NATIONAL STANDARD OF
THE PEOPLE'S REPUBLIC OF CHINA

中华人民共和国国家标准

GB/T 43302—2023

(replacing "")

Titanium and titanium alloy wires for additive manufacturing

增材制造用钛及钛合金丝材

Issued: 2023-11-27 Implemented: 2024-06-01

Issued jointly by the State Administration for Market Regulation and the Standardization Administration of the People's Republic of China

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".

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The issuing body of this document shall not be held responsible for identifying any or all such patent rights.

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

This document is under the joint jurisdiction of the National Nonferrous Metals Standardization Technical Committee (SAC/TC 243) and the National Additive Manufacturing Standardization Technical Committee (SAC/TC 562).

The drafting organizations of this document are: Baoji Titanium Group Co., Ltd., Baoji Titanium Industry Co., Ltd., State-Owned Wuhu Machinery Factory, AECC Beijing Institute of Aeronautical Materials, Western Superconducting Technologies Co., Ltd., Nonferrous Metals Techno-Economic Research Institute Co., Ltd., Northwestern Polytechnical University, Baoji Topda Titanium Industry Co., Ltd., and Shanghai Research Institute of Materials Co., Ltd.

The main drafters of this document are: Tao Hailin, Xie Chen, Zhang Guodong, Liu Xianghong, Zhang Wei, Sun Hudai, Fan Zhao, Wang Jianbin, Wei Gaoyan, Duan Xiaohui, Li Baoxia, Ma Zhongxian, Hu Zhijie, Ma Jiakun, Qing Daga, Feng Junning, Feng Yongqi, Lin Xin, Zhang Liang and Bai Zhihui.

1 Scope

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

This document applies to wires with a diameter of 1.0 mm to 7.0 mm for powder production by additive manufacturing and wires for printing.

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 cited applies. For undated references, the latest edition (including all amendments) applies.

Standard No.	Title
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

Standard No.	Title
GB/T 8180	Packaging, marking, transport and storage of wrought titanium and titanium alloy products
GB/T 34647	Designation codes for conditions of titanium and titanium alloy products
GB/T 38982	Methods for measuring dimensions of wrought titanium and titanium alloy products
GB/T 39799—2021	Dimensions, shapes, weights and permissible deviations of titanium and titanium alloy bars and wires
YS/T 1262	Methods for chemical analysis of titanium sponge, titanium and titanium alloys — Determination of multi-element contents — Inductively coupled plasma atomic emission spectrometry
YS/T 1465	Terms and atlases of surface defects of wrought titanium and titanium alloy products

3 Terms and Definitions

The terms and definitions defined in GB/T 34647, GB/T 38982 and YS/T 1465 apply to this document.

4 Classification and Designation

4.1 Designations, Conditions, Specifications and Categories of the Products

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

Table 1 — Designations, conditions, specifications and categories

Designation	Condition	Diameter, mm	Category
TA1G, TA2G, TA15, TC4, TC4ELI	Hot-working condition (R), annealed condition (M)	1.0~7.0	For powder production / for printing

4.2 Product Designation

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

Example 1: A wire for powder production manufactured with the TA1G designation, in the annealed condition, with a diameter of 3.0 mm, is designated as:

Wire for powder production TA1G M φ3 mm GB/T 43302—2023

Example 2: A wire for printing manufactured with the TC4 designation, in the hot-working condition, with a diameter of 4.5 mm, is designated as:

Wire for printing TC4 R φ4.5 mm GB/T 43302—2023

5 Technical Requirements

5.1 Chemical Composition

5.1.1

The chemical composition of the wires for powder production shall conform to the provisions of Table 2, the chemical composition of the wires for printing shall conform to the provisions of Table 3, and the other chemical composition requirements shall conform to the provisions of GB/T 3620.1.

5.1.2

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

Table 2 — Chemical composition of the wires for powder production — %

Designation	**Chemical composition (mass fraction)**												
	Main components	Impurities, not greater than	Other elements										
	Ti	Al	Si	V	Zr	Mo	Fe	C	N	H	O	Single	Total
TA1G	Balance	—	—	—	—	—	0.20	0.08	0.03	0.010	0.06	0.10	0.30
TA2G	Balance	—	—	—	—	—	0.30	0.08	0.03	0.015	0.10	0.10	0.30
TA15	Balance	5.5~7.1	≤0.15	0.8~2.5	1.5~2.5	0.5~2.0	0.10	0.08	0.03	0.015	0.12	0.10	0.30
TC4	Balance	5.5~6.5	—	3.5~4.5	—	—	0.25	0.08	0.03	0.010	0.10	0.10	0.30
TC4ELI	Balance	5.5~6.5	—	3.5~4.5	—	—	0.20	0.08	0.03	0.010	0.06	0.10	0.30

Table 3 — Chemical composition of the wires for printing — %

Designation	**Chemical composition (mass fraction)**												
	Main components	Impurities, not greater than	Other elements										
	Ti	Al	Si	V	Zr	Mo	Fe	C	N	H	O	Single	Total
TA1G	Balance	—	—	—	—	—	0.20	0.08	0.03	0.010	0.18	0.10	0.30
TA2G	Balance	—	—	—	—	—	0.30	0.08	0.03	0.015	0.20	0.10	0.30
TA15	Balance	5.5~7.6	≤0.15	0.8~2.5	1.5~2.5	0.5~2.0	0.10	0.08	0.03	0.015	0.15	0.10	0.30

Designation	Chemical composition (mass fraction)												
TC4	Balance	5.5~7.0	—	3.5~4.5	—	—	0.25	0.08	0.03	0.010	0.20	0.10	0.30
TC4ELI	Balance	5.5~7.0	—	3.5~4.5	—	—	0.20	0.08	0.03	0.010	0.12	0.10	0.30

5.2 Dimensions and Their Permissible Deviations

5.2.1

The wires shall be supplied in coils or loose coils, and the loose coils shall not be of the "figure-of-eight" shape.

5.2.2

The dimensions and their permissible deviations of the wires shall conform to the provisions of GB/T 39799—2021, in which the permissible deviations of the diameter shall conform to the provisions of Grade I in GB/T 39799—2021.

5.3 Visual Quality

5.3.1

The wires shall be supplied with pickled surfaces or machined surfaces.

5.3.2

The surfaces of the wires shall be clean, free from oil contamination and oxidation colours, and shall be free from cracks, peeling, barbs, scratches and inclusions.

5.3.3

The surfaces of the wires shall be free from local scratches, indentation damage, spots, pits and other defects exceeding the permissible deviations of the diameter.

6 Test Methods

6.1 Chemical Composition

The chemical composition of the products shall be analyzed 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 Dimensions and Their Permissible Deviations

The dimensions and their permissible deviations of the products shall be measured in accordance with the provisions of GB/T 38982.

6.3 Visual Quality

The visual quality of the products shall be inspected by visual inspection, and measured with measuring tools of appropriate accuracy 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 received products in accordance with the provisions of this document. Where the inspection results do not conform to the provisions of this document or the purchase order, a written claim shall be submitted to the supplier, and the matter shall be settled through consultation between the supplier and the purchaser. Claims on the dimensions and their permissible deviations and the visual quality shall be submitted within one month from the date of receipt of the products; claims on the chemical composition shall be submitted within three months from the date of receipt of the products. Where arbitration is required, the supplier and the purchaser shall take samples jointly or as agreed.

7.2 Batching

The products shall be submitted for acceptance in batches. Each batch shall consist of wires of the same designation, melting furnace number, diameter, condition, category, manufacturing method and the same heat treatment furnace batch.

7.3 Inspection Items

Each batch of products shall be inspected for the chemical composition, dimensions and their permissible deviations, and the visual quality.

7.4 Sampling

The sampling of the wires shall conform to the provisions of Table 4.

Table 4 — Sampling

Inspection item	Sampling provisions
Chemical composition	The nitrogen and oxygen contents shall be analyzed on samples taken from the finished products; for the other components, the supplier may report the analysis results of the ingot, and the re-verification by the purchaser shall be carried out on the finished products
Dimensions and their permissible deviations	3 coils (reels) per batch, 2 measuring points per coil
Visual quality	3 coils (reels) per batch

7.5 Judgment of Inspection Results

7.5.1

Where the chemical composition inspection result fails, one repeated inspection of the nonconforming elements is permitted; where the repeated inspection still fails, that batch of products shall be judged as nonconforming.

7.5.2

Where the dimensions and their permissible deviations and the visual quality fail, that coil (reel) of products shall be judged as nonconforming. The supplier may remove the nonconforming parts, and the qualified ones shall be re-batched.

8 Marking, Packaging, Transport, Storage and Accompanying Documents

8.1 Marking

8.1.1 Product Marking

Labels or tags shall be affixed to the qualified products, and shall contain at least:

a) name of the manufacturer;

b) designation;

c) condition;

d) specification;

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 batch of products shall be accompanied by the accompanying documents, which, in addition to the supplier information, product information, number of this document, and date of issue or date of packaging, shall preferably include:

a) a quality certificate, with the following contents:

——designation, specification and condition;

——product ingot number, batch number, weight and quantity;

——main properties and technical parameters of the product;

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

——others.

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

——ingot number or batch number;

——date of inspection;

——signature or seal of the inspector;

——others.

c) others.

9 Contents of the Purchase Order

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

a) product name;

b) designation;

c) condition;

d) specification;

e) weight;

f) quantity;

g) category;

h) supply form;

i) surface state;

j) number of this document;

k) others.