NATIONAL STANDARD OF
THE PEOPLE'S REPUBLIC OF CHINA

中华人民共和国国家标准

GB/T 13810—2017

(replacing GB/T 13810—2007)

Wrought titanium and titanium alloy for surgical implants

外科植入物用钛及钛合金加工材

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Issued jointly by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and the Standardization Administration of the People's Republic of China

Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1—2009.

This standard replaces GB/T 13810—2007 "Wrought titanium and titanium alloy for surgical implants".

Compared with GB/T 13810—2007, the main technical changes are as follows:

a) TA1ELI, TA1, TA2, TA3 and TA4 were respectively changed to TA1GELI, TA1G, TA2G, TA3G and TA4G;

b) the specification ranges of the products were expanded;

c) the supply conditions of cold-worked condition (Y) and hot-worked condition (R) were deleted;

d) a requirement was added that recycled material shall not be used as the raw material for the production of ingots and wrought products;

e) the recommended heat treatment schedule for test pieces was deleted;

f) a yield strength requirement was added for wire;

g) the microstructure requirements for sheet and plate were modified;

h) surface contamination requirements for TA1GELI, TA1G, TA2G, TA3G and TA4G were added;

i) the ultrasonic testing requirements were modified;

j) a requirement for TC20 sheet and plate was added;

k) Annex B was deleted.

This standard was proposed by the China Nonferrous Metals Industry Association.

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

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The previous editions of the standard replaced by this standard were issued as follows:

——GB/T 13810—1992, GB/T 13810—1997 and GB/T 13810—2007.

1 Scope

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

This standard applies to titanium and titanium alloy sheet and plate, bar and wire for surgical implants.

2 Normative References

The following documents contain provisions which, through normative reference in this standard, constitute indispensable provisions of this standard. For dated references, only the edition cited applies. For undated references, the latest edition (including all amendments) applies.

Standard No.	Title
GB/T 228.1—2010	Metallic materials — Tensile testing — Part 1: Method of test at room temperature
GB/T 232	Metallic materials — Bend test method
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 5168	Methods for macrostructure and microstructure examination of α-β titanium alloys
GB/T 5193—2007	Ultrasonic testing method of wrought titanium and titanium alloy products
GB/T 6394—2002	Determination of estimating the average grain size of metal
GB/T 8180	Packaging, marking, transport and storage of wrought titanium and titanium alloy products
GB/T 23603	Method of detection for surface contamination of titanium and titanium alloy
GB/T 23605	Determination of β transus temperature for titanium alloys
YS/T 1001	Ultrasonic testing method of thin titanium and titanium alloy sheets

3 Requirements

3.1 Material

3.1.1

The ingots used for the production of the products shall be melted more than once. The first melting may be carried out in a vacuum consumable arc furnace or a cold hearth furnace; the subsequent melting shall be carried out in a vacuum consumable arc furnace, and no element shall be added during the last melting.

3.1.2

The use of any recycled titanium and titanium alloy material as the raw material for the production of ingots and wrought products is not permitted.

3.1.3

Tungsten inert gas (TIG) welding without filler metal shall not be used for welding the consumable electrode.

3.2 Chemical Composition

3.2.1

The chemical composition of the products shall conform to the provisions for the corresponding designations in GB/T 3620.1, of which the hydrogen content shall not be greater than 0.008%.

3.2.2

When the purchaser re-verifies, the permissible deviations of the chemical composition of the products shall conform to the provisions of GB/T 3620.2.

3.3 Product Classification

3.3.1 Sheet and Plate

3.3.1.1 Designations, Conditions and Specifications

The designations, conditions and specifications of sheet and plate shall conform to the provisions of Table 1.

Table 1

Designation	Condition	Specification/mm		
		Thickness	Width	Length
TA1GELI, TA1G, TA2G, TA3G, TA4G, TC1, TC4ELI, TC20	Annealed (M)	0.3~25.0	300~1 000	500~3 000

3.3.1.2 Dimensions

3.3.1.2.1

The permissible deviations of the thickness, width and length of sheet and plate shall conform to the provisions of Table 2.

Table 2 — Units in millimetres

Thickness	Permissible deviation of thickness	Permissible deviation of width	Permissible deviation of length	
	High accuracy	Ordinary accuracy		
0.3~0.8	+0.07 0	±0.05	+5 0	+10 0
>0.8~1.0	+0.09 0	±0.06	+5 0	+10 0
>1.0~1.5	+0.11 0	±0.08	+5 0	+10 0
>1.5~2.0	+0.15 0	±0.11	+5 0	+10 0
>2.0~3.0	+0.18 0	±0.13	+5 0	+10 0
>3.0~4.0		±0.16		

Thickness	Permissible deviation of thickness	Permissible deviation of width	Permissible deviation of length	
	+0.22 0		+5 0	+10 0
>4.0~6.0	+0.35 0	±0.26	+5 0	+10 0
>6.0~8.0	+0.40 0	±0.30	+5 0	+10 0
>8.0~10.0	+0.50 0	±0.37	+5 0	+10 0
>10.0~20.0	+0.70 0	±0.52	+5 0	+10 0
>20.0~25.0	+0.90 0	±0.67	+5 0	+10 0

3.3.1.2.2

The flatness of sheet and plate shall not be greater than 3 mm/m.

3.3.1.2.3

The lateral bend of sheet and plate shall not be greater than 3 mm/m.

3.3.1.2.4

The edges of sheet and plate shall be cut at right angles, without cracks, curled edges or burrs, and the skew cutting shall not exceed the permissible deviations of the length and width of the sheet and plate.

3.3.1.3 Tensile Properties

The room-temperature tensile properties of sheet and plate shall conform to the provisions of Table 3.

Table 3

Designation	Thickness/ mm	Tensile strength R_m/ MPa	0.2% proof strength (non-proportional extension) $R_{P0.2}$/ MPa	Percentage elongation after fracture A/%	Percentage reduction of area Z/%
TA1GELI	0.3~25.0	≥200	≥140	≥30	—
TA1G	0.3~25.0	≥240	≥170	≥25	—
TA2G	0.3~25.0	≥400	≥275	≥25	—
TA3G	0.3~25.0	≥500	≥380	≥20	—
TA4G	0.3~25.0	≥580	≥485	≥20	—
TC4	0.5~＜5.0	≥925	≥870	≥10	—
	5.0~25.0	≥895	≥830	≥10	≥20
TC4ELI	0.5~＜5.0	≥860	≥795	≥10	—
	5.0~25.0	≥860	≥795	≥10	≥25

Designation	Thickness/ mm	Tensile strength R_m/ MPa	0.2% proof strength (non-proportional extension) $R_{p0.2}$/ MPa	Percentage elongation after fracture A/%	Percentage reduction of area Z/%
TC20	0.5~25.0	≥900	≥800	≥10	—

3.3.1.4 Bend Properties

Sheet and plate with a thickness of not greater than 5.0 mm shall be subjected to the bend test, and the bending diameter and bending angle shall conform to the provisions of Table 4. After bending, there shall be no cracks at the bent portion.

Table 4

Designation	Thickness/mm	Bending diameter/mm	Bending angle/(°)
TA1GELI	0.3~2.0	3T	105
	＞2.0~5.0	4T	105
TA1G	0.3~2.0	3T	105
	＞2.0~5.0	4T	105
TA2G	0.3~2.0	4T	105
	＞2.0~5.0	5T	105
TA3G	0.3~2.0	4T	105
	＞2.0~5.0	5T	105
TA4G	0.3~2.0	5T	105
	＞2.0~5.0	6T	105
TC4	0.5~＜1.8	9T	105
	1.8~5.0	10T	105
TC4ELI	0.5~＜1.8	9T	105
	1.8~5.0	10T	105
TC20	0.5~＜1.8	9T	105
	1.8~5.0	10T	105

NOTE: T is the nominal thickness of the sheet and plate.

3.3.1.5 Microstructure

The microstructure of TC4, TC4ELI and TC20 sheet and plate shall be that obtained by full deformation in the α+β two-phase region followed by annealing; the original β grains shall be fully broken up, and continuous grain boundary α shall not be permitted.

3.3.1.6 Grain Size

The average grain size of TA1GELI, TA1G, TA2G, TA3G and TA4G sheet and plate shall not be coarser than grade 5.0 in GB/T 6394—2002.

3.3.1.7 Surface Contamination

The sheet and plate shall be free from any oxygen-rich layer, such as α case or other surface contamination.

3.3.1.8 β Transus Temperature

When required by the purchaser and stated in the contract, the measured values of the β transus temperature for TC4, TC4ELI and TC20 sheet and plate shall be provided according to the melting furnace number.

3.3.1.9 Ultrasonic Testing

The sheet and plate shall be subjected to ultrasonic testing, of which sheet and plate with a thickness of not greater than 6.0 mm shall conform to the provisions of YS/T 1001, and sheet and plate with a thickness greater than 6.0 mm shall conform to the provisions of Grade A1 in GB/T 5193—2007.

3.3.1.10 Surface Quality

3.3.1.10.1

The sheet and plate shall be supplied with a pickled, water-ground, sand-blasted or machined surface.

3.3.1.10.2

Slight dulling and local water stains are permitted on the surface of the sheet and plate; local defects such as scratches, indentations and pits not exceeding the permissible deviation of the thickness are permitted, provided that the minimum permissible thickness of the sheet and plate is ensured.

3.3.1.10.3

Cracks, peeling, oxide scale, lapping, over-pickling, and metallic and non-metallic inclusions shall not be permitted on the surface of the sheet and plate.

3.3.1.10.4

Local defects may be removed along the rolling direction on the sheet and plate, provided that the minimum permissible thickness of the sheet and plate is ensured after removal.

3.3.1.10.5

The sheet and plate shall be free from delamination.

3.3.2 Bar

3.3.2.1 Designations, Conditions and Specifications

The designations, conditions and specifications of bar shall conform to the provisions of Table 5.

Table 5

Designation	Condition	Specification/mm	
		Diameter	Length
TA1GELI, TA1G, TA2G, TA3G, TA4G, TC4, TC4ELI, TC20	Annealed (M)	＞7.0~90.0	300~4 000

3.3.2.2 Dimensions

3.3.2.2.1

The permissible deviations of the diameter of bar shall conform to the provisions of Table 6.

Table 6

Diameter/mm	Permissible deviation of diameter/mm	
	High accuracy	Ordinary accuracy
＞7.0~10.0	0, -0.022	±0.3
＞10.0~18.0	0, -0.027	±0.4
＞18.0~25.0	0, -0.033	±0.4
＞25.0~40.0	—	±0.5
＞40.0~60.0	—	±0.6
＞60.0~90.0	—	±0.8

3.3.2.2.2

The exact length or multiple length of bar shall be within its random length range; the permissible deviation of the exact length is +15 mm, and the cutting allowance for each cut of the multiple length shall also be taken into account, with each cutting allowance being 5 mm.

3.3.2.2.3

The straightness of bar shall not be greater than 3 mm/m.

3.3.2.2.4

Both ends of the bar shall be cut flat and square, and the skew of cutting shall not be greater than 3 mm.

3.3.2.3 Tensile Properties

The room-temperature tensile properties of bar shall conform to the provisions of Table 7.

Table 7

Designation	Diameter/ mm	Tensile strength R_m/ MPa	0.2% proof strength (non-proportional extension) $R_{P0.2}$/ MPa	Percentage elongation after fracture A/%	Percentage reduction of area Z/%
TA1GELI	＞7.0~90.0	≥200	≥140	≥30	≥30
TA1G	＞7.0~90.0	≥240	≥170	≥24	≥30
TA2G	＞7.0~90.0	≥400	≥275	≥20	≥30
TA3G	＞7.0~90.0	≥500	≥380	≥18	≥30
TA4G	＞7.0~90.0	≥580	≥485	≥15	≥25
TC4	＞7.0~50.0	≥930	≥860	≥10	≥25
	＞ 50.0~90.0	≥895	≥830	≥10	≥25

Designation	Diameter/ mm	Tensile strength R_m/ MPa	0.2% proof strength (non-proportional extension) $R_{P0.2}$/ MPa	Percentage elongation after fracture A/%	Percentage reduction of area Z/%
TC4ELI	＞7.0~45.0	≥860	≥795	≥10	≥25
	＞ 45.0~65.0	≥825	≥760	≥8	≥20
	＞ 65.0~90.0	≥825	≥760	≥8	≥15
TC20	＞7.0~90.0	≥900	≥800	≥10	≥25

3.3.2.4 Macrostructure

The macrostructure of bar shall not have delamination, cracks, porosity, shrinkage tail, metallic or non-metallic inclusions, or other metallurgical defects visible to the naked eye.

3.3.2.5 Microstructure

The microstructure of TC4, TC4ELI and TC20 bar shall be that obtained by full deformation in the α+β two-phase region followed by annealing, and the microstructure type shall conform to a)~i) of Figure A.1.

3.3.2.6 Grain Size

The average grain size of TA1GELI, TA1G, TA2G, TA3G and TA4G bar shall not be coarser than grade 5.0 in GB/T 6394—2002.

3.3.2.7 Surface Contamination

The bar shall be free from any oxygen-rich layer, such as α case or other surface contamination.

3.3.2.8 β Transus Temperature

When required by the purchaser and stated in the contract, the measured values of the β transus temperature for TC4, TC4ELI and TC20 bar shall be provided according to the melting furnace number.

3.3.2.9 Ultrasonic Testing

The bar shall be subjected to ultrasonic testing; bar with a diameter of not greater than 50.0 mm shall conform to the provisions of Grade A1 in GB/T 5193—2007, and bar with a diameter greater than 50.0 mm shall conform to the provisions of Grade A in GB/T 5193—2007.

3.3.2.10 Surface Quality

3.3.2.10.1

The bar shall be delivered with a turned (ground) surface, and the surface roughness value Ra shall not be greater than 3.2 μm.

3.3.2.10.2

Slight scratches, pits and indentations not greater than the permissible deviation of the diameter are permitted on the surface of the bar, provided that the minimum permissible diameter is ensured.

3.3.2.10.3

Cracks, peeling, oxide scale, scars, and metallic and non-metallic inclusions shall not be permitted on the surface of the bar.

3.3.2.10.4

Local defects may be removed from the bar, provided that the minimum permissible diameter of the bar is ensured after removal, and the ratio of the depth to the width of the removal shall not be greater than 1:6.

3.3.3 Wire

3.3.3.1 Designations, Conditions and Specifications

The designations, conditions and specifications of wire shall conform to the provisions of Table 8. The wire is normally supplied as straight wire; when required by the purchaser and stated in the contract, it may be supplied in coils or on spools.

Table 8

Designation	Condition	Specification/mm	
		Diameter	Length
TA1GELI, TA1G, TA2G, TA3G, TA4G	Annealed (M)	0.5~2.0	500~1 000
		>2.0~7.0	500~2 000
TC4, TC4ELI, TC20	Annealed (M)	1.0~2.0	500~1 000
		>2.0~7.0	500~2 000

NOTE: The length refers only to the length of straight wire.

3.3.3.2 Dimensions

3.3.3.2.1

The permissible deviations of the diameter of wire shall conform to the provisions of Table 9.

Table 9

Diameter/mm	Permissible deviation of diameter/mm	
	High accuracy	Ordinary accuracy
0.5~3.0	—	0，-0.06
＞3.0~6.0	0，-0.018	0，-0.08
＞6.0~7.0	0，-0.022	0，-0.10

NOTE: The permissible deviation of diameter of high accuracy applies only to straight wire.

3.3.3.2.2

The permissible deviation of the length of wire is ±6 mm.

3.3.3.2.3

The straightness of straight wire with a diameter of not less than 1.0 mm shall not be greater than 3 mm/m.

3.3.3.2.4

Straight wire with a diameter of less than 1.0 mm and wire supplied in coils or on spools shall be free from kinks and dead bends.

3.3.3.2.5

Both ends of the wire shall be cut flat and square.

3.3.3.3 Tensile Properties

The room-temperature tensile properties of wire shall conform to the provisions of Table 10.

Table 10

Designation	Diameter/ mm	Tensile strength R_m/ MPa	0.2% proof strength (non-proportional extension) $R_{p0.2}$/ MPa	Percentage elongation after fracture A/%	Percentage reduction of area Z/%
TA1GELI	0.5~＜1.6	≥200	—	≥18	—
	1.6~＜3.2	≥200	≥140	≥18	—
	3.2~7.0	≥200	≥140	≥30	≥30
TA1G	0.5~＜1.6	≥240	—	≥15	—
	1.6~＜3.2	≥240	≥170	≥15	—
	3.2~7.0	≥240	≥170	≥24	≥30
TA2G	0.5~＜1.6	≥400	—	≥12	—
	1.6~＜3.2	≥400	≥275	≥12	—
	3.2~7.0	≥400	≥275	≥20	≥30
TA3G	0.5~＜1.6	≥500	—	≥10	—
	1.6~＜3.2	≥500	≥380	≥10	—
	3.2~7.0	≥500	≥380	≥18	≥30
TA4G	0.5~＜1.6	≥580	—	≥8	—
	1.6~＜3.2	≥580	≥485	≥15	—
	3.2~7.0	≥580	≥485	≥15	≥25
TC4	1.0~7.0	≥930	≥860	≥10	—
TC4ELI	1.0~7.0	≥860	≥795	≥10	—
TC20	1.0~7.0	≥900	≥800	≥10	—

3.3.3.4 Macrostructure

The macrostructure of wire with a diameter greater than 3 mm shall not have delamination, cracks, porosity, shrinkage tail, metallic or non-metallic inclusions, or other metallurgical defects visible to the naked eye.

3.3.3.5 Microstructure

The microstructure of TC4, TC4ELI and TC20 wire shall be that obtained by full deformation in the α+β two-phase region followed by annealing, and the microstructure type shall conform to a)~i) of Figure A.1.

3.3.3.6 Grain Size

The average grain size of TA1GELI, TA1G, TA2G, TA3G and TA4G wire shall not be coarser than grade 5.0 in GB/T 6394—2002.

3.3.3.7 Surface Contamination

The wire shall be free from any oxygen-rich layer, such as α case or other surface contamination.

3.3.3.8 Surface Quality

3.3.3.8.1

The wire shall be supplied with a pickled or ground surface.

3.3.3.8.2

The surface of the wire shall be clean and free from oxide film, and shall be free from cracks, peeling, burrs, stains and inclusions.

3.3.3.8.3

Slight local scratches, abrasions, spots and pits not exceeding the permissible deviation of the diameter are permitted on the surface of the wire.

4 Test Methods

4.1

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

4.2

The dimensions shall be measured with measuring instruments of corresponding accuracy. The thickness of sheet and plate shall be measured within the range of 10 mm~100 mm from the edge of the sheet and plate.

4.3

The room-temperature tensile properties shall be tested in accordance with GB/T 228.1—2010. The test pieces shall conform to the provisions of Table 11.

Table 11 — Units in millimetres

Product category	Sheet and plate	Bar	Wire			
Thickness or diameter	0.3~＜3.0	3.0~＜5.0	5.0~10.0	＞10.0~25.0	＞7.0~90.0	0.5~7.0
Test piece type	P1	P7	P7、R8	R7	R7	L_0=4d

NOTE: The R8 test piece applies only to TC4 and TC4ELI sheet and plate.

*L_0 is the original gauge length of the test piece; when the calculated value is less than 10 mm, 10 mm shall be taken.

4.4

The bend properties shall be tested in accordance with GB/T 232. The width of the test piece is 15 mm.

4.5

The macrostructure examination shall be carried out in accordance with GB/T 5168.

4.6

The microstructure examination shall be carried out in accordance with GB/T 5168, and the examination shall be performed at a magnification of 200×.

4.7

The grain size shall be determined in accordance with GB/T 6394.

4.8

The surface contamination shall be detected in accordance with GB/T 23603, and the examination shall be performed at a magnification of 100×.

4.9

The β transus temperature shall be determined in accordance with GB/T 23605.

4.10

The ultrasonic testing of sheet and plate with a thickness of not greater than 6.0 mm shall be carried out in accordance with YS/T 1001, and the ultrasonic testing of sheet and plate with a thickness greater than 6.0 mm shall be carried out in accordance with GB/T 5193; the ultrasonic testing of bar shall be carried out in accordance with GB/T 5193.

4.11

The surface quality 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 provisions of this standard and the contract (or purchase order), and a quality certificate shall be filled in.

5.1.2

The purchaser shall inspect the products received in accordance with the provisions of this standard and the contract (or purchase order). When the inspection results do not conform to the provisions of this standard and the contract (or purchase order), the matter shall be raised with the supplier within 3 months from the date of receipt of the products, and settled through negotiation between 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, melting furnace number, specification, manufacturing method, condition and from the same heat-treatment furnace batch.

5.3 Inspection Items and Sampling

The inspection items and sampling of the products shall conform to the provisions of Table 12.

Table 12

Inspection item	Sampling provision	Clause for requirements	Clause for test method
Chemical composition	1 test piece taken at random from the product for the analysis of the hydrogen content; for the other elements, the supplier reports the analysis results of the original ingot, and re-verification by the purchaser is carried out on the products	3.2	4.1
Dimensions	Every sheet (bar, coil)	3.3.1.2 3.3.2.2 3.3.3.2	4.2
Tensile properties	Sheet and plate: 2 sheets taken at random per lot, 1 transverse test piece from each sheet	3.3.1.3	4.3
	Bar: for bar with a diameter of not greater than 75 mm, 2 bars taken at random per lot, 1 longitudinal test piece from each bar; for bar with a diameter greater than 75 mm, 2 bars taken at random per lot, 1 transverse test piece from each bar	3.3.2.3	4.3
	Wire: 2 wires (coils) taken at random per lot, 1 longitudinal test piece from each	3.3.3.3	4.3
Bend properties	1 transverse test piece taken at random per lot	3.3.1.4	4.4
Macrostructure	1 transverse test piece taken at random per lot	3.3.2.4 3.3.3.4	4.5
Microstructure	1 transverse test piece taken at random per lot	3.3.1.5 3.3.2.5 3.3.3.5	4.6
Grain size	1 transverse test piece taken at random per lot	3.3.1.6 3.3.2.6 3.3.3.6	4.7
	1 test piece taken at random per lot		4.8

Inspection item	Sampling provision	Clause for requirements	Clause for test method
Surface contamination		3.3.1.7 3.3.2.7 3.3.3.7	
β transus temperature	1 test piece taken at random per lot	3.3.1.8 3.3.2.8	4.9
Ultrasonic testing	Every sheet (bar)	3.3.1.9 3.3.2.9	4.10
Surface quality	Every sheet (bar, coil)	3.3.1.10 3.3.2.10 3.3.3.8	4.11

5.4 Judgement of Inspection Results

5.4.1

When the chemical composition inspection result is non-conforming, one repeat test of the non-conforming element is permitted. If the repeat test is still non-conforming, the lot shall be judged non-conforming.

5.4.2

In the inspections of the tensile properties, bend properties, microstructure, grain size and surface contamination, if the inspection result of one test piece is non-conforming, double the number of test pieces shall be taken from the lot for a repeat test of the non-conforming item. If one test piece 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 sheet by sheet (bar by bar, coil by coil), and the conforming products may be re-formed into lots.

5.4.3

The judgement of the macrostructure shall conform to the provisions of 5.4.3.1 and 5.4.3.2.

5.4.3.1

When segregation, metallic or non-metallic inclusions or other metallurgical defects visible to the naked eye are found on the macrostructure, the lot shall be judged non-conforming. The supplier is permitted to inspect sheet by sheet (bar by bar, coil by coil), and the conforming products may be re-formed into lots.

5.4.3.2

When delamination, cracks, porosity or shrinkage tail are found on the macrostructure, the lot shall be judged non-conforming. The supplier is permitted to inspect sheet by sheet (bar by bar, coil by coil), and the conforming products may be re-formed into lots.

5.4.4

When the inspection results of the dimensions, ultrasonic testing and surface quality are non-conforming, the individual sheet (bar, coil) shall be judged non-conforming.

6 Marking, Packaging, Transport, Storage and Quality Certificate

6.1 Product Marking

The following marks (or labels) shall be made on the products that have passed inspection:

a) designation;

b) specification;

c) condition;

d) lot number;

e) number of this standard.

6.2 Packaging, Marking, Transport and Storage

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

6.3 Quality Certificate

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

a) name of the supplier;

b) product name;

c) designation, specification and condition of the products;

d) melting furnace number, lot number, lot weight and quantity;

e) heat treatment schedule;

f) the results of all analyses and inspections and the seal of the quality inspection department;

g) number of this standard;

h) date of packaging.

7 Contents of the Contract (or Purchase Order)

The contract (or purchase order) for ordering products according to this standard shall include the following contents:

a) product name;

b) designation;

c) specification;

d) condition;

e) weight or quantity;

f) number of this standard;

g) others.

Annex A (Normative) — Rating Chart for the Microstructure of Two-Phase Titanium Alloy Bar and Wire (Annealed Condition)

The microstructure rating charts for TC4, TC4ELI and TC20 bar and wire are shown in Figure A.1.

Figure A.1 shows the microstructure types a)~i) (200×), which are used for the rating of the microstructures of the above bar and wire in the annealed condition.

(Figure A.1 — Microstructure types (200×))