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Seamless steel tubes for large capacity gas cylinder

大容积气瓶用无缝钢管

(*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 GB/T 28884—2012 *Seamless steel tubes for large capacity gas cylinder* in whole. In addition to structural adjustment and editorial changes, the following technical deviations have been made with respect to the GB/T 28884—2012.

a) Revise the scope (see Clause 1, Clause 1 of 2012 Edition);

b) Revise the range of tube dimensions (see 5.1.2, 4.1.2 of 2012 Edition);

c) Add the requirements of advanced tolerance class of tube wall thickness (see 5.1.3);

d) Revise the linear tolerance to straightness(see 5.3, 4.3 of 2012 Edition);

e) Revise the requirements of end shape (see 5.5, 4.5 of 2012 Edition);

f) Revise the requirements of chemical composition (see 6.1.1, 5.1.1 of 2012 Edition);

g) Add the method and requirements of tube blank manufacturing (see 6.2.2);

h) Revise the delivery conditions of steel tube (see 6.3, 5.3 of 2012 Edition);

i) Revise the requirements of mechanical property of steel tube (see 6.4.1, 5.4.1 of 2012 Edition);

j) Revise the requirements of nonmetallic inclusions (see 6.5, 5.5 of 2012 Edition);

k) Revise the requirements of grain size (see 6.6, 5.6 of 2012 Edition);

l) Add the requirements of surface roughness (see 6.8);

m) Add the requirements of untested areas by automated ultrasonic thickness testing (see 6.9);

n) Revise the requirements of nondestructive testing (see 6.10, 5.9 of 2012 Edition);

o） Add automated ultrasonic thickness testing method（see Table 5）；

p） Revise the quantity of each test unit（see 8.2，7.2 of 2012 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 first issued in 2012，and this is the first revision.

Seamless steel tubes for large capacity gas cylinder

1 Scope

This document specifies ordering information, dimensions, shapes, masses, tolerances, technical requirements, test methods, inspection rules, packaging, marking and quality certification of seamless steel tubes for large capacity gas cylinder.

This document is applicable to seamless steel tubes (hereinafter referred to as tube) used for the gas cylinders with capacity from 150 L to 4 500 L. It is also applicable for reference to the tubes used for cylinder vessels or other capacity gas cylinders.

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 223.5, *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 223.14, *Methods for chemical analysis of iron, steel and alloy—The N-benzoy-N-phenylhydroxylamine extration photometric method for the determination of vanadium 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 spec-*

trophotometric method

GB/T 223.29，*Iron，steel and alloy—Determination of lead content—Carrier precipitation-xylenol orange spectrophotometric method*

GB/T 223.30，*Methods for chemical analysis of iron，steel and alloy—The arsenazo Ⅲ spectrophotometric method for the determination of zirconium content after separation by p-bromomandelic acid*

GB/T 223.31，*Iron，steel and alloy—Determination of arsenic content—Distillation-molybdenum blue spectrophotometric method*

GB/T 223.37，*Iron，steel and alloy—Determination of nitrogen content—Indophenol blue spectrophotometric method after distillation separation*

GB/T 223.40，*Iron，steel and alloy—Determination of niobium content—The sulphochlorophenol S spectrophotometric method*

GB/T 223.47，*Methods for chemical analysis of iron，steel and alloy—The carrier precipitation-molybdenum blue photometric method for the determination of antimony content*

GB/T 223.50，*Methods for chemical analysis of iron，steel and alloy—The phenylfluorone-CTMAB direct photometric method for the determination of tin content*

GB/T 223.59，*Iron，steel and alloy—Determination of phosphorus content—Bismuthphosphomolybdate blue spectrophotometric method and antimony phosphomolybdate blue spectrophotometric method*

GB/T 223.63，*Iron，steel and alloy—Determination of manganese content—Sodium（potassium）periodate spectrophotometric method*

GB/T 223.78，*Methods for chemical analysis of iron，steel and alloy—Curcumin spectrophotometric method for the determination of boron content*

GB/T 223.80，*Iron，steel and alloy—Determination of trace bismuth and arsenic contents—Hydride generation-atomic fluorescence spectrometric method*

GB/T 223.82，*Steel and iron—Determination of hydrogen content—Thermal conductivity/ infrared method after fusion under inert gas*

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 231.1，*Metallic materials—Brinell hardness test—Part 1：Test method*

GB/T 2102，*Acceptance，packing，marking and quality certification for steel tubular products*

GB/T 2975，*Steel and steel products—Location and preparation of samples and test pieces for mechanical 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，*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 6394，*Determination of estimating the average grain size of metal*

GB/T 10561—2023，*Determination of content of nonmetallic inclusions in steel—Micrographic method using standard diagrams*

GB/T 11261，*Steel and iron—Determination of oxygen content—The pulse heating inert gas fusion-infra-red absorption 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（Routine method）*

GB/T 30062，*Terminology of steel pipes and tubes*

GB/T 32552，*Automated full peripheral ultrasonic thickness testing of seamless and welded（except submerged arc-welded）steel tubes*

NB/T 47013.3，*Nondestructive testing of pressure equipments Part 3：Ultrasonic testing*

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

YB/T 4307，*Iron，steel and alloy—Determination of oxygen，nitrogen and hydrogen contents—TOF-mass spectroscopy method after fusion in a current of inert gas（Routine method）*

YB/T 5137，*Hot rolled and wrought round blank for high-pressure seamless steel tube*

3 Terms and definitions

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

4 Ordering information

The purchase contract or order according to this document shall include but not limited to the following information：

a） this document number；

b） name of product；

c） steel grade and group；

EXAMPLE When tubes of steel grade 30CrMoE and group 2 are ordered，the steel grade and group should be expressed as 30CrMoE-2.

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

e） dimensions（nominal outside diameter and minimum wall thickness or nominal outside diameter and nominal wall thickness，expressed in millimeters）；

f） lengths（Cut-lengths or multiple lengths）；

g） special requirements.

5 Dimensions, shapes, masses and tolerances

5.1 Outside diameter and wall thickness

5.1.1 Unless otherwise specified in the contract, the tubes are delivered by nominal outside diameter (D) and minimum wall thickness (S_{min}). If required by the purchaser, agreed between the supplier and the purchaser, and stated in the contract, the tubes may be delivered by nominal outside diameter and nominal wall thickness.

5.1.2 The nominal outside diameter and wall thickness of the tube shall be as specified in GB/T 17395. If required by the purchaser, agreed between the supplier and the purchaser, and stated in the contract, tubes with the dimensions not listed in GB/T 17395 may be supplied.

NOTE In the case of no special statement, "wall thickness" said in this document includes minimum wall thickness and nominal wall thickness.

5.1.3 Permissible variations in outside diameter and wall thickness shall be as specified in Table 1. If not stated in the contract by purchaser, the normal tolerance class of outside diameter and wall thickness shall apply, If required by the purchaser, agreed between the supplier and the purchaser, and stated in the contract, tubes with the dimensional tolerance not listed in Table 1 may be supplied.

Table 1—Tolerances on outside diameter and wall thickness

Dimensions in millimeters

Dimensions		Permissible variations	
		Normal(PA)	Advance(PC)
Nominal outside diameter (D)	All	±1%D	
Minimum wall thickness (S_{min})	$D \leqslant 559$	$^{+25\%S_{min}}_{0}$	$^{+20\%S_{min}}_{0}$
	$D > 559$	$^{+27.5\%S_{min}}_{0}$	$^{+22.5\%S_{min}}_{0}$
Nominal wall thickness (S)	$D \leqslant 559$	$^{+12.5\%S}_{-10\%S}$	±10%S
	$D > 559$	±12.5%S	$^{+12.5\%S}_{-10\%S}$

5.2 Lengths

5.2.1 The tubes shall be supplied by cut-lengths or multiple lengths.

5.2.2 Permissible variation in cut-length shall be as follows:

a） If tube length not greater than 6 000 mm，$^{+10}_{0}$ mm；

b） If tube length greater than 6 000 mm，$^{+20}_{0}$ mm.

5.2.3 Permissible variation in multiple length shall be $^{+20}_{0}$ mm. A cutting allowance of 10 mm to 15 mm shall be reserved for each cutting on the tubes delivered by multiple lengths.

5.3 Straightness

Deviations from straightness of full length shall not exceed 0.15% of tube length. Deviation from straightness over any one meter tube length shall not exceed 3.0 mm.

5.4 Out-of-roundness and unevenness in wall thickness

The out-of-roundness and unevenness in wall thickness of the tubes shall not exceed 80% of tolerances on outside diameter and wall thickness，respectively.

5.5 End shape

Both tube ends shall be square cut，and the out-of-squareness of tube end shall not exceed 1% of nominal outside diameter. All burrs at the cut ends shall be removed.

5.6 Masses

5.6.1 When nominal outside diameter and minimum wall thickness required，the tubes shall be delivered by practical mass.

5.6.2 When nominal outside diameter and nominal wall thickness required，the tubes may be delivered by practical mass or theoretical mass. The theoretical mass of the tubes shall be calculated in accordance with GB/T 17395（density of steel is 7.85 kg/dm^3）.

5.6.3 If required by the purchaser，agreed between the supplier and the purchaser，and stated in the contract，permissible deviation between practical mass and theoretical mass for a single length may be specified as ±10%，and permissible deviation between practical mass and theoretical mass of the tubes for each order may be specified as $^{+5}_{-10}$%.

6 Technical requirements

6.1 Steel grades and chemical composition

6.1.1 The steel grades and chemical composition（heat analysis）shall comply with the requirements specified in Table 2. If agreed between the supplier and the purchaser，the tubes of steel

grades and chemical composition listed in Annex A may be supplied.

Table 2—Steel grades and chemical composition

No.	Grade	Group	Chemical composition, in % by mass[a]									
			C	Si	Mn	P	S	P+S	Cr	Mo	Ni	Cu
1	30CrMoE	1[b]	0.25 to 0.35	0.15 to 0.35	0.40 to 0.90	≤0.015	≤0.010	≤0.020	0.80 to 1.10	0.15 to 0.25	≤0.30	≤0.20
2		2	0.26 to 0.33	0.17 to 0.37	0.40 to 0.70	≤0.015	≤0.010	≤0.020	0.80 to 1.10	0.15 to 0.25	≤0.30	≤0.20
3	42CrMoE	1[c]	0.40 to 0.45	0.15 to 0.35	0.75 to 1.00	≤0.015	≤0.010	≤0.020	0.80 to 1.10	0.15 to 0.25	≤0.30	≤0.20
4		2	0.38 to 0.45	0.17 to 0.37	0.50 to 0.80	≤0.015	≤0.010	≤0.020	0.90 to 1.20	0.15 to 0.25	≤0.30	≤0.20

[a] During heat analysis: w(V+Nb+Ti+B+Zr)≤0.15%; w_{As}≤0.010%, w_{Sn}≤0.010%, w_{Pb}≤0.010%, w_{Sb}≤0.010%, w_{Bi}≤0.010%, w(As+Sn+Pb+Sb+Bi)≤0.025%; w_{H}≤0.000 2%, w_{O}≤0.002 5%, w_{N}≤0.007 0%。

[b] Grade 30CrMoE group 1 is equivalent to 4 130X. If required by the purchaser, the tubes of group 1 to this document may be ordered as 4 130X.

[c] Grade 42CrMoE group 1 is equivalent to 4 142. If required by the purchaser, the tubes of group 1 to this document may be ordered as 4 142.

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

6.2 Manufacturing method

6.2.1 Steelmaking process

Steel shall be made by electric arc furnace and external refining, subsequently vacuum degassing or by oxygen converter and external refining, subsequently vacuum degassing. If required by the purchaser, agreed between the supplier and the purchaser, and stated in the contract, steel may be made by other higher demanded processes.

6.2.2 Blank manufacturing process and requirements

6.2.2.1 Blank may be manufactured by continuously casting, hot rolling or forging.

6.2.2.2 Continuously cast blank shall comply with the requirements specified in YB/T 4149. Macrostructure and defects such as center cracks, mid-radius cracks, subsurface cracks and subsurface pinholes shall not exceed rating of 1. Hot rolled or forged blank shall comply with the requirements specified in YB/T 5137.

6.2.3 Tube manufacturing process

The tubes shall be manufactured by a seamless process of either hot rolling (expanding) or hot rolling (expanding) plus cold drawing.

6.3 Delivery conditions

The tubes shall be delivered in hot rolled (expanded), cold drawn or cold drawn and subsequently heat treated conditions.

6.4 Mechanical properties

6.4.1 The longitudinal mechanical properties determined on the test pieces taken from the rough specimens subjected to quenching and tempering shall comply with the requirements specified in Table 3. If agreed between the supplier and the purchaser, and the tubes ordered with steel grade and chemical composition listed in Annex A, the mechanical properties determined on the test pieces taken from the rough specimens subjected to quenching and tempering are shown in Annex A.

Table 3—Mechanical properties

Grade	Tensile strength [a] (R_m) MPa	Low yield strength [a,b] (R_{eL}) MPa	Percentage elongation after fracture [a] ($A_{50\,mm}$) %	Yield-to-tensile strength ratio [b] R_{eL}/R_m %	Hardness (HBW)	−40 ℃ Impact absorbed energy (KV_2) J	
						Average value	Single value
30CrMoE [c]	≥720	≥485	≥20	≤86	≤269	≥60	≥48
42CrMoE [d]	≥930	≥760	≥16	≤92	≤330	≥40	≥32

[a] Tensile test piece shall be R4 specified in GB/T 228.1. If the tube size is not enough to take the R4 test piece, test piece of circular cross-section with a largest possible diameter of 8 mm or 5 mm shall be used. The gauge length of test piece shall be 5 times diameter of cross section.

[b] If yield phenomenon is not obvious, proof strength ($R_{p0.2}$) may be determined instead of R_{eL}.

[c] When ordered as 4130X, mechanical property requirements for 30CrMoE shall apply.

[d] When ordered as 4142, mechanical property requirements for 42CrMoE shall apply.

6.4.2 The Charpy V-notch impact absorbed energy of the standard test piece shall comply with the requirements specified in Table 3. If the standard test piece cannot be obtained, one of the subsize test pieces having a thickness of 7.5 mm or 5 mm may be used. If the subsize impact test pieces used, The minimum Charpy V-notch impact absorbed energy requirement for subsize test piece shall be those (including the required average and single values) specified for a standard test piece multiplied by the reduction factor listed in Table 4.

Table 4—Absorbed energy reduction factor for subsize test piece

Test piece size	Test piece dimensions(width×thickness) mm	Reduction factor
Standard test piece	10×10	1
Subsize test piece	10×7.5	5/6
Subsize test piece	10×5	2/3

6.4.3 If required by the purchaser, agreed between the supplier and the purchaser, and stated in the contract, the V-notch impact absorbed energy values at −20 ℃ or −50 ℃ may be provided by the supplier for information.

6.5 Nonmetallic inclusions

The tubes shall be checked for nonmetallic inclusions. Content of nonmetallic inclusions in the tubes shall determined according to Method A given in GB/T 10561—2023. The severity levels for thin series and thick series of Type A, B, C and D inclusions shall not be greater than 2.0 respectively. The severity levels for Type DS inclusions shall not be greater than 2.0. The sum of thin series and thick series of Type A, B, C and D inclusions shall not be greater than 6.0 respectively.

6.6 Grain size

If required by the purchaser, agreed between the supplier and the purchaser, and stated in the contract, the actual grain size of the test piece taken from the rough specimen subjected to quenching and tempering shall be No. 7.0 or finer.

6.7 Surface quality

6.7.1 The internal and external surfaces of the tubes shall be free of cracks, laps, abscission layers and scabs. These defects shall be completely removed. The dressed areas shall blend smoothly into the contour of the tube. The removal depth shall not exceed the under limit of the nominal wall thickness. The actual wall thickness in the dressed area shall be not less than the permitted minimum wall thickness.

6.7.2 The oxide scale on internal and external surfaces of the tubes shall be removed.

6.8 Surface roughness

If tube surface roughness is required by the purchaser, it shall be so stated in the contract. The surface roughness requirements shall be agreed between the purchaser and the supplier.

6.9 Full length thickness testing

Each tube shall be automated full length thickness tested（except the untested areas at tube ends），the coverage of automated thickness testing system shall be 100% of the tube surface. The wall thickness shall comply with the requirements specified in 5.1.3. The untested areas at tube ends shall be manually tested or removed.

6.10 Non-destructive testing

6.10.1 Ultrasonic testing for the detection of longitudinal and transverse imperfections shall be carried out for each tube according to the acceptance level of U2 in GB/T 5777.

6.10.2 If agreed between supplier and purchaser，and stated in the contract，ultrasonic testing for the detection of longitudinal and transverse imperfections may be carried out for each tube in accordance with NB/T 47013.3，the acceptance lever shall not be lower than Class 1 specified in NB/T 47013.3.

7 Test methods

7.1 Sampling for chemical analysis of the tubes shall conform to the requirements of GB/T 20066. Chemical analysis is usually conducted according to GB/T 4336，GB/T 11261，GB/T 20123，GB/T 20124，YB/T 4307 or other routine methods. In case of arbitration，the analysis shall be conducted according to the provisions of GB/T 223.5，GB/T 223.11，GB/T 223.14，GB/T 223.19，GB/T 223.23，GB/T 223.26，GB/T 223.29，GB/T 223.30，GB/T 223.31，GB/T 223.37，GB/T 223.40，GB/T 223.47，GB/T 223.50，GB/T 223.59，GB/T 223.63，GB/T 223.78，GB/T 223.80，GB/T 223.82，GB/T 223.84，GB/T 223.85，GB/T 223.86 and GB/T 11261.

7.2 The dimensions and shapes of each tube shall be measured using tools which satisfy the requirements for accuracy.

7.3 The internal and external surfaces of each tube shall be visually inspected under sufficient illumination.

7.4 Two tubes per each test unit shall be checked for surface roughness with a Roughness Tester at 3 positions

7.5 Methods of sampling and testing for other inspections or tests shall comply with the requirements specified in Table 5.

Table 5—Methods of sampling and testing for inspection or test

No.	Inspection or test	Sampling quantity	Sampling method	Testing method
1	Chemical composition	One per heat	GB/T 20066	7.1
2	Tensile test	Two from two tubes per test unit	GB/T 2975	GB/T 228.1
3	Hardness test	Two from two tubes per test unit	GB/T 231.1	GB/T 231.1
4	Impact test	Two groups of 3 test pieces from two tubes per test unit	GB/T 2975	GB/T 229
5	Nonmetallic inclusions	Two from two tubes per test unit	GB/T 10561—2023	GB/T 10561—2023
6	Grain size	Two from two tubes per test unit	GB/T 6394	GB/T 6394
7	automated thickness testing	Each tube	—	GB/T 32552
8	Ultrasonic testing	Each tube	—	GB/T 5777—2019, NB/T 47013.3 (agreement)

8 Inspection rules

8.1 Inspection and acceptance

Inspection and acceptance for the tubes shall be carried out by the supplier's quality and technical supervision department.

8.2 Test unit

The tubes shall be inspected and accepted by test unit. Each test unit shall comprise the tubes of the same steel grade and group, the same heat number, the same dimensions and in the same delivery condition. The quantity of each test unit shall not exceed 100 pcs.

8.3 Sampling quantity

Sampling quantity for various inspection or test of the tubes shall comply with the requirements specified in Table 5.

8.4 Rules for re-test and assessment

The rules for re-test and assessment of the tubes shall be as specified in GB/T 2102.

9 Packaging，marking and quality certification

Packaging，marking and quality certification for the tubes shall be as specified in GB/T 2102.

Annex A
（informative）
Chemical composition and mechanical properties of other steel grades

A. 1 Other grades and chemical composition

Other optional at ordering and chemical composition（heat analysis）are shown in Table A. 1.

Table A. 1—Other grades and chemical composition

No.	Grade	Chemical composition, in % by mass[a]							
		C	Si	Mn	P	S	P+S	Cr	Mo
1	34CrMo4	0. 32 to 0. 37	≤0. 40	0. 60 to 0. 90	≤0. 015	≤0. 010	≤0. 020	0. 90 to 1. 20	0. 15 to 0. 30
2	4 145	0. 43 to 0. 48	0. 15 to 0. 35	0. 75 to 1. 00	≤0. 015	≤0. 010	≤0. 020	0. 80 to 1. 10	0. 15 to 0. 25
3	SA-372 Grade J（Class 110）	0. 35 to 0. 50	0. 15 to 0. 35	0. 75 to 1. 05	≤0. 015	≤0. 010	≤0. 020	0. 80 to 1. 15	0. 15 to 0. 25
[a] During heat analysis: w(V+Nb+Ti+B+Zr)≤0. 15%; w_{As}≤0. 010%, w_{Sn}≤0. 010%, w_{Pb}≤0. 010%, w_{Sb}≤0. 010%, w_{Bi}≤0. 010%, w(As+Sn+Pb+Sb+Bi)≤0. 025%; w_H≤0. 000 2%, w_O≤0. 002 5%, w_N≤0. 007 0%.									

A. 2 Mechanical properties

As for the tubes ordered by the steel grade listed in Table A. 1, the recommended values of mechanical properties determined on the test pieces taken from the rough specimens subjected to quenching and tempering are shown in Table A. 2.

Table A. 2—Mechanical properties of other steel grades

No.	Grade	Tensile strength [a] R_m MPa	Low yield strength [a,b] R_{eL} MPa	Percentage elongation after fracture [a] $A_{50\,mm}$ %	Yield-to-tensile strength ratio [b] R_{eL}/R_m %	Hardness HBW	−40 ℃ Impact absorbed energy KV_2 J	
							Average value	Single value
1	34CrMo4	≥900	≥650	≥16	≤92	≤330	≥40	≥32
2	4145	≥930	≥760	≥16	≤92	≤330	≥40	≥32
3	SA-372 Grade J（Class 110）	≥930	≥760	≥16	≤92	≤330	≥40	≥32
[a] Tensile test piece shall be R4 specified in GB/T 228. 1. If the tube size is not enough to take the R4 test piece, test piece of circular cross-section with a largest possible diameter of 8 mm or 5 mm shall be used. The gauge length of test piece shall be 5 times diameter of cross-section. [b] If yield phenomenon is not obvious, proof strength（$R_{p0.2}$）may be determined instead of R_{eL}.								