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Electronic gas - Carbonyl sulfide

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1 Scope

The document sets out the technical requirements, sampling, test methods, inspection rules, marking, packaging, transport, storage and safety information requirements for carbonyl sulfide.

It applies to carbonyl sulfide for electronic use prepared by synthesis from carbon monoxide and sulfur as raw materials.

2 Normative references

The contents of the following documents constitute indispensable provisions of the document through normative reference in its text. For dated references, only the edition corresponding to that date applies; for undated references, the latest edition, including all amendments, applies.

The list comprises GB 190 Packaging marking of dangerous goods; GB/T 5099 (all parts) Steel seamless gas cylinders; GB/T 5832.3 Determination of trace moisture in gases-Part 3: Cavity ring-down spectroscopy; GB/T 7144 Colour marking of gas cylinders; GB/T 14193 Regulations for filling of liquefied gas cylinders; GB 15258 General rules for preparation of precautionary labels for chemicals; GB 15603 General rules for storage of hazardous chemicals; GB/T 16804 Warning labels for gas cylinders; GB/T 28726 Gas analysis-Helium ionization gas chromatography; GB/T 33145 Large volume steel seamless gas cylinders; GB/T 43306 Gas analysis-Guidelines for sampling; TSG R0005 Supervision regulation on safety technology for transportable pressure vessels; and TSG 23 Safety technical regulation for gas cylinders.

3 Terms and definitions

The document declares that there are no terms and definitions requiring definition in it.

4 Technical requirements

The technical requirements for carbonyl sulfide are to conform to Table 1.

Table 1 has two columns, the item and its index, and is continued over two pages. The purity of carbonyl sulfide (COS), as a mole fraction in units of 10 to the minus 2, is not less than 99.995. The remaining rows are impurity limits, all expressed as mole fractions in units of 10 to the minus 6: hydrogen less than 1; oxygen plus argon less than 5; nitrogen less than 20; carbon monoxide less than 3; carbon dioxide less than 10; methane less than 1; hydrogen sulfide less than 5; sulfur dioxide less than 5; carbon disulfide less than 5; moisture less than 5; and total impurity content not more than 50.

5 Sampling

Sampling of carbonyl sulfide is to comply with the provisions of GB/T 43306.

6 Test methods

A warning heads the clause: some of the test procedures specified in the document can give rise to hazardous situations, and users are to take appropriate safety and health protection measures.

6.1 Carbonyl sulfide purity. The total impurity content is calculated by Formula (1) as the sum of the ten individual impurity contents. The legend defines the symbols as hydrogen content, oxygen plus argon content, nitrogen content, carbon monoxide content, carbon dioxide content, methane content, hydrogen sulfide content, sulfur dioxide content, carbon disulfide content and moisture content, each a mole fraction in units of 10 to the minus 6, and the resulting total impurity content in the same unit. The purity is then obtained from Formula (2), whose legend gives the carbonyl sulfide purity as a mole fraction in units of 10

to the minus 2.

6.2 Determination of the contents of hydrogen, oxygen plus argon, nitrogen, carbon monoxide, carbon dioxide and methane. These contents are determined by the cut injection method specified in GB/T 28726. Other equivalent methods may be used; where the results are disputed, the method specified in the document is the referee method. The pre-separation column is a stainless steel tube about 0.6 m long with an inside diameter of about 2 mm, packed with modified carbon molecular sieve of 0.18 mm to 0.25 mm particle size, or another equivalent chromatographic column. Column I is a stainless steel tube about 2 m long with an inside diameter of about 2 mm, packed with 5A molecular sieve of 0.18 mm to 0.25 mm particle size, and serves for hydrogen, oxygen plus argon, nitrogen, carbon monoxide and methane. Column II is a stainless steel tube about 4 m long with an inside diameter of about 2 mm, packed with a high polymer (divinylbenzene) of the same particle size range, and serves for carbon dioxide. In the reference material the component contents are close to those of the components being measured and the balance gas is helium.

6.3 Determination of the contents of hydrogen sulfide, sulfur dioxide and carbon disulfide. These contents are determined by the method specified in GB/T 28726, with the same provision on equivalent methods and on the referee method. Column I is an internally coated stainless steel tube about 1.2 m long with an inside diameter of 1 mm, packed with a high polymer (a copolymer of ethylstyrene and divinylbenzene) of 0.15 mm to 0.18 mm particle size, and serves for sulfur dioxide and carbon disulfide. Column II is an internally coated stainless steel tube about 2 m long with an inside diameter of 1 mm, packed with the same type of polymer of 0.18 mm to 0.25 mm particle size, and serves for hydrogen sulfide. The reference material follows the same rule and the balance gas is helium. A reference schematic diagram of the gas flow path is given in Annex A.

6.4 Determination of moisture content. The determination is carried out in accordance with GB/T 5832.3. Other equivalent methods may be used; where the results are disputed, the method specified in GB/T 5832.3 is the referee method.

6.5 Treatment of tail gas. Measures for treating carbonyl sulfide tail gas are to be in place during the determination, so as to prevent pollution of the environment by carbonyl sulfide.

7 Inspection rules

Carbonyl sulfide products are inspected and accepted one by one. Where all inspection results meet the technical requirements of Table 1, the product is judged qualified; where any one index fails to meet the technical requirements of Table 1, the product is judged unqualified.

8 Marking, packaging, transport, storage and safety information

8.1 Marking. Carbonyl sulfide leaving the factory is to be accompanied by 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 mass in kilograms; and the number of the document together with the purity of the carbonyl sulfide. The words for electronic gas and carbonyl sulfide are to be painted on the packaging container. Packaging marking is to meet the relevant provisions of GB 190, colour marking is to meet GB/T 7144, and packaging labels are to meet the requirements of GB 15258 and GB/T 16804.

8.2 Packaging, transport and storage. Cylinders used to package carbonyl sulfide are to comply with GB/T 5099 (all parts) or with GB/T 33145. Filling, storage and transport are to comply with GB/T 14193, TSG R0005 and TSG 23, and the safety management requirements for filling, storage and transport are found in the Regulations on the Safety Management of Hazardous Chemicals and the Regulations on Safety Supervision of Special Equipment. The maximum filling quantity is calculated by Formula (3) as the product of the filling factor and the cylinder volume; the legend gives the mass of carbonyl sulfide in the cylinder in kilograms, the filling factor of carbonyl sulfide equal to 0.84 kg/L, and the marked internal volume of the cylinder in litres. Cylinders whose internal surface has been treated are recommended, and the treated cylinder is to satisfy the requirements of the document; DISS 722 or CGA 330 are recommended for the valve outlet connection. Leakage and contamination of the cylinder mouth are to be prevented. The residual liquid in carbonyl sulfide cylinders returned by users is recommended not to be lower than 5 % of the filled quantity. Storage is to comply with GB 15603: in a cool, dry and ventilated warehouse, not exposed to direct sunlight and away from heat sources.

8.3 Safety information. Safety information for carbonyl sulfide is given in Annex B.

A Annex A (informative) Schematic diagram of the gas flow path

Figure A.1 gives the reference gas flow diagram used when the hydrogen sulfide, sulfur dioxide and carbon disulfide contents of carbonyl sulfide are determined.

The key to the figure reads: 1 carrier gas inlet; 2 carrier gas filter; 3 helium purifier; 4 and 16 sample loops; 5 ten-port valve; 6 sample gas inlet; 7 sample filter; 8 flowmeter; 9 sample gas outlet; 10 helium ionization detector; 11 tail gas outlet; 12 six-port valve; 13 column I; 14 vent needle valve; 15 column II.

B Annex B (informative) Safety information

B.1 Basic information. The chemical formula is COS and the English name given is carbonyl sulfide. The relative molecular mass is 60.070, calculated with the 2018 international relative atomic masses. The codes are CAS number 463-58-1 and UN number 2204. The physical properties listed are: boiling point minus 50 °C; melting point minus 139 °C; vapour