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**NATIONAL STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA**

**GB/T 43771-2024**

**Electronic gas - Carbon monoxide**

电子气体 一氧化碳

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### 1 Scope

The document specifies the technical requirements, the sampling, the test methods, the inspection rules and the requirements for marking, packaging, transport and storage of carbon monoxide.

It applies to electronic-grade carbon monoxide prepared by purification of industrial-grade carbon monoxide.

### 2 Normative references

The normative references listed are GB 190, GB/T 5832.3, GB/T 7144, GB/T 8984, GB/T

11640, GB/T 14194, GB 15258, GB 15603, GB/T 16804, GB/T 28726, GB/T 28727, GB/T 34972, GB/T 43306, TSG R0005 and TSG 23. For dated references only the edition corresponding to that date applies; for undated references the latest edition, including all amendments, applies.

### 3 Terms and definitions

The document defines no term.

### 4 Technical requirements

The technical requirements for carbon monoxide comply with Table 1. Table 1 has two columns, item and index, and ten rows. The carbon monoxide (CO) purity, as a mole fraction expressed in units of ten to the power minus two, is not less than 99.999. The hydrogen (H<sub>2</sub>) content, as a mole fraction expressed in units of ten to the power minus six, is not more than 0.5. The oxygen plus argon (O<sub>2</sub> plus Ar) content, on the same basis, is not more than 2.0. The nitrogen (N<sub>2</sub>) content is not more than 3.0. The carbon dioxide (CO<sub>2</sub>) content is not more than 2.0. The total hydrocarbon content, counted as methane, is not more than 1.0. The total sulfur content, counted as sulfur, is not more than 0.5. The moisture (H<sub>2</sub>O) content is not more than 1.0. The iron (Fe) content, in micrograms per gram, is less than 0.001, and the nickel (Ni) content, in micrograms per gram, is less than 0.001.

### 5 Sampling

The sampling of carbon monoxide complies with GB/T 43306.

### 6 Test methods

Warning: some of the test procedures specified in the document may lead to hazardous situations, and users take suitable safety and health protection measures.

6.1 Carbon monoxide purity. The purity is calculated by formula (1) as one hundred minus the sum of the seven measured impurity contents, taken with the scaling factor printed in the formula. The symbols are:  $x$ , the carbon monoxide purity as a mole fraction in units of ten to the power minus two;  $x_1$ , the hydrogen content as a mole fraction in units of ten to the power minus six;  $x_2$ , the oxygen plus argon content on the same basis;  $x_3$ , the nitrogen content;  $x_4$ , the carbon dioxide content;  $x_5$ , the total hydrocarbon content;  $x_6$ , the total sulfur content; and  $x_7$ , the moisture content.

6.2 Determination of the hydrogen, oxygen plus argon, nitrogen and carbon dioxide content. 6.2.1 The contents are determined by the method specified in GB/T 28726; other equivalent methods may be used, and in case of dispute over the result the method specified in the document is the arbitration method. 6.2.2 The pre-separation column is a

stainless steel tube about 3 m long with an inside diameter of 3 mm, packed with 5A molecular sieve of particle size 0.15 mm to 0.18 mm, or another equivalent chromatographic column. 6.2.3 Chromatographic column I is a stainless steel tube about 3 m long with an inside diameter of 3 mm, packed with 5A molecular sieve of particle size 0.18 mm to 0.25 mm, or another equivalent column; it is used to determine the hydrogen, oxygen plus argon and nitrogen content. Chromatographic column II is a stainless steel tube about 6 m long with an inside diameter of 3 mm, packed with a polymer of particle size 0.18 mm to 0.25 mm, being, as printed in the document, a copolymer of divinylbenzene and N-2-alkenyl-2-pyrrole, or another equivalent column; it is used to determine the carbon dioxide content. 6.2.4 In the reference material the mole fraction of each component is 1 to 5 in units of ten to the power minus six, with nitrogen as the balance gas.

6.3 Determination of the total hydrocarbon content. 6.3.1 The total hydrocarbon content in carbon monoxide is determined by the method specified in GB/T 8984; other equivalent methods may be used, and in case of dispute over the result the method specified in the document is the arbitration method. 6.3.2 The pre-separation column is a stainless steel tube about 2 m long with an inside diameter of 3 mm, packed with a polymer of particle size 0.18 mm to 0.25 mm, being a copolymer of ethylstyrene and divinylbenzene, or another equivalent column. 6.3.3 The chromatographic column is a stainless steel tube about 3 m long with an inside diameter of 3 mm, packed with a silanized glass microsphere support of particle size 0.18 mm to 0.25 mm, or another equivalent column. 6.3.4 In the reference material the mole fraction of methane is 1 to 5 in units of ten to the power minus six, with nitrogen as the balance gas. 6.3.5 The reference schematic gas flow diagram and the typical chromatograms are given in Annex A.

6.4 Determination of the total sulfur content. 6.4.1 The total sulfur content in carbon monoxide is determined by the method specified in GB/T 28727; other equivalent methods may be used, and in case of dispute over the result the method specified in the document is the arbitration method. 6.4.2 The pre-separation column is a stainless steel tube about 4 m long with an inside diameter of 3 mm, packed with a polymer of particle size 0.18 mm to 0.25 mm, being a copolymer of ethylstyrene and divinylbenzene, or another equivalent column. 6.4.3 The chromatographic column is a stainless steel tube about 3 m long with an inside diameter of 3 mm, packed with a silanized glass microsphere support of particle size 0.18 mm to 0.25 mm, or another equivalent column. 6.4.4 In the reference material the mole fraction of carbonyl sulfide is 1 to 5 in units of ten to the power minus six, with nitrogen as the balance gas. 6.4.5 The reference schematic gas flow diagram is given in Annex A.

6.5 Determination of the moisture content. The determination is carried out in accordance with GB/T 5832.3. Other equivalent methods may be used, and in case of dispute over the result the method specified in GB/T 5832.3 is the arbitration method.

6.6 Determination of the iron and nickel content. The determination is carried out in accordance with GB/T 34972.

6.7 Treatment of the off-gas. During the determination, measures are provided for treating the carbon monoxide off-gas, so as to prevent pollution of the environment and injury to personnel by carbon monoxide.

## 7 Inspection rules

7.1 Batching. The cylinder-filled carbon monoxide product made continuously and steadily on the same production line forms one batch.

7.2.1 The hydrogen content, the oxygen plus argon content, the nitrogen content, the carbon dioxide content, the total hydrocarbon content, the total sulfur content and the moisture content are inspected on every cylinder; when a test result fails to meet the technical requirements of Table 1, that product is judged non-conforming.

7.2.2 The iron content and the nickel content are inspected on cylinders drawn at random in the numbers specified in Table 2. If the test results meet the technical requirements of Table 1, the batch is judged conforming. If they do not, a doubled number of cylinders is drawn at random again from the same batch and inspected; if the results then meet the technical requirements of Table 1, the batch is judged conforming apart from the non-conforming cylinders; if the results still do not meet the technical requirements of Table 1, the batch is judged non-conforming. Table 2 has two columns, the number of cylinders in the batch and the minimum number of cylinders to be sampled, and three rows: for 1 to 10 cylinders, 1; for 11 to 20 cylinders, 2; for more than 20 cylinders, 5.

## 8 Marking, packaging, transport, storage and safety information

8.1.1 Carbon monoxide leaves the works with a product quality certificate whose content includes at least the product name and the name of the manufacturer; the production date or batch number together with the shelf life; the filling pressure in megapascals; and the number of the document together with the purity of the carbon monoxide.

8.1.2 The packaging container carries the painted wording for electronic gas carbon monoxide.

8.1.3 The packaging marks for carbon monoxide comply with the relevant provisions of GB 190, the colour marking complies with GB/T 7144, and the packaging label meets the requirements of GB 15258 and GB/T 16804.

8.2.1 The cylinders used to package carbon monoxide comply with GB/T 11640.

8.2.2 The filling, transport and storage of carbon monoxide comply with GB/T 14194, TSG R0005 and TSG 23; the safety management requirements for filling, transport and storage are those of the Regulations on the Safety Management of Hazardous Chemicals and of the Regulations on the Safety Supervision of Special Equipment.

8.2.3 Cylinders with a treated internal surface should be used.