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Replacing GB 6479-2000

Seamless Steel Tubes for High-Pressure Chemical Fertilizer Equipments

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Table of Contents

Foreword

In this Standard, 4.4, 4.6, 5.1, 5.2, 5.3, 5.4.1, 5.4.2, 5.4.4, 5.4.5, 5.5, 5.6.1, 5.7, 5.8.1, 5.9, 5.10.1, clauses 6~8 are mandatory; the rest are recommendatory.

This Standard is drafted according to the requirements of GB/T 1.1-2009.

This Standard replaces GB 6479-2000 *Seamless Steel Tubes for High-Pressure Chemical Fertilizer Equipments*. Compared with GB 6479-2000, besides editorial changes, this Standard has the main technical changes as follows:

— Normative references are adjusted and added;

— Order contents are added;

— Allowable deviation of outer-diameter and wall-thickness of steel tube is modified;

— Allowable length deviation is modified;

— The requirement of flexibility along the full length is added;

— The requirements of out-of-roundness and wall unevenness are added;

— Designation and chemical composition are modified;

— Manufacturing methods are modified;

— Mechanical properties are modified;

— The requirements of flattening test are modified;

— Nonmetallic inclusion test requirements are modified;

— Non-destructive inspection requirements are modified.

This Standard was proposed by China Iron and Steel Association.

This Standard shall be under the jurisdiction of the National Technical Committee on Iron and Steel of Standardization Administration of China (SAC/TC 183).

Drafting organizations of this Standard: Angang Steel Company Limited, Ansteel Chengdu Steel-Vanadium Co., Ltd., Hunan Hualing steel pipe Holding Co., Ltd., Zhejiang University of Technology Chemical Equipment Co., Ltd., Hengyang Valin Steel Tube Co. Ltd. AND Jiangsu Valin-Xigang Special Steel Co., Ltd.

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Seamless Steel Tubes for High-Pressure Chemical Fertilizer Equipments

1 Scope

This Standard specifies seamless steel tubes for high-pressure for chemical fertilizer equipment in terms of dimension, shape, weight, technical requirements, test methods, inspection rules, packaging, marking and quality certificate, etc.

This Standard is applicable to seamless steel tube for high-pressure chemical fertilizers equipment and pipeline or the ones for other chemical equipment.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated reference, only the edition cited applies. For undated reference, the latest edition of the normative document (including any amendments) applies.

GB/T 222 Permissible Tolerances for Chemical Composition of Steel Products

GB/T 223.3 Methods for Chemical Analysis of Iron, Steel and Alloy - The Diantipyrylmethane Phosphomolybdate Gravimetric Method for the Determination of Phosphorus Content

GB/T 223. 5 Steel and Iron - Determination of Acid-soluble Silicon and Total Silicon Content - Reduced Molybdosilicate Spectrophotometric Method

GB/T 223.11 Iron Steel and Alloy - Determination of Chromium Content - Visual Titration or Potentiometric Titration 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-benzoy-N-phenylhydroxylamine Extraction Photometric Method for the Determination of Vanadium Content

GB/T 223.18 Methods for Chemical Analysis of Iron, Steel and Alloy - The

	Sodium Thiosulfate Separation Iodimetric Method for the Determination of Copper Content
GB/T 223.19	Methods for Chemical Analysis of Iron, Steel and Alloy - The Neocuproine-chloroform Extraction Photometric Method for the Determination of Copper 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 223. 37	Methods for Chemical Analysis of Iron, Steel and Alloy - The Indophenal Blue Photometric Methods for the Determination of Nitrogen Content after Distillation Separation
GB/T 223. 40	Iron, Steel and Alloy Determination of Niobium Content by the Sulphochlorophenol S Spectrophotometric Method
GB/T 223. 43	Iron, Steel and Alloy - Determination of Tungsten Content - Gravimetric Method and Spectrophotometric Method
GB/T 223. 54	Methods for Chemical Analysis of Iron, Steel and Alloy - The Flame Atomic Absorption Spectrophotometric Method for the Determination of Nickel Content
GB/T 223. 58	Methods for Chemical Analysis of Iron, Steel and Alloy - The Sodium Arsenite-sodium Nitrite Titrimetric Method for the Determination of Manganese Content
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. 61	Methods for Chemical Analysis of Iron, Steel and Alloy - The Ammonium Phosphomolybdate Volumetric Method for the Determination of Phosphorus Content
GB/T 223. 62	Methods for Chemical Analysis of Iron, Steel and Alloy - The Butyl Acetate Extraction Photometric Method for the Determination of

	Phosphorus 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. 64	Iron Steel and Alloy- Determination of Manganese Content - Flame Atomic Absorption Spectrometric Method
GB/T 223.68	GB/T 223.72 Methods for Chemical Analysis of Iron, Steel and Alloy - The Potassium Iodate Titration Method after Combustion in the Pipe Furnace for the Determination of Sulfur Content
GB/T 223. 69	Iron Steel and Alloy - Determination of Carbon Contents - Gas-volumetric Method after Combustion in the Pipe Furnace
GB/T 223. 71	Methods for Chemical Analysis of Iron, Steel and Alloy - The Gravimetric Method after Combustion in the Pipe Furnace for the Determination of Carbon Content
GB/T 223.72	Iron Steel and Alloy - Determination of Sulfur Content - Gravimetric Method
GB/T 223. 74	Methods for Chemical Analysis of Iron, Steel and Alloy - The Combustion Gravimetric/gas-volumetric Method for the Determination of Combined Carbon Content
GB/T 226	Etch Test for Macrostructure and Defect of Steels
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	Metallic Pipe - Hydraulic Test Method
GB/T 242	Metal Materials – Tube - Drift-expending Test
GB/T 246	Metallic materials – Tube - Flattening test
GB/T 1979	Standard Diagrams for Macrostructure and Defect of Structural Steels
GB/T 2102	Acceptance, Packing, Marking and Quality Certification of Steel Pipe
GB/T 2975	Steel and Steel Products - Location and Preparation of Test

	Pieces for Mechanical Testing
GB/T 4336	Standard Test Method for Spark Discharge Atomic Emission Spectrometric Analysis of Carbon and Low-alloy Steel (Routine Method)
GB/T 5777-2880	Seamless Steel Pipe and Tubing Methods for Ultrasonic Testing
GB/T 7735-2004	Steel Tubes - The Inspection Method on Eddy Current Test
GB/T 10561-2005	Steel Determination of Content of Nonmetallic Inclusions Micrographic Method using Standards Diagrams
GB/T 12606-1999	Steel Tubes - The Testing Method of Magnetic Flux Leakage
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 (Routine Method)
GB/T 20125	Low-alloy Steel - Determination of Multi-element Contents - Inductively Coupled Plasma Atomic Emission Spectrometric Method
GB/T 4149	Continuously Cast Round Billet for Seamless Steel Tube Rolling
GB/T 5137	Round Blank of Hot-rolled and Forged Seamless Steel Tube for High Pressure

3 Order

For the purpose of this Standard, the order contract or order form shall include the following information:

a) Standard No.;

Table 3 Curvature of Steel Tubes

Nominal wall-thickness of steel tube /mm	Curvature per meter / (mm/m)
≤15	≤1.5
>15~30	≤2.0
>30 or D≥351	≤3.0

4.4.2 The curvature of steel tubes along full length shall not be greater than 0.15% of the full length.

4.5 Out-of-roundness and wall unevenness

As required by the Buyer, based on the agreement of both Seller and Buyer and also indicated in the contract, the out-of-roundness and wall unevenness of steel tubes shall not exceed 80% of the tolerance of outer-diameter and wall-thickness respectively.

4.6 End shape

The surface of both ends of steel tube shall be vertical to the axis and the cutting burrs shall be cleared away.

4.7 Delivery weight

4.7.1 The steel tubes shall be delivered according to their actual weight or may be delivered according to the theoretical weight; the calculation of the theoretical weight of steel tubes shall be in accordance with those specified in GB/T 17395; the steel density shall be 7.85kg/dm^3.

4.7.2 Based on the agreement of both Seller and Buyer, deviation of actual weight from theoretical weight in the delivery shall meet the following requirements as required by the Buyer and indicated in the contract:

a) Single steel tube: ±10%;

b) Steel tubes of minimum 10t in each batch: ±7.5%.

5 Technical Requirements

5.1 Designation and chemical composition

5.1.1 Designation and chemical composition (melting analysis) of steel shall be in accordance with those specified in Table 4. The steel tubes are accepted based on the smelting composition.

tubes shall be in accordance with those specified in GB/T 222.

5.2 Manufacturing method

5.2.1 Manufacturing method of steel

The steel shall be treated by electric arc furnace and external refining with vacuum refining or oxygen converter and external refining with vacuum refining or smelted by electroslag remelting process.

Based on the agreement of both Seller and Buyer and as indicated in the contract, other highly required smelting method may be adopted. The smelting method indicated by the Buyer shall be stated in the contract.

5.2.2 Manufacturing method of tube blank

The tube blank may be manufactured by continuous casting, die casting or heat rolling (forging). The continuous casting tube blank shall meet the requirements of YB/T 4149, in which the Grade 1 or less center crack, subsurface crack and subsurface bubble is allowed for the macroscopic structure defects or other ones with higher quality requirements approved by relevant parties may also be adopted. The hot-rolled (forged) tube blank shall meet the requirements of YB/T 5137. The die casting pipe blank (steel ingot) may refer to the hot rolled (forged) ones.

5.2.3 Manufacturing method of steel tubes

The steel tube shall be made with hot rolled (squeezed and extended) or cold-drawn (rolled) seamless methods. The method designated by the Buyer shall be indicated in the contract.

5.3 Delivery state

The steel tubes shall be delivered in heat treatment state. The heat treating system shall be in accordance with those specified in Table 6 and shall be filled in the quality certificate.

Table 6 Heat Treatment System of Steel Tubes

S/N	Designations	Heat treatment system
1	10[a]	880°C~940°C normalizing
2	20[a, b, c]	880°C~940°C normalizing
3	Q345B[a, b]	880°C~940°C normalizing
4	Q345C[a, b]	880°C~940°C normalizing
5	Q345E[b, c]	880°C~940°C normalizing
6	Q345E[b, c]	880°C~940°C normalizing
7	12CrMo	900°C~960 °C normalizing, 670°C~730°C tempering

5	Q345D	490~670	345	335	325	21	19	-	-20	40	27
6	Q345E	490~670	345	335	325	21	19	-	-40	40	27
7	12CrMo	410~560	205	195	185	21	19	-	20	40	27
8	15CrMo	440~640	295	285	275	21	19	-	20	40	27
9	12Cr2Mo[a]	450~600	280			20	18	-	20	40	27
10	12Cr5Mo	390~590	195	185	175	22	20	-	20	40	27
11	10MoWVNb	470~670	295	285	275	19	17	-	20	40	27
12	12SiMoVNb	≥470	315	305	295	19	17	50	20	40	27
[a] For 12Cr2Mo steel tubes, lower yield strength or specified plastic elongation strength may be reduced by 10MPa (D≤30mm and S≤3mm).											

5.4.2 The impact absorbed energy in Table 7 is the required value of Charpy V-notch of specimen of standard dimension. Where the small-dimension impact specimen is adopted, the required value for impact absorbed energy of Charpy V-notch shall be the required impact absorbed energy of specimen of standard dimension multiplied by the decline factor in Table 8.

Table 8 Impact Absorbed Energy Decline Factor of Small-Dimension Specimen

Sample specification	Sample size (height × width)/mm	Decline factor
Standard	10×10	1.00
Small	10×7.5	0.75
Small	10×5	0.50

5.4.3 As required by the Buyer, based on the agreement of both Seller and Buyer and indicated in the contract, test temperature and impact absorbed energy of Charpy V-notch impact test of 10 and 20 steel tubes shall meet those specified in Table 9.

Table 9 Low-Temperature Impact Property

Designation	Test temperature /°C	Sample direction	Impact absorbed energy (kv_2)/j	
			Sample size (height × width) /mm	
			10×10	10×5
10	-20	Longitudinal	≥18	≥12
	-30		negotiated	negotiated
20	-20		≥18	≥12

5.4.4 The steel tubes with outer-diameter of less than 219 mm shall be sampled longitudinally along the steel tubes in the tensile test.

If the steel tube has an outer-diameter not less than 219mm, a 10 mm-diameter circular cross-section sample shall be taken in a horizontal direction along the tubes

for the tensile test where allowed by the size of the steel tube; if it is not long enough to take a 10mm-diameter sample, whichever the larger size from a 8mm-diameter or 5mm-diameter circular cross-section samples shall be adopted; where it is not long enough for a 5mm-diameter sample, the sampling shall be taken along the tubes longitudinally for the tensile test. The horizontal circular cross-section sample shall take from the test portion which has not been flattened.

5.4.5 The sample for the steel tubes having an outer-diameter less than 219mm shall be taken along the steel tube longitudinally or horizontally in the impact test; if no special provisions are indicated in the contract, the arbitration sample shall be taken along the steel tubes longitudinally.

The steel tubes having an outer-diameter not less than 219 mm shall be sampled horizontally along the steel tubes in the impact test.

The impact sample width shall be the larger one, where possible, of 10mm, 7.5 mm or 5 mm no matter which direction the steel pipes are sampled, longitudinally or horizontally.

5.5 Hydraulic test

5.5.1 The steel tube shall be subjected to the hydraulic test one by one; the test pressure shall be calculated according to Equation (2). The maximum test pressure is 20MPa; pressure stabilization time is not less than 10s. Under the test pressure, the steel tube shall be without leakage.

$$p=2SR/D \tag{2}$$

Where,

p — the test pressure, MPa; where P is less than 7MPa, it shall be rounded to 0.5MPa; where P is greater than or equal to 7MPa, it shall be rounded to 1MPa;

S — the nominal wall-thickness of steel tube, mm;

R — the allowable stress, which is 80% of the lower yield strength or specified plastic elongation strength specified in Table 7, MPa;

D — the nominal outer-diameter of steel tube, mm.

5.5.2 The Seller may use an eddy current inspection or a magnetic flux leakage testing to replace the hydraulic test. Where the eddy current inspection is adopted, the artificial defects on contrast tubes shall meet the requirements of acceptance level A in GB/T 7735-2004; where the magnetic flux leakage testing is adopted, the longitudinal notch groove in the external surface of the contrast tubes shall meet acceptance level L4 in GB/T 12606-1999.

a) Cold-drawn (rolled) steel tube: ≤ 4% of wall-thickness and the maximum depth of 0.2mm;

b) Hot-rolled (squeezed and extended) steel tube: ≤ 5% of wall-thickness and maximum depth of 0.4mm.

5.9.3 Defects at some parts not exceeding negative deviation of wall-thickness are allowable.

5.10 Nondestructive examination

5.10.1 Steel tube shall be subjected to ultrasonic inspection examination one by one according to GB/T 5777-2008. The longitudinal slot depth of contrast tubes follows L2 for cold-drawn (rolled) steel tubes or L2.5 for hot-rolled (squeeze and extended) ones.

5.10.2 When the ratio (S/D) of steel tubes is greater than 0.2, unless otherwise stated in the contract, the depth of artificial defect on the steel tube inner wall is according to GB/T 5777-2008, C.1.

5.10.3 Based on the agreement of both Seller and Buyer, other non-destructive examinations may be carried out additionally.

6 Test Methods

6.1 The dimension and shape of steel tube shall be measured by the measuring tool in conformity with accuracy requirement.

6.2 Internal and external surfaces of steel tube shall be subjected to visible examination in the abundant illuminating condition.

6.3 Sampling method and test methods for inspection items of steel tube shall be in accordance with those specified in Table 11.

c) 200 pieces, for other dimensions.

If the steel tube will not be heat treated after being cut into single sticks, then all the tube segments cut off from a stick of tube blank rolled steel tube may be taken as one stick of steel tube.

If the amount of residual steel tubes is not less than the 50% the aforementioned one, they are grouped into a batch separately. Otherwise they may be grouped into a batch with the same designation, furnace No. and specification.

7.3 Sampling quantity

Sampling quantity of each batch of steel tubes shall be selected according to those specified in Table 11 for each examination.

7.4 Re-inspection and judgment rules

The re-inspection and decision rules of steel tubes shall meet those specified in GB/T 2102.

8 Packaging, Marking and Quality Certificate

The packaging, marking and quality certificate of steel tubes shall meet those specified in GB/T 2102.

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