BS 3HR 501:2011

BSI Standards Publication

AEROSPACE SERIES

Specification for nickel-chromium-cobalt-titanium-aluminium heat-resisting alloy cold drawn wire for springs and springs (Nickel base, Cr 19.5, Co 18.0, Ti 2.5, Al 1.5)

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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This standard supersedes BS 2HR 501:1973, which is withdrawn.

Information about this document

This is a full revision of BS HR 501. The principal change from the previous edition is that 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-chromium-cobalt-titanium-aluminium heat-resisting alloy cold drawn wire for the manufacture of springs (designation HR 501A) and springs.

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-chromium-cobalt-titanium-aluminium heat-resisting alloy cold drawn wire for springs and springs**

1	**Material designation**			**BS HR 501**							
2	**Chemical composition %**	Element		C	Si	Mn	S	Ag	Al	B	Bi
		Min.		—	—	—	—	—	1.0	—	—
		Max.		0.13	1.0	1.0	0.015	5 ppm	2.0	0.020	1 ppm
		Element		Co	Cr	Cu	Fe	Pb	Ti	Zr	Ni
		Min.		15.0	18.0	—	—	—	2.0	—	Base
		Max.		21.0	21.0	0.2	1.5	20 ppm	3.0	0.15	
3	**Method of melting**			Induction melted, vacuum refined and cast in air or consumable electrode remelted.							
4.1	**Form**			Wire (HR 501A)							
4.2	**Method of production**			Cold drawn				Formed from HR 501A wire			
4.3	**Limit dimension(s)**		mm	D ≤ 8.0				D ≤ 8.0			
5	**Technical specification**			Sections 1 and 7 of BS HR 100				Sections 1 and 7 of BS HR 100			

6.1	**Delivery condition**	Cold drawn	Formed + precipitation treated
	Heat treatment	—	θ = (600 ±10) °C / t = 16 h / AC [1)]
6.2	**Delivery condition code**	F	U
7	**Use condition**	Delivery condition	Delivery condition
	Heat treatment	—	—

Characteristics

8.1	**Test sample(s)**			See Section 7 of BS HR 100				See Section 7 of BS HR 100			
8.2	**Test piece(s)**			See Section 7 of BS HR 100				See Section 7 of BS HR 100			
8.3	**Heat treatment**			Delivery condition	Reference (see line 29)			Use condition			
9	**Dimensions concerned**		mm	—	0.44 ≤ D ≤ 1.0	1.0 < D ≤ 5.0	5.0 < D ≤ 8.0	0.44 ≤ D ≤ 1.0	1.0 < D ≤ 5.0	5.0 < D ≤ 8.0	
10	**Thickness of cladding on each face**		%	—							
11	**Direction of test piece**			—	L			L			
12	**T**	**Temperature**	θ	°C	—	Ambient			Ambient		
13		**Proof stress**	$R_{p0.2}$	MPa	—	—	≥ 1 160	≥ 1 000	—	≥ 1 160	≥ 1 000
14		**Strength**	R_m	MPa	—	≥ 1 540	≥ 1 390	≥ 1 310	≥ 1 540	≥ 1 390	≥ 1 310
15		**Elongation**	A_{50mm}	%	—	—	—	≥ 10	—	—	≥ 10
16		**Reduction of area**	Z	%	—						
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)]						

Table 1 **Technical requirements for nickel-chromium-cobalt-titanium-aluminium heat-resisting alloy cold drawn wire for springs and springs** *(continued)*

29	**Reference heat treatment**	—	Precipitation treated θ = (600 ±10) °C / t = 16 h / AC
37	**Reverse bend test**	—	See Section 7 of BS HR 100
		3	Wire
		4	a or D > 2 mm
		5	Delivery condition
		6	Former radius: Round wire: 3D Other section: as agreed between the manufacture and purchaser
		7	No failure after: Round wire: three bends Other section: as agreed between the manufacture and purchaser
42	**Simple torsion test**	—	See Section 7 of BS HR 100
		3	Wire
		4	0.45 mm ≤ a or D ≤ 5.0 mm
		5	Reference (see line 29)
		6	Length between grips: Round wire: 100D Other section: as agreed between the manufacture and purchaser
		7	No failure after: Round wire: eight turns Other section: as agreed between the manufacture and purchaser
43	**Wrapping test**	—	See Section 7 of BS HR 100
		3	Wire
		4	a or D ≤ 2 mm
		5	Delivery condition
		6	Mandrel diameter: Round wire: D Other section: as agreed between the manufacture and purchaser
		7	No failure after eight turns
44	**External defects**	—	See Section 7 of BS HR 100
		3	Wire
51	**Macrostructure**	—	See Section 7 of BS HR 100
		3	Wire
95	**Marking**	—	See Section 7 of BS HR 100
96	**Dimensional inspection**	—	See Section 7 of BS HR 100
98	**Notes**	—	[1)] If required by the purchaser and stated on the order, an alternative precipitation treatment of θ = (650 ±10) °C / t = 4 h / AC may be used.

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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BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

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