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Replace GB/T 9808—2008

Seamless steel tubes for drilling

钻探用无缝钢管

（*English Translation*）

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Foreword

SAC/TC 183 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This document is drafted in accordance with the rules given in the GB/T 1.1—2020 *Directives for standardization—Part 1: Rules for the structure and drafting of standardizing documents.*

This document replaces the GB/T 9808—2008 *Seamless steel tubes for drilling*. In addition to a number of editorial changes, the following technical deviations have been made with respect to the GB/T 9808—2008(the previous edition):

a) Add the terms and definitions (see Clause 3);

b) Delete the dimensions table of the steel tubes with the nominal outside diameter and nominal wall thickness(see Table 1 of 2008 Edition);

c) Revise the permissible variation in wall thickness of steel tube(see Table 2, Table 3 of 2008 Edition);

d) Revise the rang of random length, torlerance on cut-length and multiple lengths of steel tube (see 6.3.1 and 6.3.2.1, 5.3.1 and 5.3.2 of 2008 Edition);

e) Revise the requirements for the straightness of full length steel tube (see 6.4.2, 5.4.2 of 2008 Edition);

f) Revise the requirements for end shape of tube (see 6.7, 5.7 of 2008 Edition);

g) Revise the requirements for the permissible mass variation of single length steel tube (see 6.8.2, 5.8.2 of 2008 Edition);

h) Add the grades ZT750, ZT850 and ZT950, and delete the grades ZT540 and ZT740(see Table 5, 6.1.1 of 2008 Edition);

i) Revise the requirements for content of elements S and P(see Table 5, 6.1.2 of 2008 Edition);

j) Revise the steel-making process(see 7.2.1, 6.2.1 of 2008 Edition);

k) Revise the requirements for tube blank manufacturing process(see 7.2.2, 6.2.2 of 2008 Edition);

l) Delete the hot extrusion manufacturing method of steel tube(see 6.2.3 of 2008 Edition);

m) Add the requirements for tensile properties, impact properties, and Rockwell hardness of Grades ZT750, ZT850 and ZT950 (see 7.4.1 to 7.4.3);

n) Revise the tensile strength of grade ZT590, proof strength, the percentage elongation after fracture, and test piece requirements of ZT520(see Table 6, Table 6 of 2008 Edition);

o) Add the inspection frequency of dimensions, shapes and surface quality(see Table 8);

p) Revise the rules for test unit(see 9.2, 8.2 of 2008 Edition);

q) Revise the requirements for marking(see Clause 10, 9.1 of 2008 Edition).

Attention is drawn to the possibility that some of the element of this document may be the subject of patent rights. SAC shall not be held responsible for identifying any or all such patent rights.

This document was proposed by China Iron and Steel Association.

This document was prepared by SAC/TC 183 Technical Committee on Steel of Standardization Administration of China.

The document was issued in 1988 as first edition, was first revised in 2008, and this is the second revision.

Seamless steel tubes for drilling

1 Scope

This document specifies designation, ordering information, dimensions, shapes, masses, technical requirements, test methods, inspection rules, packing, marking and quality certification of the seamless steel tubes for drilling.

This document is applicable to steel tubes for making casing, core tubing and casing coupling, used in geological core drilling, water well drilling, hydro-geological drilling, and engineering drilling. This document is also applicable to steel tubes (hereinafter referred to as tube) for making ordinary drilling tube and joints, shot bit(calyx bit), wire-line coring drilling tube and drill rod joint, and drill collar and drill collar joints.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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 223.85, *Steel and iron—Determination of sulfur 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 230.1, *Metallic materials—Rockwell hardness test—Part 1: Test method*

GB/T 2102, *Acceptance, packaging, marking and quality certification of stee tubular products*

GB/T 2975, *Steel and steel products—Location and preparation of samples and test pieces for me-*

chanical testing

GB/T 4336,*Carbon and low-alloy steel—Determination of multi-element contents—Spark discharge atomic emission spectrometric method (routine method)*

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 9151,*Terms of drilling engineering*

GB/T 12606—2016,*Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections*

GB/T 16950,*Geological core drilling tools*

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 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 4149,*Continuously cast round billet for seamless steel tube rolling*

YB/T 5221,*Alloy structure steel round tube blank hot rolled and forged for making seamless tube*

3 Terms and definitions

For the purposes of this document, the terms and definitions give in GB/T 9151, GB/T 16950 and GB/T 30062 apply.

4 Designation

Steel grade shall be indicated with two parts: the first capital letters of the Chinese pinyin for "Zuan Tan"("ZT"), and the specified minimum proof strength (in MPa). For example: ZT490.

5 Ordering information

The purchase contract or order according to this document shall include the following information:

a) this document number;

b) name of product;

c) steel grade;

d) ordering quantity (total mass or total length);

e) delivery conditions;

f) dimensions;

g) special requirements.

6 Dimensions, shapes and masses

6.1 Outside diameter and wall thickness

The nominal diameter (D) and nominal wall thickness (S) of the steel tube shall comply with the requirements specified in GB/T 17395. If required by the purchaser and agreed between the supplier and purchaser, steel tube with dimensions not listed in GB/T 17395 may be supplied.

6.2 Permissible variation in outside diameter and wall thickness

6.2.1 The permissible variations in outside diameter of the steel tube shall comply with the requirements specified in Table 1.

Table 1—Permissible variations in outside diameter

In millimetres

Steel tube type	Permissible variations
Hot-rolled steel tube	$^{+1\%D}_{-0.5\%D}$ or $^{+0.65}_{-0.35}$, whichever is the greater
Cold-drawn or cold-rolled steel tube	$\pm 0.5\%D$ or ± 0.20, whichever is the greater

6.2.2 The permissible variation in wall thickness of the hot-rolled steel tube shall comply with the requirements specified in Table 2.

Table 2—Permissible variations in wall thickness of the hot-rolled steel tube

In millimetres

Steel tube type	Nominal wall thickness (S)	Permissible variations
Hot-rolled steel tube	≤10	$^{+12.5\%S}_{-10\%S}$
	>10	$\pm 10\%S$
Cold-drawn or cold-rolled steel tube	—	$\pm 8\%S$
NOTE "—"is used for "not applicable".		

6.2.3 If required by the purchaser, agreed between the supplier and purchaser, and specified in the contract, steel tube with the permissible variation not listed in Table 1 and Table 2 may be supplied.

6.3 Lengths

6.3.1 Random lengths

The random lengths of steel tube are 4 000 mm to 12 000 mm. If required by the purchaser, agreed between the supplier and purchaser, and specified in the contract, steel tube with a length greater than 12 000 mm may be supplied.

6.3.2 Cut-lengths and multiple lengths

6.3.3.1 If required by the purchaser, agreed between the supplier and purchaser, and specified in the contract, steel tube may be supplied in cut-lengths or multiple lengths. When the steel tube is delivered in cut-length or multiple lengths, the permissible variation in length is $^{+30}_{0}$ mm.

6.3.3.2 When the steel tube is delivered in multiple-lengths, each cutting allowance shall meet the following requirements:

a) For outside diameter ≤159 mm, 5 mm to 10 mm;

b) For outside diameter ＞159 mm，10 mm to 15 mm.

6.4 Straightness

6.4.1 The deviation from straightness per meter of the steel tube used for making wire-line coring drill rod shall not exceed 1.0 mm，and the straightness per meter of other steel tube shall comply with the requirements specified in Table 3.

Table 3—Straightness over any one meter length of steel tube

In millimetres

Nominal wall thickness（*S*）	Deviation from straightness
≤15	≤1.5
＞15	≤2.0

6.4.2 The full length straightness of the steel tube used for making geological core drilling tube shall not exceed 0.1% of the total length，and the full length straightness of other steel tube shall not exceed 0.15% of the total length.

6.5 Out-of-Roundness and unevenness in wall thickness

If required by the purchaser，agreed between the supplier and purchaser，and specified in the contract，the out-of-roundness and unevenness in wall thickness of the steel tube shall not exceed 80% of the outside diameter tolerance and the wall thickness tolerance respectively.

6.6 Drift requirements

If required by the purchaser，agreed between the supplier and purchaser，and specified in the contract，the steel tube used for making wire-line coring drill rod may be drift-tested throughout its entire length. Drift dimensions shall comply with the requirements specified in Table 4，and the drift shall pass freely through the tube.

Table 4—Drift dimensions

In millimetres

Diameter of drift	Length of drift
$d^{a}-1.0$	300
[a] *d* is the inside diameter of steel tube，which is the nominal outside diameter minus twice the nominal wall thickness of steel tube.	

6.7 End shape

The both end faces of tubes shall be perpendicular to the axis of tubes, and all burrs at the ends shall be removed.

6.8 Masses

6.8.1 Steel tube may be delivered by either actual mass or theoretical mass. The theoretical mass of the steel tube shall be calculated according to GB/T 17395, the density of the steel is defined as 7.85 kg/dm^3.

6.8.2 If required by the purchaser, agreed between the supplier and purchaser, and specified in the contract, the deviation between the theoretical mass and the actual mass of the steel tube delivered shall meet the following requirements:

a) Single length: $^{+10\%}_{-3.5\%}$;

b) Steel tubes with a minimum mass of 10 t per unit: ±7.5%.

7 Technical requirements

7.1 Grades and chemical composition

7.1.1 The grades and chemical composition (heat analysis) of the steel shall comply with the requirements specified in Table 5.

Table 5—Grades and chemical composition

No.	Grade	Chemical composition(mass fraction) %	
		P	S
1	ZT380	≤0.025	≤0.020
2	ZT490		
3	ZT520		
4	ZT590	≤0.020	≤0.015
5	ZT640		
6	ZT750		
7	ZT850		
8	ZT950		

7.1.2 If product analysis required by purchaser, it shall be so stated in the contract. The permissible variations of the product analysis for the steel tube shall comply with the requirements specified in GB/T 222.

7.2 Manufacturing method

7.2.1 Steel-making process

7.2.1.1 The steel shall be made by electric arc furnace and external refining or oxygen converter and external refining.

7.2.1.2 When agreed between the supplier and the purchaser, other steel-making process may also be used. If a certain melting method is required by the purchaser, it shall be specified in the contract.

7.2.2 Blank manufacturing process

The blanks for the steel tube may be manufactured by continuous casting, hot rolling or hot forging. The continuous casting tube billet shall meet the requirements specified in YB/T 4149. The hot rolled or hot forged blanks shall meet the requirements specified in YB/T 5221.

7.2.3 Steel tube manufacturing process

The steel tube shall be manufactured by a seamless process through hot rolling ,or cold drawing or cold rolling. When a specific steel tube manufacturing process is required by purchaser, it shall be specified in the contract.

7.3 Delivery conditions

The hot-rolled steel tube shall be delivered in the condition of hot rolling or heat treatment.

When heat treatment is required by purchaser,It shall be specified in the contract. The cold-drawn or cold-rolled steel tube shall be delivered in the condition of heat treatments.

7.4 Mechanical properties

7.4.1 Tensile properties

The longitudinal tensile properties at room temperature of the steel tube in delivery condition shall comply with the requirements specified in Table 6.

Table 6—Mechanical properties of steel tube

No.	Grade	Proof strength $R_{p0.2}$ MPa	Tensile strength R_m MPa	Elongation after fracture A %	Impact absorbed energy KV_2 J	Rockwell hardness[a] HRC
		Min.				Max.
1	ZT380	380	640	14	—	—
2	ZT490	490	690	12	—	—
3	ZT520	520	780	12	—	—
4	ZT590	590	780	12	—	—
5	ZT640	640	790	12	—	—
6	ZT750	750	850	14	54	34
7	ZT850	850	950	14	54	36
8	ZT950	950	1050	13	54	38

NOTE "—"is used for "not applicable".

[a] If required by the purchaser, agreed between the supplier and purchaser, and specified in the contract, other Rockwell hardness values may be specified.

7.4.2 Impact properties

7.4.2.1 For grade ZT750, ZT850, and ZT950, the steel tube with outside diameter not less than 70 mm and wall thickness not less than 6.5 mm, the longitudinal Charpy V-notch impact test at room temperature shall be carried out. The absorbed energy of the impact test shall comply with Table 6. The absorbed energy is calculated from the arithmetic average value of a set of three test pieces. One individual value may be below the specified value, but no less than 70% of that value.

7.4.2.2 If required by the purchaser, agreed between the supplier and purchaser, and specified in the contract, the longitudinal Charpy V-notch impact test at room temperature may aslo be carried out for the steel tubes other than those required in 7.4.2.1. The impact absorbed energy shall be agreed by both parties.

7.4.2.3 When limited by the dimensions of steel tube, sub-sized test piece may be prepared instead of full size ones. When sub-sized test piece is used, the minimum Charpy V-notch impact absorbed energy requirement for subsize test piece shall be that specified for a standard test piece multiplied by the reduction factor listed in Table 7. The larger possible sized test piece shall be preferred.

Table 7—Absorbed energy reduction factor of sub-size impact specimens

Test piece size	Specimen dimensions (width × thickness) mm	Reduction factor
Full-sized	10×10	1
Sub-sized	10×7.5	0.75
Sub-sized	10×5	0.5
Sub-sized	10×2.5	0.25

7.4.3 Hardness

7.4.3.1 For grade ZT750, ZT850, and ZT950, when the nominal wall thickness of steel tube is less than 7.62 mm, Rockwell hardness test shall be carried out by measuring 3 indentations in the mid-wall of the specimen. When the nominal wall thickness is not less than 7.62 mm, Rockwell hardness test shall be carried out by measuring 3 indentations, near the inside-wall, at mid-wall and near the outside-wall of the transverse(cross section) of the specimen. The Rockwell hardness values for each location shall comply with the requirements in Table 6.

7.4.3.2 Indentations near the outside-wall and inside-wall surfaces shall be 2.5 mm to 3.8 mm from the applicable surfaces, the indentation center is not closer 2.5 indentation diameters from the edge of the surface. the indentation centers shall not be closer 3 the indentation center from each other, alternate spacing of rows may be permitted.

7.5 Surface quality

The internal and external surfaces of the steel tube shall be free of cracks, laps, scabs, rolling wrinkles,and abscission layers. These defects shall be completely removed, and the removal depth shall not exceed 10% of the nominal wall thickness. The actual wall thickness in the dressed area shall be not less than the permitted minimum wall thickness. Other local imperfections not exceeding the lower limit of wall thickness are permissible.

7.6 Non-destructive testing

The supplier shall apply one of the test methods of eddy current testing,flux leakage testing, or ultrasonic testing to conduct non-destructive testing for steel tube. When eddy current testing is carried out according to the requirements specified in GB/T 7735—2016, the acceptance level is E3H or E3. When magnetic flux leakage testing is carried out according to the requirements specified in GB/T 12606—2016, the acceptance level is F3. When ultrasonic testing is carried out according to the requirements specified in GB/T 5777—2019, the acceptance level is U2.5 for cold-drawn or cold-rolled steel tube and U3 for hot-rolled steel tube.

8 Test methods

8.1 The sampling of the chemical composition of the steel tube shall comply with GB/T 20066. Chemical analysis is usually conducted according to GB/T 4336, GB/T 20123 and GB/T 20125 or other general methods. In case of arbitration, the analysis shall be conducted according to the requirements in GB/T 223.59, GB/T 223.85 and GB/T 20125.

8.2 The dimensions and shapes of the steel tube shall be measured using tools that meet the requirements for accuracy.

8.3 The internal and external surfaces of the steel tube shall be visually inspected under sufficient illumination.

8.4 The sampling method and test method for test items of the steel tube shall comply with the requirements specified in Table 8.

Table 8—Test Items, sampling quantities, sampling methods and test methods

No.	Test items	Sampling quantity	Sampling method	Test method
1	Chemical composition	One per heat	GB/T 20066	See 8.1
2	Tensile test	Two from different tubes per test unit	GB/T 2975	GB/T 228.1
3	Impact test	A set of three test pieces from each one of two steel tubes per test unit	GB/T 2975	GB/T 229
4	Hardness	Two from different tubes per test unit	GB/T 230.1	GB/T 230.1
5	Eddy current testing	Each tube	—	GB/T 7735—2016
6	Magnetic flux leakage testing	Each tube	—	GB/T 12606—2016
7	Ultrasonic testing	Each tube	—	GB/T 5777—2019
8	Dimensions and shapes	At least once per 4 h per operating shift plus whenever any change of tube size occurs during the operating shift	—	See 8.2
9	Surface quality	Each tube	—	See 8.3
NOTE "—"is used for "not applicable".				

9 Inspection rules

9.1 Inspection and acceptance

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

9.2 Test unit

9.2.1 Steel tube shall be checked and accepted by test unit. Each test unit consist of steel tubes of same grade, same heat number, same dimensions and is subjected to the same heat treatment (if applicable). The quantity of each test unit shall not exceed the following requirements:

a) 400 pcs for steel tubes with the outside diameter not greater than 76 mm and the wall thickness not greater than 3 mm;

b) 200 pcs for steel tubes with other dimensions.

9.2.2 If the steel tube is cut into individual lengths and not followed by heat treatment, all sections of the tube rolled from the same billet shall be regarded as one piece.

9.3 Sampling quantity

The sampling quantities for various test items of the steel tube shall comply with the requirements specified in Table 8.

9.4 Re-testing and assessment rules

The rules for re-testing and assessment of the steel tube shall comply with the requirements in GB/T 2102.

10 Packing, marking and quality certificate

The packing, marking and quality certificate of the steel tubes shall comply with GB/T 2102.