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High-pressure seamless steel tubes for diesel engine

柴油机用高压无缝钢管

(ISO 8535-1:2016, Diesel engines - Steel tubes for high-pressure fuel injection pipes - Part 1: Requirements for seamless cold-drawn single-wall tubes, NEQ)

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High-pressure seamless steel tubes for diesel engine

1 Scope

This document specifies the classification and code, order content, size, shape, weight and allowable deviation, technical requirements, test methods, inspection rules, packaging, marking and quality certificates of high-pressure seamless steel tubes for diesel engine.

This document applies to cold-drawn (rolled) seamless steel tubes (hereinafter referred to as "steel tubes") which are used for the manufacture of high-pressure oil tubes of the diesel engine injection system.

2 Normative references

The contents of the following documents constitute the indispensable clauses of this document through normative references in the text. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

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

GB/T 223.5, Steel and iron - Determination of acid-soluble silicon and total silicon content - Reduced molybdenosilicate spectrophotometric method

GB/T 223.9, Iron, steel and alloy - Determination of aluminium content - Chrom azurol S photometric method

GB/T 223.12, Methods for chemical analysis of iron, steel and alloy - The sodium carbonate separation-diphenyl carbazide photometric method for the determination of chromium content

GB/T 223.14, Methods for chemical analysis of iron, steel and alloy - The N-benzoyl-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content

GB/T 223.23, Iron, steel and alloy - Determination of nickel content - The dimethylglyoxime spectrophotometric method

GB/T 223.26, Iron, steel and alloy - Determination of molybdenum content - The thiocyanate spectrophotometric 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)

GB/T 20124, Steel and iron - Determination of nitrogen content - Thermal conductimetric method after fusion in a current of inert gas

GB/T 20125, Low-alloy steel - Determination of multi-element contents - Inductively coupled plasma atomic emission spectrometric method

GB/T 30062, Terminology of steel pipes and tubes

YB/T 5293, Metallic materials - Forging test

3 Terms and definitions

Terms and definitions determined by GB/T 30062 are applicable to this document.

4 Classification and code

4.1 The steel tubes are classified as follows according to their use:

- a) Class A: for diesel engines and maintenance tubing of general requirements;
- b) Class B: for diesel engines of high-precision requirements;
- c) Class C: for diesel engine injection pump test bench or other special requirements.

4.2 The classification and code of steel tubes, according to dimensional accuracy, are as follows:

- a) Ordinary grade PA;
- b) Higher grade PC.

4.3 When steel tubes are delivered according to their performance codes, they are divided into 1 ~ 6, a total of 6 classes (see Table 5).

of the fixed length of the steel tube is ${}^{+15}_0$ mm; each incision of the double length shall have a margin of 5 mm ~ 10 mm.

6.4 Bending

The steel tube shall have practical straightness; its bending shall not be greater than 1.0 mm/400mm; there shall be no local deformation.

6.5 End shape

The end faces of both ends of the steel tube shall be perpendicular to the axis of the steel tube; the cut burrs shall be removed.

6.6 Weight

6.6.1 Steel tubes can be delivered according to the actual weight or the theoretical weight. The theoretical weight per meter of steel tube is calculated according to GB/T 17395 (the density of steel is 7.85 kg/dm³).

6.6.2 According to the requirements of the buyer, if it is negotiated between the supplier and the buyer, and indicated in the contract, the allowable deviation between the actual weight and the theoretical weight of the delivered steel tube is:

- a) Single steel tube: $\pm 10\%$;
- b) Each batch of steel tubes with a minimum of 10t: $\pm 7.5\%$.

6.7 Example of designation

Example 1: The steel tube, of which the performance is grade 2, the outer diameter is 6 mm, the inner diameter is 2 mm, the use is class B, of ordinary precision, and is delivered in normal length, is marked as:

2-D6×d2-PA-B-PA-GB/T 3093-2021

Example 2: The steel tube, of which the designation is Q355NE, the outer diameter is 10 mm, the inner diameter is 3 mm, the use is class C, of high-grade precision, and is delivered in normal length, is marked as:

Q355NE-D10×d3-C-PC-GB/T 3093-2021

7 Technical requirements

7.1 Designation and chemical composition

7.6.1 The steel tubes shall be subjected to a hydraulic test one by one. The test pressure is calculated according to Formula (1); the maximum test pressure is 20 MPa. Under the test pressure, the voltage stabilization time shall be no less than 5 s; the steel tube shall not leak.

$$p = 2SR/D \quad \dots\dots\dots (1)$$

Where:

p – test pressure, in megapascals (MPa);

S – calculated wall thickness of the steel tube, in millimeters (mm);

R – allowable stress, which is 60% of the upper yield strength that is specified in Table 4 and Table 5, in megapascals (MPa);

D – nominal outer diameter of the steel tube, in millimeters (mm).

7.6.2 The supplier may use eddy current testing to replace the hydraulic test. In eddy current testing, the acceptance grade shall meet the requirements of E4H or E4 in GB/T 7735-2016.

7.7 Non-metallic inclusions

The non-metallic inclusions of steel tubes are graded according to the method A in GB/T 10561-2005; the fine and coarse grades of A, B, C, and D inclusions shall not be greater than 1.5 respectively.

7.8 Surface quality

There shall be no cracks, folds, breaks, delamination, scars, rust and scale on the inner and outer surfaces of the steel tube. These defects shall be completely removed; the actual wall thickness at the cleaning site shall not be less than 92% of the calculated wall thickness.

7.9 Inner surface cleanliness

The inner surface of the steel tube shall be clean; there shall be no impurities or coatings that affect the processing and use performance. Dry and clean compressed air of no less than 0.8 MPa shall be used to sweep the inner surface of the steel tube one by one. During acceptance, solid or liquid substances shall not be blown out.

8 Test method

8.1 Sampling for chemical composition analysis of steel tubes shall comply with the rules of GB/T 20066. For chemical composition analysis, usually comply

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