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Pressure relief devices for gas cylinders

气瓶安全泄压装置

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Pressure relief devices for gas cylinders

1 Scope

This document specifies the types and structural types, installation requirements, selection requirements, basic requirements, calculation of minimum flow capacity for safety and rated capacity, requirements for the determination of operating pressure or operating temperature, as well as marking, installation, and maintenance of pressure relief devices for gas cylinders.

This document applies to gas cylinders of various structures and types containing various gases.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 8337 Fusible plug device for gas cylinders

GB/T 13005 Terminology of gas cylinders

GB/T 16918 Bursting disc safety devices for gas cylinders

GB/T 17268 Non-refillable steel welded cylinders for industrial use

GB 18428 Glass bulbs used for automatic fire extinguishing systems

GB/T 42536 Assembly valve on high pressure hydrogen storage cylinder for vehicles

3 Terms, definitions, and symbols

For the purpose of this document, the terms and definitions defined in GB/T 13005 and the following apply.

3.1 Terms and definitions

3.1.1

pressure relief device

M : the molar mass of the medium contained in the cylinder, in kilograms per kilomole (kg/kmol);

P : the discharge pressure (absolute pressure), in megapascals (MPa);

NOTE: For bursting disc devices, this is the design bursting pressure; for TPRDs, when the medium in the cylinder is liquefied gas, this is the saturated vapor pressure of the medium contained at its operating temperature; when the medium in the cylinder is compressed gas, this is the ideal pressure at its operating temperature; for safety valves, this is the rated discharge pressure.

P_c : the critical pressure (absolute pressure), in megapascals (Mpa);

q : the latent heat of vaporization of the medium contained in the cylinder at the discharge pressure, in kilojoules per kilogram (kJ/kg);

T : the temperature of the medium at the discharge pressure (absolute temperature), in Kelvin (K);

T_c : the critical temperature (absolute temperature), in Kelvin (K);

V : the nominal volume of the gas cylinder, in liters (L);

W_r : the rated capacity of the pressure relief device, in kilograms per hour (kg/h);

W_s : the minimum flow capacity for safety of the gas cylinder, in kilograms per hour (kg/h);

Z : the compressibility coefficient of the gas at absolute pressure P and absolute temperature T .

4 Types and structural types of pressure relief devices

4.1 Fusible plug device

It is composed of a fusible alloy and a plug seat. The plug seat is directly connected to the shell or valve body. When the temperature reaches a predetermined value, the fusible alloy melts and release the gas within the cylinder directly. Fusible plug devices shall comply with the requirements of GB/T 8337.

4.2 Fusible alloy activated device

It is composed of a fusible alloy and an actuator. The actuator is connected to the valve body. When the temperature reaches a predetermined value, the fusible alloy melts, triggering the actuator to activate and release the gas within the cylinder.

4.3 Glass bulb activated device

It is composed of a glass bulb (also called a glass ball), a support, and an actuator. The actuator is connected to the valve body. When the temperature reaches a predetermined value, the glass bulb shatters, triggering the actuator to activate and release the gas within the cylinder.

4.4 Bursting disc device

It is composed of a bursting disc, a clamping ring, and fasteners (for non-refillable steel welded cylinders, the disc can be welded directly to the opening in the shell). When the gas pressure in the cylinder reaches a predetermined value, the disc ruptures, releasing the gas within the cylinder. The bursting disc device shall comply with the requirements of GB/T 16918.

4.5 Safety valve

A reversible pressure control device consisting of a valve boss, a valve disc, and a spring. When the gas pressure in the cylinder reaches a predetermined value, the valve disc, compressed by the spring, moves away from the valve boss, releasing the gas within the cylinder. When the pressure drops to a predetermined value, the valve disc recloses.

4.6 Bursting disc-fusible plug composite device

A pressure relief device consisting of a bursting disc and a fusible plug connected in series. The fusible plug is positioned on the discharge side of the bursting disc. When the temperature reaches a predetermined value, the gas pressure in the cylinder also reaches a predetermined value, the fusible alloy melts and the bursting disc ruptures, releasing the gas within the cylinder.

4.7 Bursting disc-safety valve composite device

A pressure relief device consisting of a bursting disc and a safety valve connected in series. When the gas pressure in the cylinder reaches a predetermined value, the bursting disc ruptures first, and the released gas opens the safety valve, releasing the gas within the cylinder.

5 Requirements for the installation of pressure relief devices

5.1 The following gas cylinders shall be equipped with pressure relief devices:

- a) cylinders for on-board storage of fuel for automotive vehicle;
- b) cylinders for metal hydride reversible hydrogen storage and release systems;
- c) fiber-wound gas cylinders containing compressed gases and high-pressure liquefied gases;
- d) acetylene cylinders;

- e) welded insulated gas cylinders;
- f) bundles containing liquefied gases;
- g) large-volume gas cylinders for tube trailers and tube bundle containers;
- h) non-refillable steel welded cylinders.

5.2 Gas cylinders containing pyrophoric gases (the first digit of the FTSC code in GB/T 16163 is “3”) or highly toxic gases (the second digit of the FTSC code in GB/T 16163 is “3”) shall not be equipped with pressure relief devices.

5.3 Gas cylinders containing acidic corrosive gases that form hydrohalic acids (the fourth digit of the FTSC code in GB/T 16163 is “3”) may not be equipped with pressure relief devices.

5.4 Civilian liquefied petroleum gas cylinders and civilian liquefied dimethyl ether cylinders shall not be equipped with pressure relief devices.

5.5 Nitrogen, inert gas, and oxygen cylinders (excluding fiber-wound gas cylinders) are generally not equipped with pressure relief devices.

5.6 Whether or not to install pressure relief devices on gas cylinders other than those specified above shall be proposed by the user unit and determined through consultation between the gas cylinder manufacturer and the safety accessory manufacturer.

6 Requirements for the selection of pressure relief devices

6.1 Gas cylinders containing toxic gases (the second digit of the FTSC code in GB/T 16163 is “2”) shall not be equipped with separate safety valves; gas cylinders containing low-pressure toxic gases may be equipped with fusible plug devices; gas cylinders containing high-pressure toxic gases shall use bursting disc-fusible plug composite devices.

6.2 Gas cylinders containing flammable and combustible low-pressure liquefied gases (the first digit of the FTSC code in GB/T 16163 is “2”) should be equipped with safety valves or composite devices with a safety valve.

6.3 Gas cylinders containing combustible gases that are easily decomposed or polymerized (the first digit of the FTSC code in GB/T 16163 is “5”) shall be equipped with fusible plug devices.

6.4 Cryogenic insulated gas cylinders containing liquefied natural gas and other flammable gases shall be equipped with at least two parallel safety valves; welded insulated cylinders containing other cryogenic liquefied gases shall be equipped with parallel bursting disc devices and safety valves. The bursting disc device is used to prevent the shell (liner) from bursting due to pressure buildup caused by high

temperatures in a fire environment; the safety valve is used to prevent explosion caused by pressure buildup due to complete failure of the gas cylinder's insulation.

6.5 Liquefied petroleum gas cylinders for vehicles and liquefied dimethyl ether cylinders for vehicles shall be equipped with a combination valve with a safety valve or a separate safety valve.

6.6 Compressed natural gas cylinders for vehicles with seamless steel structures and metal liner fiber-wound structures shall be equipped with bursting disc-fusible plug composite devices.

6.7 Compressed hydrogen cylinders for vehicles shall be equipped with TPRDs.

6.8 Non-refillable steel welded cylinders shall be equipped with bursting discs.

6.9 Fiber-wound gas cylinders for breathing apparatus shall be equipped with bursting discs.

6.10 Seamless steel gas cylinder bundles containing liquefied gases shall be equipped with safety valves.

6.11 Other gas cylinders shall be equipped with appropriate pressure relief devices in accordance with relevant product standards.

7 Basic requirements for pressure relief devices

7.1 Design requirements

7.1.1 The structure of the device shall be appropriate for the operating environment and conditions.

7.1.2 The installation of the device shall not hinder the normal use and handling of the gas cylinder.

7.1.3 The exhaust reaction force generated when the device is opened shall not adversely affect the gas cylinder.

7.1.4 For gas cylinders containing flammable gases, the structure and installation of the device shall ensure that the exhausted gas is discharged directly into the atmosphere, minimizing unnecessary obstruction or impact on other equipment.

7.1.5 The device shall have good sealing performance under normal operating conditions.

7.1.6 The TPRD installed in compressed hydrogen cylinders for vehicles shall comply with the requirements of GB/T 42536, and the glass bulb shall use the products manufactured in accordance with GB 18428.

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