BS 2HR 404:2011

BSI Standards Publication

AEROSPACE SERIES

Specification for nickel-cobalt-chromium-molybdenum-titanium-aluminium heat-resisting alloy seamless tubes (Nickel base, Co 20, Cr 20, Mo 5.9, Ti 2.1, Al 0.5)

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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 31 January 2011. It was prepared by Panel ACE/61/-/48, *Heat resisting alloys for aerospace purposes*, 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

This standard supersedes BS HR 404:1973, which is withdrawn.

Information about this document

This is a full revision of BS HR 404 and introduces the following principal changes.

a) Change in title.

b) Requirements are stated in tabular format in accordance with EN 4500-1 and EN 4500-3.

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 methods are expressed either as a set of instructions or 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 nickel-cobalt-chromium-molybdenum-titanium-aluminium heat-resisting alloy seamless tubes.

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 HR 100, *Procedure for inspection, testing and acceptance of wrought heat resisting alloys*

3 Technical requirements

Material to this standard shall conform to Table 1.

NOTE The format and symbols used in Table 1 are derived from EN 4500-1 and EN 4500-3.

Table 1 **Technical requirements for nickel-cobalt-chromium-molybdenum-titanium-aluminium heat-resisting alloy seamless tubes**

1	**Material designation**			**BS HR 404**								
2	**Chemical composition %**	Element		C	Si	Mn	S	Ag	Al	B	Bi	Co
		Min.		0.04	—	—	—	—	0.30	—	—	19.0
		Max.		0.08	0.40	0.60	0.007	5 ppm	0.60	0.005	1 ppm	21.0
		Element		Cr	Cu	Fe	Mo	Pb	Ti	Al + Ti	Ni	
		Min.		19.0	—	—	5.6	—	1.9	2.4	Base	
		Max.		21.0	0.2	0.7	6.1	20 ppm	2.4	2.8		
3	**Method of melting**			Induction melted and cast in air; induction melted, vacuum refined and cast in air; consumable electrode remelted.								
4.1	**Form**			Seamless tube								
4.2	**Method of production**			—								
4.3	**Limit dimension(s)**		mm	—								
5	**Technical specification**			Sections 1 and 6 of BS HR 100								

6.1	**Delivery condition**	Cold worked + solution treated
	Heat treatment	θ = (1 150 ±10) °C / t ≤ 15 min / AC or other medium
6.2	**Delivery condition code**	W
7	**Use condition**	Solution treated + precipitation treated
	Heat treatment	Delivery condition + θ = (800 ±10) °C / t = 8 h / AC

Characteristics

8.1	**Test sample(s)**			See Section 6 of BS HR 100				
8.2	**Test piece(s)**			See Section 6 of BS HR 100				
8.3	**Heat treatment**			Delivery condition	Use condition		Reference [1] (see line 29)	
9	**Dimensions concerned**		mm	—	a < 0.5	a ≥ 0.5	—	
10	**Thickness of cladding on each face**		%	—				
11	**Direction of test piece**			—	L	L	—	
12	**T** **Temperature**	θ	°C	Ambient	780	780	—	
13	**Proof stress**	$R_{p0.2}$	MPa	—	—	≥ 400	—	
14	**Strength**	R_m	MPa	—	≥ 540	≥ 540	—	
15	**Elongation**	A	%	—	—	≥ 9 ($A_{25\ mm}$)	—	
16	**Reduction of area**	Z	%	—				
17	**Hardness**			HV ≤ 230	—	—	—	
18	**Shear strength**	R_c	MPa	—				
19	**Bending**	κ	—	—				
20	**Impact strength**			—				
21	**C** **Temperature**	θ	°C	—	—	—	780	
22	**Time**		h	—	—	—	50	
23	**Stress**	σ_a	MPa	—	—	—	120	
24	**Elongation**	a	%	—	—	—	Total plastic strain ≤ 0.10	
25	**Rupture stress**	σ_R	MPa	—				
26	**Elongation at rupture**	A	%	—				
27	**Notes** (see line 98)			[1]				

Table 1 **Technical requirements for nickel-cobalt-chromium-molybdenum-titanium-aluminium heat-resisting alloy seamless tubes** *(continued)*

29	**Reference heat treatment**	—	Solution treated + precipitation treated θ = (1 150 ±10) °C / 1.5 h ≤ t ≤ 2.5 h / WQ + θ = (800 ±10) °C / t = 8 h / AC
33	**Flattening test**	—	See Section 6 of BS HR 100
		5	Delivery condition
		6	Wall thickness (mm) — Flattening distance < 1 — Closed flat ≥ 1 — Flattened to a distance of not more than five times the wall thickness
		7	The samples shall be free from cracks.
44	**External defects**	—	See Section 6 of BS HR 100
95	**Marking**	—	See Section 6 of BS HR 100
96	**Dimensional inspection**	—	See Section 6 of BS HR 100
98	**Notes**	—	[1)] Tested at a stage prior to manufacture of the tube.

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.

EN 4500-1, *Metallic materials – Rules for the drafting and presentation of material standards – Part 1: General rules* [1)]

EN 4500-3, *Metallic materials – Rules for the drafting and presentation of material standards – Part 3: Specific rules for heat resisting alloys* [1)]

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

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