

6.5.5 Filling of dissolved acetylene

(1) Before filling, follow the requirements of relevant standards to determine the amount of solvent added and add solvent;

(2) The filling amount of acetylene in the acetylene cylinder as well as the mass ratio of acetylene to solvent (acetylene to ketone ratio) shall comply with the requirements of relevant standards;

(3) During the filling process, the wall temperature of the gas cylinder shall not exceed 40°C. The volumetric flow rate of filling is less than 0.015 m^3/h • L;

(4) Generally, it is filled twice. The interval between the two fillings is not less than 8 h. The pressure inside the gas cylinder after standing for 8 h shall meet the requirements of relevant standards.

6.5.6 Filling of mixed gas

(1) The gas cylinder which is filled with mixed gas shall be pretreated by appropriate means such as heating and vacuuming;

(2) Before filling the gas, it shall, based on the nature of each gas component of the mixed gas, determine the filling sequence of each gas component;

Where:

F_r - Filling factor of low-pressure liquefied gas, kg/L;

ρ - The liquid's density of the low-pressure liquefied gas at the highest liquidus temperature, kg/L;

C - The maximum negative deviation of the liquid's density, which generally takes 0 ~ 3.

For a gas consisting of a mixture of two or more liquefied gases, it shall use test to determine the liquid's density at the maximum temperature of use; use the formula (6-1) to determine the maximum limit value of the filling factor.

6.6.1.2 High-pressure liquefied gas

The filling factor of the commonly used high-pressure liquefied gas shall be in accordance with the provisions of Appendix C. The maximum limit value of the filling factor of other high-pressure liquefied gases may be determined according to formula (6-2).

$$F_r = \frac{PM}{ZRT} \qquad (6\text{-}2)$$

Where:

F_r - The filling factor of high-pressure liquefied gas, kg/L;

T - The maximum temperature of use of gas cylinder, K;

M - The molecular weight of gas;

R - The gas constant, R = 8.314 × 10^{-3} MPa • m^3 / (kmol • K);

Z - The compression factor of the gas at a pressure of P and a temperature of T;

P - Allowable pressure (absolute) of the gas cylinder, which takes the nominal working pressure of the gas cylinder according to the requirements of relevant standards, MPa.

6.7 Safety requirements for the use of gas cylinders and gas

6.7.1 Basic requirements

The gas cylinder's filling organization shall provide the cylinder gas's distribution organization and the consumer with the gas cylinders which meet the requirements of the safety technical specifications and corresponding standards. It shall be responsible for publicizing and training the knowledge on

For the filled cylinder for toxic gas or the filled cylinder the contained gas of which may cause combustion, explosion, poisonous substance generation in case of contact with each other, they shall be stored in different rooms; meanwhile there shall be anti-poison tools and firefighting equipment nearby. When storing the cylindered gas which is easy to initiate polymerization or decomposition, it shall, according to the nature of the gas, control the maximum temperature of the storage space and specify the storage period according to the nature of gas.

6.7.2 Special requirements for welded insulated LNG gas cylinders for vehicles

The filling organization shall provide safe use instructions to the uses of the gas cylinders for vehicle. The guiding work shall include at least the following contents:

(1) It shall use the welded insulated LNG gas cylinders for vehicles in open spaces;

(2) At an eye-catching position on the warning label of the gas cylinder, there shall be a prompt which prohibits the driver to drive or park the vehicles which use the LNG fuel into a closed space such as a parking lot (garage) in the building;

(3) The using organization of public transport vehicles using LNG as fuel shall have safety management systems, institutions and personnel for gas cylinders for vehicles; implement safety management of the welded insulated LNG cylinder for vehicles and is responsible for its safety of use. The management system includes at least the gas filling and discharging operation procedures, routine maintenance of welded insulated LNG cylinders, emergency disposal, drills.

Note 6-1: A filled cylinder is a cylinder which is filled with a specified amount of gas.

Note 6-2: An empty cylinder is, after the exit-factory and periodic inspection, a gas cylinder which is filled with a protective gas such as nitrogen in a pressure less than 0.275 MPa (at 21°C) by the relevant organizations according to the requirements.

7 Periodic inspection

7.1 Inspection agency and its inspectors

The gas cylinder's periodic inspection agency shall, in accordance with the "Accreditation criteria on special equipment inspection agencies" (TSG Z7001), obtain the periodic inspection approval certificate for gas cylinders, conduct periodic inspections of gas cylinders in strict accordance with the approved

(1) Gas cylinder which contains nitrogen, sulfur hexafluoride, inert gas, non-corrosive high-purity gas with a purity of more than or equal to 99.999% is inspected once every 5 years;

(2) Gas cylinders which contain gas corrosive to the cylinder materials, diving cylinders, gas cylinders that are often in contact with seawater are inspected once every 2 years;

(3) Gas cylinders which contain other gases are inspected once every 3 years.

For the aforementioned gas cylinders which contain mixed gas, the inspection cycle shall be determined according to the gas with the shortest inspection period in the mixed gas.

Note 7-1: Excluding liquefied petroleum gas cylinders, liquefied dimethyl ether cylinders, dissolved acetylene gas cylinders, gas cylinders for vehicles, welded insulated gas cylinders.

7.4.1.2 Dissolved acetylene gas cylinders and composite gas cylinders for respirators

They are inspected once every 3 years.

7.4.1.3 Liquefied petroleum gas cylinders for vehicles and liquefied dimethyl ether cylinders for vehicles

They are inspected once every 5 years.

7.4.1.4 Liquefied petroleum gas cylinders, liquefied dimethyl ether cylinders

They are inspected once every 4 years.

7.4.1.5 Fiber-wrapped gas cylinders for vehicles

They are inspected in accordance with the provisions of GB 24162 “Periodic inspection and evaluation of hoop wrapped fiber reinforced composite gas cylinders with metal liners of compressed natural gas for automotive vehicles”.

7.4.1.6 Compressed natural gas cylinders for vehicles

They are inspected in accordance with the provisions of GB 19533 “Periodic inspection and evaluation of steel gas cylinders for the on-board storage of compressed natural gas as a fuel”.

7.4.1.7 Welded insulated gas cylinders (including welded insulated gas cylinders for vehicles)

They are inspected once every 3 years. If there is any problem found in the

the gas cylinder shall be recovered and treated. The recovery and treatment shall at least meet the following requirements:

(1) The residual gas contained in the toxic and flammable gas cylinders shall be recycled in an environmentally friendly manner and shall not be discharged into the atmosphere;

(2) After confirming that the pressure drop in the cylinder is zero, the cylinder valve can be removed;

(3) Gas cylinders which contain flammable gas shall be replaced. Gas cylinders which contain flammable liquefied gases such as liquefied petroleum gas shall be internally treated by means of steam purging or other methods that do not damage the material of the cylinder and do not degrade the material properties of the cylinder, to reach the specified safety requirements. Otherwise, it is prohibited to use the compressed air to carry out airtightness test.

7.7 Inspection items and requirements:

(1) The items and requirements for periodic inspection of all types of gas cylinders shall comply with the requirements of relevant safety technical specifications and the corresponding national standards. For gas cylinder products that have no corresponding national standards on periodic inspection, they shall be carried out in accordance with the provisions of clause 1.5 of this Regulation;

(2) The periodic inspection of gas cylinders shall be carried out one by one. During the inspection, if it is found that the gas cylinders are welded, repaired, patched, disassembled, refurbished, they shall be scrapped;

(3) The gas cylinder's periodic inspection agency shall ensure that the gas cylinders and gas cylinder's valves that pass the inspection can safely use for one inspection cycle under normal use conditions. The gas cylinders that cannot be safely used to the next inspection cycle shall be scrapped. The gas cylinder's valves that cannot guarantee the safe use to the next inspection cycle shall be replaced.

7.8 Inspection records and reports

The gas cylinder's periodic inspection agency shall fill in the inspection record carefully. After the inspection, it shall issue the inspection report of gas cylinders on the qualified or scrapped gas cylinder (see Appendix D for the format). The inspection record and inspection report shall be true and accurate.

7.9 Elimination of use function

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