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Seamless stainless steel pipes for oxygen pipeline

氧气管线用不锈钢无缝钢管

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Seamless stainless steel pipes for oxygen pipeline

1 Scope

This document specifies the classification and code, order content, size, shape, weight, technical requirements, test methods, inspection rules, packaging, marking and quality certificates of the stainless-steel seamless steel pipe for oxygen pipeline.

This document applies to stainless steel seamless steel pipes (hereinafter referred to as "steel pipes") for conveying oxygen and liquid oxygen.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 222 Permissible tolerances for chemical composition of steel products

GB/T 223.11 Iron, steel and alloy -- Determination of chromium content -- Visual titration or potentiometric titration method

GB/T 223.25 Methods for chemical analysis of iron, steel and alloy. The dimethylglyoxime gravimetric method for the determination of nickel content

GB/T 223.28 Methods for chemical analysis of iron, steel and alloy. The α-benzoin oxime gravimetric method for the determination of molybdenum content

GB/T 223.40 Iron, steel and alloy -- Determination of niobium content by the sulphochlorophenol S spectrophotometric method

GB/T 223.59 Iron, steel and alloy -- Determination of phosphorus content -- Bismuth phosphomolybdate blue spectrophotometric method and antimony phosphomolybdate blue spectrophotometric method

GB/T 223.60 Methods for chemical analysis of iron, steel and alloy - The perchloric acid dehydration gravimetric method for the determination of silicon content

GB/T 223.63 Methods for chemical analysis of iron, steel and alloy - The sodium (potassium) periodate photometric method for the determination of manganese content

GB/T 223.84 Steel and iron -- Determination of titanium content -- Diantipyrylmethane spectrophotometric method

GB/T 223.85 Steel and iron -- Determination of sulfur content -- Infrared absorption method after combustion in an induction furnace

GB/T 223.86 Steel and iron -- Determination of total carbon content -- Infrared absorption method after combustion in an induction furnace

GB/T 228.1 Metallic materials -- Tensile testing -- Part 1: Method of test at room temperature

GB/T 229 Metallic materials -- Charpy pendulum impact test method

GB/T 241 Metal materials -- Tube -- Hydrostatic pressure test

GB/T 242 Metal materials -- Tube -- Drift-expending test

GB/T 246 Metallic materials -- Tube -- Flattening test

GB/T 1031 Geometrical Product Specifications (GPS) -- Surface texture: Profile method -- Surface roughness parameters and their values

GB/T 2102 Acceptance, packing, marking and quality certification of steel pipe

GB/T 2975 Steel and steel products -- Location and preparation of samples and test pieces for mechanical testing

GB/T 5777-2019 Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections

GB/T 7735-2016 Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for detection of imperfections

GB/T 11170 Stainless steel -- Determination of multi-element contents -- Spark discharge atomic emission spectrometric method (Routine method)

GB/T 17395 Dimensions, shapes, masses and tolerances of seamless steel tubes

GB/T 20066 Steel and iron -- Sampling and preparation of samples for the determination of chemical composition

GB/T 20123 Steel and iron -- Determination of total carbon and sulfur content Infrared absorption method after combustion in an induction furnace (routine method)

a) When the wall thickness is not greater than 15 mm, it is 1.5 mm/m;

b) When the wall thickness is greater than 15 mm, it is 2.0 mm/m.

6.4 Terminal outline

6.4.1 The end faces of both ends of the steel pipe shall be perpendicular to the axis of the steel pipe, and the burrs shall be removed from the incision.

6.4.2 According to the requirements of the buyer, after negotiation between the supplier and the buyer, and indicated in the contract, the two ends of the steel pipe can be processed with grooves, and the groove type can be determined by negotiation between the supplier and the buyer.

6.5 Out of roundness and uneven wall thickness

The out-of-roundness and uneven-wall-thickness of the steel pipe shall not exceed 80% of the outer diameter tolerance and wall thickness tolerance, respectively.

6.6 Weight

6.6.1 Steel pipes shall be delivered by actual weight. According to the requirements of the buyer, after negotiation between the supplier and the buyer, and indicated in the contract, the steel pipe can be delivered according to the theoretical weight.

6.6.2 The theoretical weight per meter of the steel pipe is calculated according to formula (1):

$$W = \frac{\pi}{1\ 000}\rho S(D - S) \qquad \cdots\cdots(1)$$

Where:

W --- Theoretical weight per meter of steel pipe, in kilograms per meter (kg/m);

π --- Pi, to be taken as 3.1416;

ρ --- Density of steel, in kilograms per cubic decimeter (kg/dm^3), see Table 4 for the density of steel;

S --- Wall thickness of steel pipe, in millimeters (mm);

D --- The nominal outer diameter of the steel pipe, in millimeters (mm).

6.6.3 For steel pipes delivered according to the nominal outer diameter and the minimum wall thickness, the theoretical weight shall be calculated by the average wall thickness; the average wall thickness shall be the average value of the maximum and minimum wall thickness calculated according to the wall thickness and the allowable deviation.

and the buyer, and indicated in the contract, other test pressure can be used for the hydraulic pressure test.

7.5.4 With the consent of the purchaser, the supplier can replace the hydraulic pressure test with eddy current inspection; the acceptance level of eddy current inspection shall comply with E4H or E4 regulations of GB/T 7735-2016.

7.6 Processing property

7.6.1 Flattening

The steel pipe shall be subjected to a flattening test. During the flattening test, the sample shall be pressed to that the distance between the two plates reduces to H; H is calculated according to formula (3). After flattened, there shall be no cracks or splits on the outside of the bend of the sample.

$$H = \frac{(1+\alpha)S}{\alpha + S/D} \qquad \cdots\cdots(3)$$

Where:

H --- The distance between the two plates, in millimeters (mm);

α --- Deformation coefficient per unit length, to be taken as 0.09;

S --- Wall thickness of the steel pipe, in millimeters (mm);

D --- The nominal outer diameter of the steel pipe, in millimeters (mm).

7.6.2 Flaring

The flaring test shall be carried out for steel pipes with an outer diameter of not more than 150 mm and a wall thickness of not more than 10 mm. The taper of the top core for the flaring test shall be 60°, the expansion value of the outer diameter after flaring shall be 10%, and there shall be no cracks or cracks in the sample after flaring.

7.7 Degreasing

The inner and outer surfaces of the steel pipe shall be degreased. The supplier can choose any one of the following methods for surface inspection, and the degreasing treatment shall meet the corresponding requirements:

a) Use ultraviolet light with a wavelength of 320 nm~380 nm to inspect the surface of the steel pipe; if there is no fluorescence of grease, the treatment is qualified;

b) Use clean and dry white filter paper or silk cloth to wipe the surface of the steel pipe; if there is no trace of grease, the treatment is qualified;

c) Use oil-free steam to flush the steel pipe, take the condensate with a clean utensil, and put a piece of pure camphor with a diameter of less than 1 mm into the condensate; if the camphor pellet is continuously rotated, the treatment is qualified;

d) Quantitative analysis of the oil content on the surface of the degreased steel pipe; if it is not more than 120 mg/m^2, the treatment is qualified; the analysis method shall be in accordance with the regulations of Appendix A.

7.8 Surface quality

7.8.1 The inner and outer surfaces of the steel pipe shall be smooth and free from cracks, folds, creases, delamination, scarring, burrs and rust. These defects shall be completely cleared; the removal depth shall not exceed 10% of the wall thickness, and the actual wall thickness at the defect removal location shall not be less than the minimum allowable wall thickness.

7.8.2 The roughness (*Ra*) of the inner surface of the steel pipe shall meet the requirements in Table 6. When the roughness grade is not specified in the contract, the steel pipe shall be delivered with an ordinary grade.

Table 6 -- Roughness grade of the inner surface of steel pipe

Ordinary grade PA	Advanced PC
$Ra \leqslant 6.3\ \mu m$	$Ra \leqslant 3.2\ \mu m$

7.9 Ultrasonic testing

Steel pipes shall be subjected to ultrasonic testing. The acceptance level of ultrasonic testing shall meet the requirements of U2.5 in GB/T 5777-2019.

8 Test methods

8.1 Sampling for chemical composition analysis of steel pipes shall comply with the rules of GB/T 20066. Chemical composition analysis is usually carried out by complying with GB/T 11170, GB/T 20123 or other general methods; the arbitration shall comply with the regulations of GB/T 223.11, GB/T 223.25, GB/T 223.28, GB/T 223.40, GB/T 223.59, GB/T 223.60, GB/T 223.63, GB/T 223.84, GB/T 223.85, and GB/T 223.86.

8.2 For steel pipes with an outer diameter of less than 219 mm, the specimens for the tensile test shall be taken along the longitudinal direction of the steel pipes; for steel pipes with an outer diameter of not less than 219 mm, if the sizes of the steel pipes are appropriate, the specimens for the tensile test shall be preferentially taken along the transverse direction of the steel pipes.

9 Inspection rules

9.1 Inspection and acceptance

The inspection and acceptance of steel pipes shall be carried out by the quality and technical supervision department of the supplier.

9.2 Grouping rules

Steel pipes shall be inspected and accepted in batches. Each batch shall consist of steel pipes with the same grade, the same heat number, the same specification and the same heat treatment regime (heat number). The number of steel pipes in each batch shall not exceed the following requirements:

a) When the outer diameter is not greater than 76 mm and the wall thickness is not greater than 3 mm, the number shall be 500 pieces;

b) When the outer diameter is greater than 351 mm, the number shall be 50 pieces;

c) When the outer diameter is other dimensions, the number shall be 200 pieces.

9.3 Number of samples

The number of samples for each inspection of each batch of steel pipes shall meet the requirements in Table 7.

9.4 Re-inspection and judgment rules

The re-inspection and judgment rules for steel pipes shall comply with the provisions of GB/T 2102.

10 Packaging, marking and quality certificate

10.1 The protective packaging materials shall be used for the packaging of steel pipes. Commonly used protective packaging materials are kraft paper, vapor-phase anti-rust paper, oil-proof paper, plastic film or plastic caps for sealing both ends of steel pipes. When the steel pipe with an outer diameter greater than 426 mm does not have a cap, a sackcloth or plastic cloth can be used to seal and pack both ends of the pipe. The remaining requirements of the steel pipe packaging shall comply with the provisions of GB/T 2102.

10.2 The outer packaging of the steel pipe shall clearly be marked with “Used for oxygen; grease is prohibited.” The remaining requirements of the steel pipe marking shall comply with the provisions of GB/T 2102.

Appendix A

(Normative)

Determination method of grease residue on the surface of the steel pipe

A.1 General rule

Determine the residual amount of grease on the surface of the steel pipe by gravimetric method or oil analyzer.

A.2 Gravimetric method

A.2.1 Principle

Clean the surface of the steel pipe to be tested with carbon tetrachloride, and heat it to volatilize the carbon tetrachloride to obtain residual oil.

A.2.2 Instruments and materials

The instruments and materials for the test shall include:

a) A 300 mL beaker;

b) A water bath;

c) A dryer;

d) Carbon tetrachloride;

e) Medium-speed qualitative filter paper;

f) A gauze;

g) A balance with a measurement accuracy of not less than 0.0001 g;

h) An incubator.

A.2.3 Test procedure

A.2.3.1 Test (quantitative) for the oil content of carbon tetrachloride product: weigh the beaker, take carbon tetrachloride, and filter the carbon tetrachloride with medium-speed qualitative filter paper to the weight-known beaker until it reaches 300 mL; place the

beaker in an (85±5) °C water bath to make the carbon tetrachloride volatilize. When seeing that the carbon tetrachloride in the beaker has volatilized, put the beaker into a (50±5) °C incubator to dry for 30 min, and then put it into a desiccator to cool for 30 min; weigh the beaker. Calculate the weight difference of the beaker before and after being used for filtration; it is the oil content W of carbon tetrachloride.

A.2.3.2 Test for residual oil amount: take a certain amount of carbon tetrachloride to clean the residual oil on the surface of the steel pipe to be tested, and the cleaning area shall be greater than 1 m^2; if the area is less than 1 m^2, then it shall be all cleaned. Take 300 mL of used carbon tetrachloride, and filter the carbon tetrachloride with medium-speed qualitative filter paper into a weight-known beaker until it reaches 300 mL. Place the beaker in an (85±5) °C water bath to make the carbon tetrachloride volatilize. When seeing that the carbon tetrachloride in the beaker has volatilized, put the beaker into a (50±5) °C incubator to dry for 30 min, then put it into a desiccator to cool for 30 min; weigh the beaker. Calculate the weight difference W_1 of the beaker before and after being used for filtration. The residual amount of the grease on the measured surface is calculated according to formula (A.1):

$$P = \frac{W_1 - W}{A} \times \frac{B}{300} \qquad \text{……(A.1)}$$

Where:

P --- The residual amount of grease on the tested surface, in milligrams per square meter (mg/m^2);

W_1 --- The oil content of carbon tetrachloride used for cleaning the surface of the steel pipe, in milligrams (mg);

W --- The oil content of carbon tetrachloride reagent, in milligrams (mg);

A --- The cleaned area, in square meters (m^2);

B --- The amount of carbon tetrachloride used for cleaning, in milliliters (mL).

A.2.3.3 Test for the residual oil amount on the wiping cloth: for the parts that are inconvenient to be cleaned, use a tweezer to clip an oil-free and clean cloth to absorb a certain amount of carbon tetrachloride, and wipe the surface of the steel pipe; the wiped area is the same as the cleaned area. After wiping, squeeze out the carbon tetrachloride from the cloth, and filter the carbon tetrachloride with medium-speed qualitative filter paper into a weight-known beaker until it reaches 300 mL. Place the beaker in an (85±5) °C water bath to make the carbon tetrachloride volatilize. When seeing that the carbon tetrachloride in the beaker has volatilized, put the beaker into a (50±5) °C incubator to dry for 30 min, then put it into a desiccator to cool for 30 min; weigh the

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