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# National Standards of the People's Republic of China

## **GB/T** 14194-2017

In substitute of GB/T 14194-2006

# **Rules for filling of compressed gas cylinders**

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GB/T 14194-2017

**Preface**

This standard was drafted in accordance with the provisions of GB/T 1.1-2009.

This standard replaces GB/T 14194-2006 *Rules for Filling of Permanent Gas Cylinders.*

Compared with GB/T 14194-2006, the main technical changes other than editable modification in this standard are as follows:

—— The scope of application of the standard was revised (see chapter 1 of this standard and chapter 1 of the standard of 2006 edition);

—— The regulations of vacuuming for cylinders of combustible gas and strong oxidizing gas before filling are added, and the specific requirements for vacuum value are proposed (see 4.4 and 4.5);

—— The specific limit value of impurity content in cylinder gas is deleted (see 5.2 of 2006 edition);

—— The principle of determining the filling quantity of cylinders is modified. In another word, the filling pressure shall not exceed 2 / 3 of the hydraulic test pressure of cylinders under the reference temperature (20℃) (see 5.5 of this standard and 5.4 of the standard of 2006 edition);

—— The maximum filling pressure is limited for several gases with characteristics, such as fluorine and nitric oxide (see 5.6);

—— Based on the modified principle of determination of filling quantity, the maximum filling pressure of several common gases at different filling temperatures is comprehensively modified (see Table 1 of this standard and table 1 of the standard of 2006 edition);

—— The relevant data of nitrogen is added in the item of the highest filling pressure of common compressed gas in Table 1 (see Table 1);

—— The temperature from the gas outlet of the vaporizer to the filling pipe is limited to not less than -30 ℃ (see 5.9).

This standard is proposed by and under the centralized management of China Gas Cylinders Standardization Technical Committees (SAC/TC 31).

This standard was drafted by Hangzhou New Century Mixed Gas Co., Ltd., Beijing Praxair Utility Gas Co., Ltd., and Beijing AP BAIF Gases Industry Co., Ltd.

The main drafters of this standard include: Wu Yuesang, Hao Cheng, Shen Jianlin, Song Qi and Zhao Junxiu.

The former standards substituted by this standard are as below:

—— GB 14194-1993, GB/T 14194-2006.

## **Rules for filling of compressed gas cylinder**

1 Scope

This standard specifies the basic principles and safety technical requirements for filling of compressed gas cylinders.

This standard is applicable to the filling of compressed gas cylinders.

This standard is not applicable to the filling of gas mixture (except natural gas) cylinders and compressed natural gas cylinders for vehicles.

2 Normative references

The following documents are essential to the application of this document. For dated references, only the dated versions shall be applicable to this document. For any undated references, the latest version (including all amendments) is applicable to this document.

GB/T 7144 Coloured cylinder mark for gases

GB/T 13005 Terminology of gas cylinders

GB/T 15383 Connection types and dimensions for gas cylinder valve outlets

3 Terms and definitions

The following terms and definitions and those defined in GB/T 13005 are applicable to this document.

3.1 Cryogenic liquid gas

It refers to the gas with critical temperature of lower than or equal to -50 ℃, which is liquefied due to low temperature during storage and transportation.

3.2 Filling temperature

It refers to the actual temperature of the gas in the cylinder at the end of filling.

3.3 Filling pressure

It refers to the pressure of the gas in the cylinder at the end of filling.

4 Inspection and handling before filling

4.1 The cylinder shall be in the charge of a specially assigned person and inspected one by one before filling, and the inspection and requirements shall at least include the following:

a) Cylinders shall be produced by units with "Special Equipment Manufacturing License";

b) Imported cylinders shall be approved by the Special Equipment Safety Supervision and Management Department;

c) The gas to be filled shall be consistent with the name or chemical formula of the filled gas described in the manufacturing steel seal mark of the cylinder;

d) The name and chemical formula of the filled gas printed on the warning label shall be consistent with the steel seal mark of the cylinder;

e) The cylinder shall be the one owned by this filling station or the one managed by other filling stations;

f) The colour mark on the outer surface of the cylinder shall conform to the provisions of GB/T 7144 and be clear and easy to recognize;

g) The thread type of the outlet of the cylinder valve shall comply with the provisions of GB/T 15383. In another word, the outlet thread of the cylinder valve for combustible gas shall be left-handed, and the outlet thread of the cylinder valve for other gases shall be right-handed;

h) The outer surface of the cylinder shall be free of cracks, serious corrosion, obvious deformation, and other serious external damage defects;

i) The cylinder shall be within the stipulated validity period of inspection;

j) Safety accessories for cylinders shall be complete and meet safety requirements;

k) Regarding the cylinder to be filled with oxygen or other strongly oxidizing gas, the cylinder body and valve shall not be contaminated with grease or other combustible materials.

4.2 Cylinders not meeting the requirements of 4.1 are prohibited from filling.

4.3 For the cylinder with color or other marks and the thread at the outlet of the cylinder valve not in conformity with the regulations of the gas, the filling behavior is not allowed, the cause shall be found out, and the local Special Equipment Safety Supervision and Management Department shall be reported for treatment.

4.4 The cylinders newly put into use or inflated for the first time after internal inspection shall be vacuumized or replaced according to regulations before filling, and can be filled only after it is confirmed to be qualified.

4.5 In terms of the cylinders to be filled with combustible gas and oxidizing gas, if no residual pressure holding valve is installed, it shall be vacuumized before refilling. The gas cylinders to be filled with combustible gas shall be vacuumized to below -80kPa, and the one to be filled with oxidizing gas shall be vacuumized to below -50kPa.

4.6 During the validity period of the inspection, if major defects are found or any doubts for the internal conditions of the cylinder, cylinder valves and accessories in the visual inspection, the cylinder shall be sent to the inspection agency first for technical inspection and evaluation according to the regulations, and it can be reused only after passing the inspection. The cylinder which has been in storage and out of service for more than one inspection cycle shall be inspected before use.

4.7 When the cylinder imported from abroad or used abroad is required to be filled in China, it shall be approved by the Special Equipment Safety Supervision and Management Department and pass the inspection of Inspection Agencies before filling.

4.8 The cylinder that is not qualified after inspection (include the one to be handled) shall be stored in isolation from the qualified ones and marked clearly to prevent confusion.

5 Filling

5.1 The threaded connection shall be adopted for the connection between the filling gas piping of the cylinder and the cylinder valve, and clamp connection for filling is prohibited.

5.2 Pointer pressure gauges are adopted for filling systems of cylinders, with an accuracy of not less than level 1.6 and a dial diameter of not less than 100 mm. The check period shall not exceed 6 months.

5.3 The impurity content in the gas to be filled shall conform to the requirements of the corresponding gas standards, otherwise filling is prohibited.

5.4 When filling the gas into the cylinder, the following regulations shall be strictly observed:

a) Checking and confirming that the cylinder is qualified before filling (records shall be kept);

b) When filling with the anti-misloading joint, carefully checking whether the thread of the air outlet of the cylinder valve is consistent with the thread type specified by the filled gas, and whether all parts of the anti-misloading joint are flexible and easy to use;

c) The operation of opening the cylinder valve shall be gently, and attention shall be paid to monitor the abnormal sound in the cylinder;

d) It is prohibited to knock the cylinder valves and pipelines with wrenches and other metal appliances;

e) Checking the cylinder body temperature one by one to see whether they are consistent before the gas pressure in the cylinder reaches 7MPa, and checking the cylinder valve and all connecting parts one by one to see whether they are properly sealed before the gas pressure in the cylinder reaches 10MPa. In case of any abnormality, it shall be handled properly in time;

f) The filling flow of cylinders shall not be greater than 8m3/h (under standard state);

g) When filling a cylinder with an inflatable busbar, it is forbidden to insert an empty cylinder for filling during the filling process.

5.5 The filling quantity of the cylinder shall be strictly controlled to ensure that the pressure of the gas in the cylinder does not exceed 2/3 of the hydraulic test pressure of the cylinder at the reference temperature (20℃ for domestic use).

5.6 The maximum filling pressure of several gases with characteristics at the reference temperature of 20℃ is defined as follows:

a) The filling pressure of fluorine (F2) and oxygen difluoride (OF2) shall not be greater than 3.0MPa, the hydraulic test pressure of cylinders shall not be less than 20MPa, and the fluorine filling quantity of each cylinder shall not exceed 5kg;

b) The filling pressure of nitric oxide (NO) shall not be greater than 5MPa, and the hydraulic test pressure of cylinders shall not be less than 20MPa;

c) Dry (water content less than 5×10-6) and sulfur-free carbon monoxide (CO) can be filled with steel cylinders, with the filling pressure of exceed 5/6 of the nominal working pressure of the cylinder and not exceed 13MPa.

5.7 Regarding various common compressed gases filled with domestic cylinders, the filling pressure (gauge pressure) shall not exceed the provisions in Table 1.

**Table 1 The maximum filling pressure of common compressed gases at different filling temperatures**

|  |  |  |
| --- | --- | --- |
| Name of gases | Filling temperature /℃ | Maximum filling pressure of cylinders /MPa |
| Nominal working pressure15MPa | Nominal working pressure20MPa |
| Oxygen | 5 | 13.9 | 18.3 |
| 10 | 14.2 | 18.8 |
| 15 | 14.6 | 19.4 |
| 20 | 15.0 | 20.0 |
| 25 | 15.3 | 20.5 |
| 30 | 15.7 | 21.0 |
| 35 | 16.0 | 21.5 |
| 40 | 16.4 | 22.0 |
| 45 | 16.8 | 22.6 |
| 50 | 17.1 | 23.1 |
| Air | 5 | 14.0 | 18.5 |
| 10 | 14.3 | 19.0 |
| 15 | 14.6 | 19.5 |
| 20 | 15.0 | 20.0 |
| 25 | 15.3 | 20.5 |
| 30 | 15.6 | 21.0 |
| 35 | 15.9 | 21.5 |
| 40 | 16.2 | 22.0 |
| 45 | 16.5 | 22.5 |
| 50 | 16.8 | 23.0 |
| Nitrogen | 5 | 14.0 | 18.5 |
| 10 | 14.3 | 19.0 |
| 15 | 14.6 | 19.5 |
| 20 | 15.0 | 20.0 |
| 25 | 15.3 | 20.5 |
| 30 | 15.7 | 21.0 |
| 35 | 16.0 | 21.5 |
| 40 | 16.3 | 22.0 |
| 45 | 16.7 | 22.5 |
| 50 | 17.0 | 23.0 |

Table 1 (Continued)

|  |  |  |
| --- | --- | --- |
| Name of gases | Filling temperature /℃ | Maximum filling pressure of cylinders /MPa |
| Nominal working pressure15MPa | Nominal working pressure20MPa |
| Hydrogen | 5 | 14.1 | 19.0 |
| 10 | 14.4 | 19.3 |
| 15 | 14.7 | 19.6 |
| 20 | 15.0 | 20.0 |
| 25 | 15.3 | 20.4 |
| 30 | 15.6 | 20.8 |
| 35 | 15.9 | 21.2 |
| 40 | 16.2 | 21.6 |
| 45 | 16.5 | 22.0 |
| 50 | 16.8 | 22.4 |
| Methane | 5 | 13.5 | 17.8 |
| 10 | 14.0 | 18.5 |
| 15 | 14.5 | 19.3 |
| 20 | 15.0 | 20.0 |
| 25 | 15.5 | 20.8 |
| 30 | 16.0 | 21.6 |
| 35 | 16.5 | 22.4 |
| 40 | 16.9 | 23.2 |
| 45 | 17.4 | 24.0 |
| 50 | 18.0 | 24.7 |
| Carbon monoxide(Aluminum alloy cylinder only) | 5 | 14.0 | 18.4 |
| 10 | 14.3 | 19.0 |
| 15 | 14.7 | 19.5 |
| 20 | 15.0 | 20.0 |
| 25 | 15.4 | 20.5 |
| 30 | 15.7 | 20.9 |
| 35 | 16.1 | 21.4 |
| 40 | 16.4 | 21.9 |
| 45 | 16.8 | 22.4 |
| 50 | 17.2 | 22.9 |
| Argon gas | 5 | 13.9 | 18.4 |
| 10 | 14.3 | 18.9 |

Table 1 (Continued)

|  |  |  |
| --- | --- | --- |
| Name of gases | Filling temperature /℃ | Maximum filling pressure of cylinders /MPa |
| Nominal working pressure15MPa | Nominal working pressure20MPa |
| Argon gas | 1520 | 14.715.0 | 19.520.0 |
| 25 | 15.4 | 20.5 |
| 3035 | 15.716.1 | 21.021.5 |
| 40 | 16.4 | 22.0 |
| 45 | 16.8 | 22.5 |
| 50 | 17.1 | 22.9 |
| Helium | 5 | 14.2 | 19.0 |
| 10 | 14.5 | 19.3 |
| 15 | 14.8 | 19.7 |
| 20 | 15.0 | 20.0 |
| 2530 | 15.315.5 | 20.320.7 |
| 35 | 15.8 | 21.0 |
| 40 | 16.0 | 21.4 |
| 45 | 16.3 | 21.7 |
| 50 | 16.5 | 22.0 |

The filling pressure of other compressed gases shall not exceed the pressure value calculated by formula (1).



Where:

P- The maximum filling pressure of the cylinder (absolute), in MPa;

T- Filling temperature in Kelvin (k);

Z- Compression coefficient of gases at the pressure (P) and temperature (T);

P0- Nominal working pressure of cylinders, in MPa;

T0- The reference temperature of the cylinders (it is set at 20℃ for domestic use, i.e. 293K), in Kelvin (K);

Z0- Compression coefficient of gases at the pressure (P0) and temperature (T0);

5.8 The filling temperature shall be determined according to the following methods:

The result of the ambient temperature of the filling room plusing the inflation temperature difference is taken as the filling temperature of the cylinder, where the inflation temperature difference refers to the difference between the actually measured gas filling temperature and the room temperature during the temperature measurement test.

The inflation temperature difference shall be determined by the test at the specified filling speed. The test results shall be hung or pasted on the wall.

5.9 During the filling process of the cylinder after vaporization of cryogenic liquid gases, the following provisions shall also be observed:

a) Checking the gas outlet temperature of the cryogenic liquid vaporizer and whether the pressure control device is in a normal state before filling;

b) A cold pump process is required before opening the cryogenic liquid pump (the cold pump time shall be determined according to the pump's operating instructions);

c) During the filling process of cylinders, no serious icing phenomenon is allowed on the cryogenic liquid vaporizer, and the temperature from the gas outlet of vaporizer to the filling pipeline shall not be lower than -30 ℃. In case of the above phenomenon occurs, it shall be handled properly in time;

d) In the cryogenic liquid pressurized vaporization cylinder, the discharge volume of the cryogenic pump shall match the heat exchange area and filling quantity of vaporizer, and the filling time of each cylinder shall not be less than 30min. When the outlet temperature of the vaporizer is lower than -30℃ and overpressure occurs, there shall be a system alarm and knock-off block;

e) The operator of cryogenic liquid filling station shall be equipped with reliable anti-freezing PPE.

5.10 After filling, the cylinder shall be in the charge of a specially assigned person and inspected one by one. When it does not meet the requirements, it is prohibited to leave the factory, and shall be handled properly. The inspection shall at least include the followings:

a) Whether the pressure (filling quantity) and mass in the cylinder meet the requirements of safety technical specifications and relevant standards;

b) Whether the screw thread of the cylinder valve outlet and its sealing surface are in good condition;

c) Whether there are serious defects such as bulging, deformation or leakage after the cylinder is filled;

d) Whether there is any sign showing that the temperature of the cylinder body increased abnormally;

e) Whether the cap, filling label and warning label of the cylinder are complete.

6 Filling record

6.1 The filling unit shall assign a special person to fill in the filling record of the cylinder, which shall at least include the filling date, cylinder number, room temperature, filling medium, filling pressure, starting and ending time of filling, filling person, any abnormality found or not, etc.

6.2 The filling unit shall keep the filling records of cylinders in a proper manner, which shall be kept at least for 1 year.

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