BS 3TA 28:2009+A1:2015

BSI Standards Publication

AEROSPACE SERIES

Specification for forging stock and wire of titanium-aluminium-vanadium alloy (tensile strength 1 100–1300 MPa) (limiting ruling section 20 mm)

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Date	Text affected
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Contents

Summary of pages
This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 4, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 30 November 2009. It was prepared by Panel ACE/61/-/49, *Titanium and its alloys*, under the authority of Technical Committee ACE/61, *Metallic materials for aerospace purposes*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

BS 3TA 28:2009+A1:2015 supersedes BS 3TA 28:2009, which is withdrawn.

Information about this document

This standard is a full revision of BS TA 28, and introduces the following principal changes.

a) Requirements are stated in tabular format in accordance with EN 4500-1 and EN 4500-4.

b) Chemical composition has been amended to add requirements for "other" elements.

c) Melting method details have been deleted and replaced by reference to Section 1 of BS TA 100.

d) Reference to BS EN 2002-16 has been added for penetrant flaw detection.

e) Reference to EN 4050-2 has been added for ultrasonic flaw detection.

The start and finish of text introduced or altered by Amendment No.1 is indicated in the text by tags ⟨A1⟩ and ⟨/A1⟩. Minor editorial changes are not tagged.

Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies requirements for titanium-aluminium-vanadium alloy forging stock and wire with a tensile strength of 1 100 MPa to 1 300 MPa.

2 Normative references

The following referenced documents are indispensable for the application 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.

BS TA 100, *Procedure for inspection, testing and acceptance of wrought titanium and titanium alloys*

EN 2002-16, *Metallic materials – Test methods – Part 16: Non-destructive testing – Penetrant testing* [1)]

[A1] BS EN 4050-2 [A1], *Aerospace series – Test method for metallic materials – Ultrasonic inspection of bars, plates, forging stock and forgings – Part 2: Performance of test*

[A1] BS EN 4179, *Aerospace series – Qualification and approval of personnel for non-destructive testing* [A1]

3 Technical requirements

Material to this standard shall conform to Table 1.

NOTE The format and symbols used in Table 1 are derived from [A1] *BS EN 4500-001 and BS EN 4500-004* [A1].

1) Published as ASD-STAN Prestandard at the date of publication of this standard.

Table 1 **Technical requirements for titanium-aluminium-vanadium alloy forging stock and wire**

1	**Material designation**			**BS TA 28**											
2	**Chemical composition %**	Element		Al	V	Fe	C	O_2	N_2	H_2	Y	Others		Ti	
												Each	Total		
		Min.		5.50	3.50	—	—	—	—	—	—	—	—	Base	
		Max.		6.75	4.50	0.30	0.08	0.20	0.050	0.008	0.005	0.10	0.40		
3	**Method of melting**			See Section 1 of BS TA 100											
4.1	**Form**			Forging stock and wire [1)]											
4.2	**Method of production**			—											
4.3	**Limit dimension(s)**		mm	a or D $\leqslant$ 20											
5	**Technical specification**			Sections 1 and 3 of BS TA 100 (forging stock); Sections 1 and 8 of BS TA 100 (wire)											

6.1	**Delivery condition**	Hot finished (with or without subsequent cold reduction) + straightened + either descaled or centreless ground.	Annealed + either descaled or centreless ground [2)]
	Heat treatment	—	700 °C $\leqslant \theta \leqslant$ 800 °C / t $\geqslant$ 1 h / AC or FC [3)]
6.2	**Delivery condition code**	U	U
7	**Use condition**	Delivery condition	Delivery condition
	Heat treatment	—	—

Characteristics

8.1	**Test sample(s)**				See Section 3 (forging stock) and Section 8 (wire) of BS TA 100
8.2	**Test piece(s)**				See Section 3 (forging stock) and Section 8 (wire) of BS TA 100
8.3	**Heat treatment**				Reference (see line 29)
9	**Dimensions concerned**			mm	a or D $\leqslant$ 20
10	**Thickness of cladding on each face**			%	—
11	**Direction of test piece**				L
12	**T**	**Temperature**	θ	°C	Ambient
13		**Proof stress**	$R_{p0.2}$	MPa	$\geqslant$ 970
14		**Strength**	R_m	MPa	1 100 $\leqslant R_m \leqslant$ 1 300
15		**Elongation**	A	%	$\geqslant$ 8
16		**Reduction of area**	Z	%	$\geqslant$ 20
17	**Hardness**				—
18	**Shear strength**		R_c	MPa	—
19	**Bending**		κ	—	—
20	**Impact strength**				—
21	**C**	**Temperature**	θ	°C	—
22		**Time**		h	—
23		**Stress**	σ_a	MPa	—
24		**Elongation**	a	%	—
25		**Rupture stress**	σ_R	MPa	—
26		**Elongation at rupture**	A	%	—
27	**Notes** (see line 98)				1), 2), 3)

Table 1 **Technical requirements for titanium-aluminium-vanadium alloy forging stock and wire** *(continued)*

<table>
<tr><td>29</td><td>Reference heat treatment</td><td>—</td><td>Solution treated + precipitation treated
870 °C ⩽ θ ⩽ 950 °C / WQ [4), 5)] + 460 °C ⩽ θ ⩽ 550 °C / = ⩾ 2 h / AC</td></tr>
<tr><td>44</td><td>External defects (visual)</td><td>—</td><td>See Section 3 (forging stock) and Section 8 (wire) of BS TA 100</td></tr>
<tr><td rowspan="4">44</td><td rowspan="4">External defects (penetrant)</td><td>1</td><td>EN 2002-16</td></tr>
<tr><td>2</td><td>Each product 100%</td></tr>
<tr><td>5</td><td>Delivery condition</td></tr>
<tr><td>7</td><td>Product shall be free from harmful defects</td></tr>
<tr><td rowspan="4">〚A1〛
44</td><td rowspan="4">External defects (eddy current) – alternative to penetrant</td><td>1</td><td>The eddy current technique shall be agreed between the manufacturer and the purchaser and shall be stated in an inspection schedule
Eddy current testing to the requirements of this Standard shall only be carried out and supervised by personnel holding an appropriate current qualification in accordance with BS EN 4179</td></tr>
<tr><td>2</td><td>Each product 100%</td></tr>
<tr><td>5</td><td>Delivery condition</td></tr>
<tr><td>7</td><td>Product shall be free from harmful defects 〚/A1〛</td></tr>
<tr><td rowspan="4">61</td><td rowspan="4">Internal defects (ultrasonic)</td><td>1</td><td>〚A1〛 BS EN 4050-2 〚/A1〛</td></tr>
<tr><td>2</td><td>Each product 100%</td></tr>
<tr><td>5</td><td>〚A1〛 Delivery condition or, where this is impractical, at an intermediate stage of manufacture. 〚/A1〛</td></tr>
<tr><td>6</td><td>〚A1〛 Delivery condition 〚/A1〛</td></tr>
<tr><td>7</td><td>Product shall be free from harmful defects</td></tr>
<tr><td>74</td><td>Surface contamination</td><td>—</td><td>See Section 3 (forging stock) and Section 8 (wire) of BS TA 100</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>95</td><td>Marking</td><td>—</td><td>See Section 3 (forging stock) and Section 8 (wire) of BS TA 100</td></tr>
<tr><td>96</td><td>Dimensional inspection</td><td>—</td><td>See Section 3 (forging stock) and Section 8 (wire) of BS TA 100</td></tr>
<tr><td>98</td><td>Notes</td><td>—</td><td>1) British Standards covering other forms of material of similar composition are:
<table>
<tr><td rowspan="2">R_m (MPa)</td><td>min.</td><td>895</td><td>900</td><td>920</td><td>960</td></tr>
<tr><td>max.</td><td>1 150</td><td>1 160</td><td>1 180</td><td>1 270</td></tr>
<tr><td colspan="2">Limiting ruling section (mm)</td><td></td><td>150</td><td></td><td></td></tr>
<tr><td colspan="2">Maximum thickness (mm)</td><td>100</td><td></td><td colspan="2"></td></tr>
<tr><td colspan="2">Form</td><td colspan="4">British Standard</td></tr>
<tr><td colspan="2">Sheet</td><td>—</td><td>—</td><td>BS TA 59</td><td>BS TA 10</td></tr>
<tr><td colspan="2">Bar and section for machining</td><td>—</td><td>BS TA 11</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">Forging stock</td><td>—</td><td>〚A1〛 BS EN 3310 〚/A1〛</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">Forgings</td><td>—</td><td>〚A1〛 BS EN 3312 〚/A1〛</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">Plate</td><td>BS TA 56</td><td>—</td><td>—</td><td>—</td></tr>
</table>
2) When agreed between manufacturer and the purchaser and stated on the drawing, order or inspection schedule
3) Selected temperature shall be held at ±10 °C
4) Selected temperature shall be held at +10 °C, for not less than 10 min for sizes up to and including 10 mm and for sizes over 10 mm held at the selected temperature +10 °C for not less than 30 min
5) Attention is drawn to the fact that exceeding 960 °C might lead to overheating</td></tr>
<tr><td>99</td><td>Typical use</td><td></td><td>Primarily intended for the manufacture of fasteners conforming to the requirements of the BS “A” series of British Standards</td></tr>
</table>

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS TA 10, *Specification of titanium-aluminium-vanadium alloy (Tensile strength 960–1 270 MPa)*

BS TA 11, *Specification for bar and section for machining of titanium-aluminium-vanadium alloy (Tensile strength 900–1 160 MPa) (Limiting ruling section 150 mm)*

〉A1〈 Text deleted 〉A1〈

BS TA 56, *Specification for plate of titanium-aluminium-vanadium alloy (Tensile strength 895–1 150 MPa) (Maximum thickness 100 mm)*

BS TA 59, *Specification for sheet and strip of titanium-aluminium-vanadium alloy (Tensile strength 920–1 180 MPa)*

〉A1〈 BS EN 3310, *Aerospace series – Titanium alloy TI-P64001 (Ti-6Al-4V) – Not heat treated – Forging stock, for annealed forgings – De* $\leqslant$ *360 mm*

BS EN 3312, Aerospace series – Titanium alloy Ti-6Al-4V – Annealed – Forgings De $\leqslant$ *150 mm* 〉A1〈

〉A1〈 BS EN 4500-001 〉A1〈, *Aerospace series – Metallic materials – Rules for the drafting and presentation of material standards – Part 1: General rules*

〉A1〈 BS EN 4500-004 〉A1〈, *Aerospace series – Metallic materials – Rules for the drafting and presentation of material standards – Part 4: Specific rules for titanium and titanium alloys*

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