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GB/T 26057—2010

Titanium and Titanium Alloy Welded Tubes

钛及钛合金焊接管

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Foreword

This standard is under the jurisdiction of the National Nonferrous Metals Standardization Technical Committee (SAC/TC 243).

The responsible drafting organizations of this standard are: Baoji Titanium Group Co., Ltd., and Xi'an Baoji Meitai Valinox Welded Tube Co., Ltd.

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1 Scope

This standard specifies the requirements, test methods, inspection rules, marking, packaging, transport, storage, certificate of quality and contents of the contract (or purchase order) for titanium and titanium alloy welded tubes.

This standard applies to titanium and titanium alloy tubes produced by the welding method, for general industrial applications.

2 Normative References

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

Standard No.	Title
GB/T 228	Metallic materials — Tensile testing at ambient temperature
GB/T 241	Metallic materials — Tube — Hydrostatic pressure testing
GB/T 246	Metallic materials — Tube — Flattening test
GB/T 3620.1	Designation and composition of titanium and titanium alloys
GB/T 3620.2	Permissible deviations in chemical composition for wrought titanium and titanium alloy products
GB/T 4698 (all parts)	Methods for chemical analysis of titanium sponge, titanium and titanium alloys
GB/T 8180	Packaging, marking, transport and storage of wrought titanium and titanium alloy products
GB/T 12969.1	Method of ultrasonic inspection for titanium and titanium alloy tubes
YS/T 658	Titanium strip for welded tubes

3 Requirements

3.1 Product Classification

The designations, conditions and specifications of titanium and titanium alloy welded tubes shall conform to the requirements of Table 1.

Table 1 — Designations, conditions and specifications of tubes

Designation	Condition	Outside diameter/mm	Wall thickness/ mm							
			0.5	0.6	0.7	0.8	1.0	1.25	1.65	2.1
TA1, TA2, TA3, TA8, TA8-1, TA9, TA9-1, TA10	M (annealed)	10~15	○	○	○	—	—	—	—	—
		＞15~27	○	○	○	○	○	○	○	—
		＞27~32	○	○	○	○	○	○	○	○
		＞32~38	—	○	○	○	○	○	○	○

NOTE: "○" denotes a specification that can be produced in accordance with this standard.

3.2 Material

The titanium strip for welded tubes shall conform to the requirements of YS/T 658.

3.3 Chemical Composition

The chemical composition of the products shall conform to the requirements of GB/T 3620.1. When the purchaser carries out re-verification, the permissible deviations of the chemical composition shall conform to the requirements of GB/T 3620.2.

3.4 Mechanical Properties

The mechanical properties of the tubes at room temperature in the supplied condition shall conform to the requirements of Table 2.

Table 2 — Mechanical properties at room temperature

Alloy designation	Condition	Tensile strength Rm/ MPa	0.2% proof strength Rp0.2/MPa	Percentage elongation after fracture A50mm/%
TA1	M	≥240	140~310	≥24
TA2	M (annealed)	≥400	275~450	≥20
TA3		≥500	380~550	≥18
TA8		≥400	275~450	≥20
TA8-1		≥240	140~310	≥24
TA9		≥400	275~450	≥20
TA9-1		≥240	140~310	≥24
TA10		≥483	≥345	≥18

3.5 Technological Properties

3.5.1 Flattening Test

3.5.1.1 The tubes shall be subjected to the flattening test. When flattened to the specified distance H between the platens, no cracks shall appear on the surface of the tube. H shall be calculated by formula (1):

$$H = (1+e)t / (e + t/D) \quad \text{..... (1)}$$

where:

H — distance between the platens, in millimetres (mm);

t — nominal wall thickness of the tube, in millimetres (mm);

D — nominal outside diameter of the tube, in millimetres (mm);

e — constant; when the tube diameter is not greater than 25.4 mm, e = 0.04; when the tube diameter is greater than 25.4 mm, e = 0.06.

3.5.1.2 For tubes with D/t < 10, cracks occurring at the positions corresponding to "6 o'clock" and "12 o'clock" on the inner surface of the tube during the flattening test shall not be taken as a basis for rejection.

3.5.1.3 The flattening direction and the position of the weld are shown in Figure 1.

Figure 1 — Flattening direction and weld position

NOTE: The figure is not reproduced in this translation; see the original Chinese standard.

3.5.2 Pneumatic (Hydrostatic) Pressure Test

3.5.2.1 The tubes shall be subjected to the pneumatic pressure test. When required by the purchaser and stated in the contract (or purchase order), the tubes may also be subjected to the hydrostatic pressure test in lieu of the pneumatic pressure test.

3.5.2.2 In the pneumatic pressure test, the internal pressure of the tube shall be 0.7 MPa and maintained for 5 s; the tube shall not leak.

3.5.2.3 In the hydrostatic pressure test, the test pressure selected by the purchaser shall be stated in the contract (or purchase order). When not stated in the contract (or purchase order), the test pressure shall be calculated by formula (2):

$$P = 0.85S / (D/2 - 0.4t) \quad \text{..... (2)}$$

where:

P — test pressure, in megapascals (MPa);

S — allowable stress, taken as 50% of the corresponding minimum 0.2% proof strength, in megapascals (MPa);

D — nominal outside diameter of the tube, in millimetres (mm);

t — nominal wall thickness of the tube, in millimetres (mm).

The maximum pressure in the hydrostatic pressure test shall not be greater than 17.2 MPa; the pressure shall be maintained for not less than 5 s, and the tube shall not distort or leak.

3.6 Dimensions and Permissible Deviations

3.6.1 The permissible deviations of the outside diameter and wall thickness of the tubes shall conform to the requirements of Table 3. The ovality of the tubes shall not exceed the permissible deviation of the outside diameter. The permissible deviation of the wall thickness does not apply to the weld; the permissible increase in wall thickness at the weld is +0.79 mm.

Table 3 — Permissible deviations of outside diameter and wall thickness

Permissible deviation of outside diameter/mm	Permissible deviation of wall thickness
±0.30	±10% of the nominal wall thickness

3.6.2 The length range of the tubes is 500 mm~15 000 mm; lengths beyond this range may be supplied subject to agreement.

3.6.3 The cut lengths or multiple lengths of the tubes shall be within the range of the un-cut random lengths. For cut lengths not greater than 6 000 mm, the permissible deviation is +6/0 mm; for cut lengths greater than 6 000 mm, the permissible deviation is +10/0 mm. For multiple lengths, the saw kerf allowance of the tube shall additionally be included, the allowance per cut being 5 mm.

3.6.4 Both ends of the tubes shall be cut flat and free from burrs; the end squareness shall conform to the requirements of Table 4.

Table 4 — End squareness — Units in millimetres

Outside diameter	End squareness, max.
＞10~30	2
＞30~38	3

3.6.5 The straightness of the tubes over any 3 m length shall not be greater than 6.35 mm.

3.7 Ultrasonic Inspection

The tubes shall be subjected to ultrasonic inspection and shall conform to the requirements of GB/T 12969.1.

3.8 Visual Quality

3.8.1 The inner and outer surfaces of the tubes shall be clean and free from cracks, folds, peeling, pinholes and other defects visible to the naked eye; the weld shall be fully filled and smoothly transitioned.

3.8.2 Local defects on the tube surface may be removed, provided that after removal the outside diameter and wall thickness do not exceed the permissible deviations.

3.8.3 Scratches, dents, raised points and straightening marks not exceeding the permissible deviations of the outside diameter and wall thickness are permitted on the tube surface. Different colours of the tubes after pickling are permitted.

4 Test Methods

4.1 Method of Chemical Composition Analysis

The chemical composition analysis of the tubes shall be carried out in accordance with GB/T 4698.

4.2 Method of Mechanical Property Inspection

4.2.1 The room-temperature tensile test method for the tubes shall be carried out in accordance with GB/T 228.

4.2.2 For tubes with an outside diameter not greater than 30 mm, the S8 specimen in GB/T 228 shall be used; for tubes with an outside diameter greater than 30 mm, the S4 specimen shall be used. The S4 specimen shall be prepared so that the weld is located at the middle of the specimen.

4.3 Method of Technological Property Inspection

4.3.1 The flattening test of the tubes shall be carried out in accordance with GB/T 246.

4.3.2 The pneumatic pressure test of the tubes shall be carried out by a method agreed between the supplier and the purchaser.

4.3.3 The hydrostatic pressure test of the tubes shall be carried out in accordance with GB/T 241.

4.4 Method of Measuring Dimensions and Permissible Deviations

The dimensions and permissible deviations of the tubes shall be measured with measuring tools of appropriate accuracy.

4.5 Method of Ultrasonic Inspection

The ultrasonic inspection of the tubes shall be carried out in accordance with GB/T 12969.1.

4.6 Method of Visual Quality Inspection

The visual quality of the tubes shall be inspected by visual examination.

5 Inspection Rules

5.1 Inspection and Acceptance

5.1.1 The products shall be inspected by the supplier to ensure that the product quality conforms to the requirements of this standard and the contract (or purchase order), and a certificate of quality shall be issued.

5.1.2 The products received by the purchaser may be accepted in accordance with the provisions of this standard. If the inspection results do not conform to the requirements of this standard and the contract (or purchase order), the matter shall be raised with the supplier within three months from the date of receipt of the products, and shall be resolved through consultation between the supplier and the purchaser. If arbitration is required, the arbitration samples shall be taken jointly by the supplier and the purchaser.

5.2 Batching

The products shall be submitted for acceptance in lots. Each lot shall consist of products of the same designation, the same specification, the same manufacturing method, the same condition and produced by heat treatment with the same parameters in the same heat-treatment furnace.

5.3 Inspection Items and Sampling Provisions

Each lot of products shall be inspected for chemical composition, mechanical properties, technological properties, dimensions and permissible deviations, ultrasonic inspection and visual quality. The inspection items stated in the contract (or purchase order) shall also be inspected. The inspection items and sampling provisions for the products are given in Table 5.

Table 5 — Inspection items and sampling provisions for products

Inspection item	Sampling provision	Clause for requirements	Clause for test method
Chemical composition	The hydrogen content is sampled on the finished tube; for the other chemical composition elements, the supplier reports the analysis results of the titanium strip; the purchaser may sample and analyze on the finished tube	3.3	4.1
Mechanical properties	2 tubes taken at random per lot, 1 specimen from each tube	3.4	4.2
Flattening test	2 tubes taken at random per lot, 1 specimen from each tube	3.5.1	4.3.1
Pneumatic (hydrostatic) pressure test	Each tube	3.5.2	4.3.2, 4.3.3
Dimensions and permissible deviations	Each tube	3.6	4.4
Ultrasonic inspection	Each tube	3.7	4.5
Visual quality	Each tube	3.8	4.6

5.4 Judgement of Inspection Results

5.4.1 When the chemical composition is non-conforming, the whole lot shall be judged non-conforming.

5.4.2 In the room-temperature mechanical property inspection and the flattening test, if the inspection result of one specimen is non-conforming, twice the number of specimens shall be taken from the lot for repeat testing of the non-conforming item; if any one specimen in the repeat test results is still non-conforming, the lot shall be judged non-conforming. However, the supplier is permitted to inspect the non-conforming item tube by tube and re-form lots with the conforming tubes for delivery.

5.4.3 When the pneumatic (hydrostatic) pressure test, the dimensions and dimensional permissible deviations, the ultrasonic inspection or the visual quality of the tubes are non-conforming, the individual tube shall be judged non-conforming.

6 Marking, Packaging, Transport, Storage and Certificate of Quality

6.1 Marking

The following contents shall be marked on the tubes that have passed inspection and on the packing cases:

a) product designation;

b) product name;

c) specification;

d) supplied condition;

e) lot number;

f) number of this standard.

6.2 Packaging, Transport and Storage

The packaging, transport and storage of the products shall conform to the relevant provisions of GB/T 8180.

6.3 Certificate of Quality

Each lot of tubes shall be accompanied by a certificate of quality, stating:

a) name of the supplier;

b) name of the product;

c) product designation, specification and condition;

d) lot number, lot weight and number of tubes;

e) results of all analyses and inspections and the inspection stamp of the supplier's quality inspection department;

f) number of this standard;

g) date of packaging.

7 Contents of the Contract (or Purchase Order)

The contract (or purchase order) for ordering the materials specified in this standard shall include the following contents:

a) name of the product;

b) designation;

c) condition;

d) dimensions and specification;

e) weight or number of tubes;

f) number of this standard;

g) others.