BS 2HR 52:2010

BSI Standards Publication

AEROSPACE SERIES

Specification for heat-resisting steel billets, bars, forgings and parts (Ni 25.5, Cr 14.7, Ti 1.8, Mn 1.5, Mo 1.2, V 0.3)

Publishing and copyright information

ISBN 978 0 580 67437 2

ICS 49.025.10

The following BSI references relate to the work on this standard:
Committee reference ACE/61
Draft for comment 09/30201778 DC

Publication history

First published September 1973
Second (present) edition, January 2010

Amendments issued since publication

Date	Text affected

Contents

Summary of pages
This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 8, 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 2010. It was prepared by Panel ACE/61/-/48, *Heat resisting 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

This standard supersedes BS HR 52:1973, which is withdrawn.

Information about this document

This is a full revision of BS HR 52, 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 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 nickel-chromium-titanium-manganese-molybdenum-vanadium heat-resisting steel supplied in the following forms, and as parts.

a) Bars for machining: solution treated, designation HR 52A.

b) Billets and bars for forging: hot or cold worked and subsequently machined or ground, designation HR 52B.

c) Forgings: solution treated, designation HR 52C.

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

3.1 Material to this standard shall conform to Table 1, Table 2 and Table 3.

NOTE The format and symbols used in Table 1, Table 2 and Table 3 are derived from EN 4500-1 and EN 4500-3.

3.2 Parts finally heat-treated after machining shall conform to Section **1** and Section **8** of BS HR 100.

3.3 Parts shall be supplied in the solution treated and precipitation treated condition.

Table 1 **Technical requirements for nickel-chromium-titanium-manganese-molybdenum-vanadium heat-resisting steel bars for machining**

1	**Material designation**			**BS HR 52**						
2	**Chemical composition %**	Element		C	Si	Mn	P	S	Al	B
		Min.		—	—	—	—	—	—	0.003 0
		Max.		0.06	0.5	2.0	0.020	0.015	0.35	0.010
		Element		Cr	Mo	Ni	Pb	Ti	V	Fe
		Min.		13.5	1.0	24.0	—	1.7	0.10	Base
		Max.		16.0	1.5	27.0	50 ppm	2.0	0.50	
3	**Method of melting**			Air melted; vacuum melted; air melted and vacuum refined; consumable electrode remelted						
4.1	**Form**			Bars for machining (HR 52A)						
4.2	**Method of production**			—						
4.3	**Limit dimension(s)**		mm	—						
5	**Technical specification**			Sections 1 and 2 of BS HR 100						

6.1	**Delivery condition**		Solution treated	
	Heat treatment		θ = (980 ±10) °C / t ⩾ 1 h / AC	
6.2	**Delivery condition code**		W	
7	**Use condition**		Solution treated + precipitation treated	
	Heat treatment		Delivery condition + θ = (720 ±10) °C [1] / t ⩾ 16 h / AC	
			Characteristics	
8.1	**Test sample(s)**		See Section 2 of BS HR 100	
8.2	**Test piece(s)**		See Section 2 of BS HR 100	
8.3	**Heat treatment**		Delivery condition	Use condition
9	**Dimensions concerned**	mm	—	
10	**Thickness of cladding on each face**	%	—	
11	**Direction of test piece**		L	
12	T **Temperature**	θ °C	Ambient	Ambient
13	T **Proof stress**	$R_{p0.2}$ MPa	—	⩾ 580
14	T **Strength**	R_m MPa	—	⩾ 850
15	T **Elongation**	A %	—	⩾ 20
16	T **Reduction of area**	Z %	—	—
17	**Hardness**		HBW ⩽ 217 or HV ⩽ 230	HBW ⩾ 235 or HV ⩾ 250
18	**Shear strength**	R_c MPa	—	
19	**Bending**	κ —	—	
20	**Impact strength**		—	
21	C **Temperature**	θ °C	—	650 [2]
22	C **Time**	h	—	t_R ⩾ 30 [2]
23	C **Stress**	σ_a MPa	—	—
24	C **Elongation**	a %	—	—
25	C **Rupture stress**	σ_R MPa	—	410 [2]
26	C **Elongation at rupture**	A %	—	⩾ 3.5 [2]
27	**Notes** (see line 98)		[1], [2]	

Table 1 **Technical requirements for nickel-chromium-titanium-manganese-molybdenum-vanadium heat-resisting steel bars for machining** *(continued)*

34	**Grain size**	—	See Section 1 of BS HR 100
		2	One per batch
		3	Transverse sample. One end of bar.
		5	Use condition
		7	<table><tr><th>a or D (mm)</th><th>Average grain size (mm)</th></tr><tr><td>⩽ 100</td><td>⩽ 0.127</td></tr><tr><td>> 100</td><td>⩽ 0.254</td></tr></table>
44	**External defects**	—	See Section 2 of BS HR 100
51	**Macrostructure**	—	See Section 2 of BS HR 100
61	**Internal defects**	—	See Section 2 of BS HR 100
95	**Marking**	—	See Section 2 of BS HR 100
96	**Dimensional inspection**	—	See Section 2 of BS HR 100
98	**Notes**	—	[1] Heat steadily from 550 °C to 720 °C in a minimum of 1 h. [2] The test shall be carried out on a combined notched and unnotched test piece or on separate notched and unnotched test pieces. If a combined test piece is used, rupture shall occur in the unnotched portion. If separate test pieces are used, the time to rupture of the notched test piece shall exceed that of the unnotched test piece.

Table 2 **Technical requirements for nickel-chromium-titanium-manganese-molybdenum-vanadium heat-resisting steel billets and bars for forging**

1	**Material designation**			**BS HR 52**						
2	**Chemical composition %**	Element		C	Si	Mn	P	S	Al	B
		Min.		—	—	—	—	—	—	0.003 0
		Max.		0.06	0.5	2.0	0.020	0.015	0.35	0.010
		Element		Cr	Mo	Ni	Pb	Ti	V	Fe
		Min.		13.5	1.0	24.0	—	1.7	0.10	Base
		Max.		16.0	1.5	27.0	50 ppm	2.0	0.50	
3	**Method of melting**			Air melted; vacuum melted; air melted and vacuum refined; consumable electrode remelted						
4.1	**Form**			Billets and bars for forging (HR 52B)						
4.2	**Method of production**			—						
4.3	**Limit dimension(s)**		mm	—						
5	**Technical specification**			Sections 1 and 3 of BS HR 100						

6.1	**Delivery condition**	Hot or cold worked and subsequently machined or ground [1)]
	Heat treatment	—
6.2	**Delivery condition code**	F
7	**Use condition**	Delivery condition
	Heat treatment	—

					Characteristics	
8.1	**Test sample(s)**				See Section 3 of BS HR 100	
8.2	**Test piece(s)**				See Section 3 of BS HR 100	
8.3	**Heat treatment**				Delivery condition	Reference (see line 29)
9	**Dimensions concerned**			mm	—	
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	—	⩾ 580
14		**Strength**	R_m	MPa	—	⩾ 850
15		**Elongation**	A	%	—	⩾ 20
16		**Reduction of area**	Z	%	—	—
17	**Hardness**				—	HBW ⩾ 235 or HV ⩾ 250
18	**Shear strength**		R_c	MPa	—	
19	**Bending**		κ	—	—	
20	**Impact strength**				—	
21	**C**	**Temperature**	θ	°C	—	650 [2)]
22		**Time**		h	—	t_R ⩾ 30 [2)]
23		**Stress**	σ_a	MPa	—	—
24		**Elongation**	a	%	—	—
25		**Rupture stress**	σ_R	MPa	—	410 [2)]
26		**Elongation at rupture**	A	%	—	⩾ 3.5 [2)]
27	**Notes** (see line 98)				[1), 2)]	

Table 2 **Technical requirements for nickel-chromium-titanium-manganese-molybdenum-vanadium heat-resisting steel billets and bars for forging** *(continued)*

29	**Reference heat treatment**	—	Solution treated + precipitation treated θ = (980 ±10) °C / t ⩾ 1 h / AC + θ = (720 ±10) °C[3] / t ⩾ 16 h / AC
44	**External defects**	—	See Section 3 of BS HR 100
51	**Macrostructure**	—	See Section 3 of BS HR 100
61	**Internal defects**	—	See Section 3 of BS HR 100
95	**Marking**	—	See Section 3 of BS HR 100
96	**Dimensional inspection**	—	See Section 3 of BS HR 100
98	**Notes**	—	[1] Material of other than round section may be supplied in the descaled condition. [2] The test shall be carried out on a combined notched and unnotched test piece or on separate notched and unnotched test pieces. If a combined test piece is used, rupture shall occur in the unnotched portion. If separate test pieces are used, the time to rupture of the notched test piece shall exceed that of the unnotched test piece. [3] Heat steadily from 550 °C to 720 °C in a minimum of 1 h.

Table 3 **Technical requirements for nickel-chromium-titanium-manganese-molybdenum-vanadium heat-resisting steel forgings**

1	**Material designation**			**BS HR 52**						
2	**Chemical composition %**	Element		C	Si	Mn	P	S	Al	B
		Min.		—	—	—	—	—	—	0.003 0
		Max.		0.06	0.5	2.0	0.020	0.015	0.35	0.010
		Element		Cr	Mo	Ni	Pb	Ti	V	Fe
		Min.		13.5	1.0	24.0	—	1.7	0.10	Base
		Max.		16.0	1.5	27.0	50 ppm	2.0	0.50	
3	**Method of melting**			Air melted; vacuum melted; air melted and vacuum refined; consumable electrode remelted						
4.1	**Form**			Forgings (HR 52C)						
4.2	**Method of production**			Forged from HR 52B stock						
4.3	**Limit dimension(s)**		mm	—						
5	**Technical specification**			Sections 1 and 4 of BS HR 100						

6.1	**Delivery condition**		Solution treated	
	Heat treatment		θ = (980 ±10) °C / t ⩾ 1 h / AC	
6.2	**Delivery condition code**		W	
7	**Use condition**		Solution treated + precipitation treated	
	Heat treatment		Delivery condition + θ = (720 ±10) °C [1] / t ⩾ 16 h / AC	

Characteristics

8.1	**Test sample(s)**			See Section 4 of BS HR 100		
8.2	**Test piece(s)**			See Section 4 of BS HR 100		
8.3	**Heat treatment**			Delivery condition	Use condition	
9	**Dimensions concerned**		mm	—		
10	**Thickness of cladding on each face**		%	—		
11	**Direction of test piece**			L		
12	**T**	**Temperature**	θ °C	Ambient	Ambient	
13		**Proof stress**	$R_{p0.2}$ MPa	—	⩾ 580	
14		**Strength**	R_m MPa	—	⩾ 850	
15		**Elongation**	A %	—	⩾ 20	
16		**Reduction of area**	Z %	—	—	
17	**Hardness**			HBW ⩽ 217 or HV ⩽ 230	HBW ⩾ 235 or HV ⩾ 250	
18	**Shear strength**		R_c MPa	—		
19	**Bending**		κ —	—		
20	**Impact strength**			—		
21	**C**	**Temperature**	θ °C	—	650 [2]	
22		**Time**	h	—	t_R ⩾ 30 [2]	
23		**Stress**	σ_a MPa	—	—	
24		**Elongation**	a %	—	—	
25		**Rupture stress**	σ_R MPa	—	410 [2]	
26		**Elongation at rupture**	A %	—	⩾ 3.5 [2]	
27	**Notes** (see line 98)			[1], [2]		

Table 3 **Technical requirements for nickel-chromium-titanium-manganese-molybdenum-vanadium heat-resisting steel forgings** *(continued)*

34	**Grain size**	—	See Section 1 of BS HR 100
		2	One per batch
		3	Transverse sample. At locations stated on the drawing.
		5	Use condition
		7	a or D (mm) / Average grain size (mm) ⩽ 100 / ⩽ 0.127 > 100 / ⩽ 0.254
44	**External defects**	—	See Section 4 of BS HR 100
51	**Macrostructure (grain flow)**	—	See Section 4 of BS HR 100
61	**Internal defects**	—	See Section 4 of BS HR 100
95	**Marking**	—	See Section 4 of BS HR 100
96	**Dimensional inspection**	—	See Section 4 of BS HR 100
98	**Notes**	—	[1] Heat steadily from 550 °C to 720 °C in a minimum of 1 h. [2] The test shall be carried out on a combined notched and unnotched test piece or on separate notched and unnotched test pieces. If a combined test piece is used, rupture shall occur in the unnotched portion. If separate test pieces are used, the time to rupture of the notched test piece shall exceed that of the unnotched test piece.

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

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
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