NATIONAL STANDARD OF
THE PEOPLE'S REPUBLIC OF CHINA

中华人民共和国国家标准

GB/T 3622—2023

(replacing GB/T 3622—2012)

Titanium and titanium alloy strip and foil

钛及钛合金带、箔材

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Foreword

This document was drafted in accordance with the rules given in GB/T 1.1—2020 "Directives for standardization — Part 1: Structure and drafting rules for standardization documents".

This document replaces GB/T 3622—2012 "Titanium and titanium alloy strip and foil". Compared with GB/T 3622—2012, apart from structural adjustments and editorial changes, the main technical changes are as follows:

a) "terms and definitions" was added (see Clause 3);

b) the technical requirements for TA1, TA2 products were changed, and TA3 and TA4 were deleted (see Table 5 and Table 6; Table 1 and Table 2 of the 2012 edition);

c) the technical requirements for TA0, TA1G, TA2G, TA3G and TA4G products were added (see Table 1, Table 5 and Table 6);

d) the specification ranges of the products were changed (see Table 1; Table 1 of the 2012 edition);

e) the shape dimensions and their permissible deviations were changed (see 5.2; 3.5 of the 2012 edition);

f) the room-temperature tensile properties were changed (see 5.3; 3.4 of the 2012 edition);

g) the visual quality requirements were changed (see 5.5; 3.6 of the 2012 edition);

h) the analysis methods of the chemical composition were changed (see 6.1; 4.1 of the 2012 edition);

i) the test method of the room-temperature tensile properties was changed (see 6.3; 4.2 of the 2012 edition);

j) the product marking requirements were changed (see 8.1; 6.1 of the 2012 edition);

k) the packaging requirements were changed (see 8.2; 6.2 of the 2012 edition).

Please note that some of the contents of this document may involve patents. The issuing organization of this document does not bear the responsibility of identifying patents.

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

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

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This document was first issued in 1983, first revised in 1999, second revised in 2012, and this is the third revision.

1 Scope

This document specifies the classification and marking, technical requirements, test methods, inspection rules, marking, packaging, transport, storage, accompanying documents and contents of the purchase order for titanium and titanium alloy strip and foil (hereinafter referred to as "strip" and "foil" respectively).

This document applies to titanium and titanium alloy strip and foil produced by the rolling method.

2 Normative References

The following documents contain provisions which, through normative reference in this document, constitute indispensable provisions of this document. For dated references, only the edition corresponding to that date applies to this document; for undated references, the latest edition (including all amendments) applies to this document.

Standard No.	Title
GB/T 228.1—2021	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 6611	Terms and metallographs of titanium and titanium alloys
GB/T 8180	Packaging, marking, transport and storage of wrought titanium and titanium alloy products
GB/T 38982	Testing methods for shape dimensions of wrought titanium and titanium alloy products
YS/T 1262	Methods for chemical analysis of titanium sponge, titanium and titanium alloys — Determination of multi-element content — Inductively coupled plasma atomic emission spectrometry

3 Terms and Definitions

For the purposes of this document, the terms and definitions given in GB/T 6611 and GB/T 38982 and the following apply.

3.1

strip

products with a thickness of 0.10 mm~5.00 mm and a width of not greater than 1 500 mm, supplied in coil form.

3.2

foil

products with a thickness of less than 0.10 mm and a width of not greater than 300 mm, supplied in coil form.

4 Classification and Marking

4.1 Product Classification

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

Table 1 — Designations, conditions and specifications

Designation	Product classification	Condition	Specification/ mm		
			Thickness	Width	Length
TA0, TA1, TA2, TA1G, TA2G, TA3G, TA4G, TA8, TA8-1, TA9, TA9-1, TA10	Foil	Cold-worked (Y) Annealed (M)	0.01~＜0.10	30~300	≥500
		Cold-worked (Y) Annealed (M)	0.10~＜0.30	50~300	≥500
	Strip	Cold-worked (Y) Annealed (M)	0.30~3.00	50~1 300	≥5 000
		Hot-worked (R) Annealed (M)	＞3.00~5.00	≤1 500	≥5 000

NOTE: The forms of supply include trimmed and untrimmed; when not stated, the products shall be supplied trimmed.

4.2 Product Marking

The product marking shall be expressed in the order of product name, designation, condition, specification and number of this document.

Example 1: For foil manufactured from designation TA1G, in the cold-worked condition (Y), with a thickness of 0.03 mm and a width of 80 mm, the marking is:

Foil TA1G Y 0.03×80 GB/T 3622—2023

Example 2: For strip manufactured from designation TA2G, in the annealed condition (M), with a thickness of 0.40 mm and a width of 150 mm, the marking is:

Strip TA2G M 0.40×150 GB/T 3622—2023

5 Technical Requirements

5.1 Chemical Composition

5.1.1

The chemical composition of strip and foil shall conform to the provisions of GB/T 3620.1.

5.1.2

When the purchaser takes samples from the products for the re-verification of the chemical composition, the permissible deviations of the chemical composition shall conform to the provisions of GB/T 3620.2.

5.2 Shape Dimensions and Their Permissible Deviations

5.2.1

The permissible deviations of the thickness of strip and foil shall conform to the provisions of Table 2. The precision class of the thickness permissible deviations shall be stated in the purchase order; when not stated, the products shall be supplied with ordinary accuracy.

Table 2 — Permissible deviations of thickness — Units in millimetres

Thickness	Permissible deviations of thickness for the specified width range			
	≤1 000	＞1 000~1 500		
	Ordinary accuracy	High accuracy	Ordinary accuracy	High accuracy
0.01~0.02	±0.003	±0.002	—	—
＞0.02~0.05	±0.005	±0.003	—	—
＞0.05~0.07	±0.007	±0.005	—	—
＞0.07~0.09	±0.010	±0.007	—	—
＞0.09~0.15	±0.015	±0.010	—	—
＞0.15~0.20	±0.02	±0.015	—	—
＞0.20~0.30	±0.03	±0.02	—	—
＞0.30~0.50	±0.05	±0.04	±0.07	±0.06
＞0.50~1.00	±0.07	±0.05	±0.09	±0.07
＞1.00~1.50	±0.11	±0.06	±0.13	±0.11
＞1.50~2.00	±0.15	±0.07	±0.16	±0.13
	±0.18	±0.09	±0.20	±0.18

Thickness	Permissible deviations of thickness for the specified width range			
＞ 2.00~3.00				
＞ 3.00~4.75	±0.22	±0.11	±0.30	±0.22
＞ 4.75~5.00	±0.35	±0.25	±0.40	±0.35

5.2.2

The permissible deviations of the width of strip and foil shall conform to the provisions of Table 3. The class of the width permissible deviations shall be stated in the purchase order; when not stated, the products shall be supplied with ordinary accuracy.

Table 3 — Permissible deviations of width — Units in millimetres

Thickness	Permissible deviations of width	
	Ordinary accuracy	High accuracy
0.01~0.30	±1.0	±0.5
＞0.30~1.00	—	—
＞1.00~1.50	+3.2 0	+1.6 0
＞1.50~3.00	—	—
＞3.00~5.00	+5.0 0	+1.6 0

5.2.3

The edges of strip and foil supplied trimmed shall be even, and the irregularity of trimming on the edges shall not exceed half of the permissible deviation of the width.

5.2.4

The shape of strip and foil supplied trimmed shall conform to the provisions of Figure 1 and Table 4.

(Figure 1 — Shapes of coils)

Table 4 — Telescoping of coils — Units in millimetres

Width	Telescoping value a
30~200	≤8
＞200~500	≤10
＞500~1 000	≤20
＞1 000~1 500	≤30

5.2.5

The shape dimensions and their permissible deviations of strip and foil supplied untrimmed shall be agreed upon between the supplier and the purchaser.

5.3 Room-Temperature Tensile Properties

5.3.1

The room-temperature tensile properties of strip in the annealed condition shall conform to the provisions of Table 5. When not stated in the purchase order, the percentage elongation after fracture shall be accepted according to Class Ⅰ; when required by the purchaser and stated in the purchase order, it may be accepted according to Class Ⅱ.

Table 5 — Room-temperature tensile properties

Designation	Condition	Thickness/ mm	Tensile strength Rm/ MPa	0.2% proof strength (plastic extension) Rp0.2/ MPa	Percentage elongation after fracture A50mm/%	
					Class Ⅰ	Class Ⅱ
TA0	M	0.10~2.00	280~420	≥170	≥40	—
TA1	M	0.10~2.00	370~530	≥250	≥35	—
TA2	M	0.10~2.00	440~620	≥320	≥30	—
TA1G	M	0.10~＜0.50	≥240	140~310	≥24	≥40
		0.50~＜2.00	≥240	140~310	≥24	≥35
		2.00~5.00	≥240	140~310	≥24	—
TA2G	M	0.10~＜0.50	≥345	275~450	≥20	≥30
		0.50~＜2.00	≥345	275~450	≥20	≥25
		2.00~5.00	≥345	275~450	≥20	—
TA3G	M	0.10~5.00	≥450	380~550	≥18	—
TA4G	M	0.10~5.00	≥550	485~655	≥15	—
TA8	M	0.10~＜0.50	≥345	275~450	≥20	≥30
		0.50~＜2.00	≥345	275~450	≥20	≥25
		2.00~5.00	≥345	275~450	≥20	—
TA8-1	M	0.10~＜0.50	≥240	140~310	≥24	≥40
		0.50~＜2.00	≥240	140~310	≥24	≥35
		2.00~5.00	≥240	140~310	≥24	—
TA9	M	0.10~＜0.50	≥345	275~450	≥20	≥30
		0.50~＜2.00	≥345	275~450	≥20	≥25

Designation	Condition	Thickness/ mm	Tensile strength Rm/ MPa	0.2% proof strength (plastic extension) Rp0.2/ MPa	Percentage elongation after fracture A50mm/%	
		2.00~5.00	≥345	275~450	≥20	—
TA9-1	M	0.10~＜0.50	≥240	140~310	≥24	≥40
		0.50~＜2.00	≥240	140~310	≥24	≥35
		2.00~5.00	≥240	140~310	≥24	—
TA10 (Class A)	M	0.10~5.00	≥485	≥345	≥18	—
TA10 (Class B)	M	0.10~5.00	≥345	≥275	≥25	—

NOTE: The room-temperature tensile properties of TA10 strip are divided into Class A and Class B; Class A applies to general industry, and Class B applies to the cladding material used for clad plates.

5.3.2

For strip in the hot-worked and cold-worked conditions, when required by the purchaser and stated in the purchase order, the measured values of the room-temperature tensile properties shall be reported.

5.3.3

When not stated in the purchase order, TA10 strip shall be supplied according to Class A; when agreed upon between the supplier and the purchaser and stated in the purchase order, it may be supplied according to Class B.

5.3.4

When required by the purchaser and stated in the purchase order, the measured values of the room-temperature tensile properties of foil may be reported.

5.4 Bend Properties

5.4.1

Strip in the annealed condition shall be subjected to the bend test, and there shall be no cracks at the bent portion. The diameter of the bending punch and the bending angle shall conform to the provisions of Table 6.

5.4.2

The bend properties of foil in the annealed condition shall be agreed upon between the supplier and the purchaser and stated in the purchase order.

Table 6 — Bend properties

Designation	Thickness/mm	Diameter of the bending punch/mm	Bending angle/(°)
TA0	0.10~2.00	3T	≥150
TA1	0.10~2.00	3T	≥150

Designation	Thickness/mm	Diameter of the bending punch/mm	Bending angle/(°)
TA2	0.10~2.00	3T	≥140
TA1G	0.10~＜2.00	3T	≥105
	2.00~5.00	4T	≥105
TA2G	0.10~＜2.00	4T	≥105
	2.00~5.00	5T	≥105
TA3G	0.10~＜2.00	4T	≥105
	2.00~5.00	5T	≥105
TA4G	0.10~＜2.00	5T	≥105
	2.00~5.00	6T	≥105
TA8	0.10~＜2.00	4T	≥105
	2.00~5.00	5T	≥105
TA8-1	0.10~＜2.00	3T	≥105
	2.00~5.00	4T	≥105
TA9	0.10~＜2.00	4T	≥105
	2.00~5.00	5T	≥105
TA9-1	0.10~＜2.00	3T	≥105
	2.00~5.00	4T	≥105
TA10	0.10~＜2.00	4T	≥105
	2.00~5.00	5T	≥105

NOTE: T is the thickness of the bend test piece.

5.5 Visual Quality

5.5.1

Strip and foil shall be supplied with a pickled or bright surface.

5.5.2

The surface of strip and foil shall be clean and smooth. Minor defects on the surface may be removed by local grinding, provided that after removal the thickness of the strip and foil conforms to the requirements of their permissible deviations.

5.5.3

Slight dulling and defects that do not affect subsequent use are permitted on the surface of strip and foil. Local defects such as scratches, indentations, pits, spots and grinding marks not exceeding half of the permissible deviation of the thickness are permitted on strip and foil, provided that the thickness of the strip and foil is

ensured to conform to the requirements of their permissible deviations; for strip and foil in the annealed condition, slight local abrasions and wrinkles caused by degreasing are permitted.

5.5.4

The surface defects of strip and foil (such as macroscopic defects including cracks, peeling, oxide scale, lapping, metallic and non-metallic inclusions, as well as traces of over-pickling) shall not exceed 5% of the entire titanium coil. A series of defects within a length of 1 m counts as one defect. Example: for a titanium coil with a length of 100 m, the defects shall not exceed 5 places.

5.5.5

The edges of strip and foil shall be free from splits and curled edges, and slight burrs are permitted.

6 Test Methods

6.1 Chemical Composition

The chemical composition analysis of the products shall be carried out in accordance with the provisions of GB/T 4698 (all parts) or YS/T 1262. The arbitration analysis shall be carried out in accordance with the provisions of GB/T 4698 (all parts).

6.2 Shape Dimensions and Their Permissible Deviations

The measurement of the shape dimensions and their permissible deviations of the products shall be carried out in accordance with the provisions of GB/T 38982, of which the thickness permissible deviation shall be measured at positions not less than 100 mm from the end of the coil and not less than 25 mm from the edge.

6.3 Room-Temperature Tensile Properties

The inspection of the room-temperature tensile properties of the products shall be carried out in accordance with the provisions of GB/T 228.1—2021. The P5 test piece shall be taken for products with a thickness of less than 3 mm; the P12 test piece shall be taken for products with a thickness of not less than 3 mm.

6.4 Bend Properties

The inspection of the bend properties of the products shall be carried out in accordance with the provisions of GB/T 232, with the width of the test piece being 15 mm.

6.5 Visual Quality

The visual quality of the products shall be inspected by the visual examination method, and measuring instruments of corresponding accuracy shall be used for measurement when necessary.

7 Inspection Rules

7.1 Inspection and Acceptance

7.1.1

The products shall be inspected by the supplier or a third party to ensure that the product quality conforms to the provisions of this document and the purchase order.

7.1.2

The purchaser may inspect the products received in accordance with the provisions of this document and the purchase order. When the inspection results do not conform to the provisions of this document or the purchase order, the matter shall be raised with the supplier in writing and settled through negotiation between the supplier and the purchaser. Objections concerning the shape dimensions and their permissible deviations and the visual quality shall be raised within one month from the date of receipt of the products; objections concerning the chemical composition, room-temperature tensile properties and bend properties shall be raised within three months from the date of receipt of the products. If arbitration is required, sampling shall be carried out jointly by the supplier and the purchaser at the purchaser's premises or as agreed upon.

7.2 Batching

The products shall be submitted for acceptance in lots. Each lot shall consist of products of the same designation, melting furnace number, thickness, condition, manufacturing method and from the same heat-treatment furnace batch.

7.3 Inspection Items

Each lot of products shall be subjected to the inspection of the chemical composition, shape dimensions and their permissible deviations, room-temperature tensile properties, bend properties and visual quality.

7.4 Sampling

The sampling of the products shall conform to the provisions of Table 7.

Table 7 — Sampling

Inspection item	Sampling provision	Clause for technical requirements	Clause for test method
Chemical composition	1 sample taken at random per lot	5.1	6.1
Shape dimensions and their permissible deviations	Every coil	5.2	6.2
Room-temperature tensile properties	Width ≤120 mm: 2 coils selected at random per lot, 1 longitudinal test piece from each coil	5.3	6.3
	Width ＞120 mm: 2 coils selected at random per lot, 1 transverse test piece from each coil		
Bend properties		5.4	6.4

Inspection item	Sampling provision	Clause for technical requirements	Clause for test method
	Width ≤200 mm: 2 coils selected at random per lot, 1 longitudinal test piece from each coil		
	Width ＞200 mm: 2 coils selected at random per lot, 1 transverse test piece from each coil		
Visual quality	Every coil	5.5	6.5

NOTE: The hydrogen content shall be analyzed on samples taken from the finished products; for the other elements, the supplier reports the analysis results of the ingot, and the re-verification by the purchaser is carried out on the finished products.

7.5 Judgement of Inspection Results

7.5.1

When the inspection result of the chemical composition is non-conforming, the lot of products shall be judged non-conforming.

7.5.2

When any inspection result of the shape dimensions and their permissible deviations or the visual quality is non-conforming, the individual product shall be judged non-conforming.

7.5.3

In the tests of the room-temperature tensile properties and the bend properties, when 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 inspection. When one test piece in the repeat inspection is still non-conforming, the lot of products shall be judged non-conforming.

8 Marking, Packaging, Transport, Storage and Accompanying Documents

8.1 Marking

8.1.1 Product Marking

The following marks (or labels) shall be made on the products that have passed inspection, and at least the following contents shall be stated:

a) name of the manufacturer and trademark;

b) designation;

c) specification;

d) condition;

e) batch number;

f) number of this document.

8.1.2 Packaging Marking

The packaging marking of the products shall conform to the provisions of GB/T 8180.

8.2 Packaging, Transport and Storage

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

8.3 Accompanying Documents

Each lot of products shall be accompanied by accompanying documents, which shall include the supplier information, product information, number of this document and the date of delivery or date of packaging, and shall also preferably include the following documents:

a) a quality certificate, with the following contents:

——product name, designation, specification and condition;

——ingot number, batch number, batch weight and quantity of the products;

——main properties and technical parameters of the products;

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

b) a certificate of conformity, with the following contents:

——ingot number or batch number;

——date of inspection;

——signature or seal of the inspector.

9 Contents of the Purchase Order

The purchaser may, according to its own needs, list the following contents in the purchase order for ordering the products specified in this document:

a) product name;

b) designation;

c) specification;

d) condition;

e) weight;

f) quantity;

g) number of this document;

h) others.