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Specification for

Wrought steels

in the form of blooms, billets, bars and forgings

Part 6. SI metric values (for use with BS 970: Parts 1 to 5)

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Foreword

This British Standard has been prepared under the authority of the Iron and Steel Industry Standards Committee and forms part 6 of the revision of BS 970, which is published in six parts as follows:

Part 1. Carbon and carbon manganese steels, including free cutting steels

Part 2. Direct hardening alloy steels, including alloy steels capable of surface hardening by nitriding

Part 3. Steels for case hardening, and Supplement No. 1 to BS 970: Part 3, Requirements for carbon and carbon manganese steels for case hardening, including free cutting steels

Part 4. Stainless, heat resisting and valve steels

Part 5. Carbon and alloy spring steels for the manufacture of hot formed springs

Part 6. SI metric equivalents (for use with BS 970: Parts 1 to 5)

This part of the standard gives converted values, in metric units, for limiting ruling section and size (excluding standard bar sizes and tolerances), stress (mechanical properties) and hardenability requirements included in parts 1 to 5. For practical purposes, the metric values quoted have been rounded where appropriate and therefore they are not necessarily exact mathematical equivalents of the imperial values. In the case of tensile strength and yield stress, the metric values are quoted to the nearest 10 N/mm^2 and 5 N/mm^2 respectively, in accordance with agreements reached in the Iron and Steel Industry Standards Committee. The average difference between the rounded conversions of stress values given in this part and the absolute equivalents of the imperial stress values in parts 1 to 5 is

+ 0.11 % for tensile strength

+ 0.01 % for yield stress and 0.2 % proof stress.

The maximum positive and negative deviation of any rounded conversion from an absolute equivalent (as given in parts 1 to 5) is

$^{+\ 1.8}_{-\ 1.0}$ % for tensile strength

$^{+\ 1.0}_{-\ 0.8}$ % for yield stress and 0.2 % proof stress.

When material is ordered to metric requirements, the metric values given in part 6 apply and, except as provided in clause 2, the provisions of the appropriate parts 1 to 5 continue to apply in all other respects.

It is stressed that the metric values specified in this part are only intended to apply for an interim period. The values in no way presuppose the requirements which may be contained in a full metric revision of parts 1 to 5 of BS 970. This revision is in the course of preparation and will take account of relevant ISO and European work.

It is also intended that provisions for metric tolerances on steel bar size, together with updated metric standard bar sizes, will be published as soon as agreement on these is reached.

BS 970 : Part 6 : 1973

British Standard Specification for

Wrought steels

in the form of blooms, billets, bars and forgings
Part 6. SI metric values (for use with BS 970: Parts 1 to 5)

1. Scope

This part of BS 970 specifies values in SI metric units for use in place of the values specified in imperial units in the parts 1 to 5 of BS 970, for

(a) Limiting ruling section and size (excluding standard bar sizes and tolerances)

(b) stress (mechanical properties)

(c) hardenability requirements.

NOTE. The titles of the British Standards referred to in this standard are listed on the inside back cover.

2. General

When it is required that steel to any of the parts 1 to 5 of BS 970 shall be supplied to metric units for limiting ruling section and size, stress, hardenability, the appropriate values given in clauses 4, 5, 6 and 7 of this part of BS 970 shall apply. The requirements of the relevant parts 1 to 5 of BS 970 shall continue to apply in all other respects with the following exceptions:

(a) that, unless it is specifically requested by the purchaser that the circular section tensile test pieces shall be to the inch dimensions specified in parts 1 to 5, they shall be to the dimensions of one of the circular section test pieces specified in BS 18:Part 2.

NOTE. Until agreement is reached on a preferred size of metric dimensions circular section test piece it is recommended that either the 11.28 or the 13.82 mm diameter test piece should be specified.

(b) that the purchaser may require the provisions for standard bar sizes and tolerances in imperial units to be waived.

NOTE 1. When the purchaser requires imperial bar sizes, the bars may be supplied to the sizes stated in Appendix A of BS 970: Parts 1 to 5, converted to equivalents in metric units (mm) based on a conversion factor of 25.4. In this case it is recommended that the relevant tolerances stated in each Appendix A of Parts 1 to 5, also converted to equivalents in metric units (mm) based on a conversion factor of 25.4, should apply.

NOTE 2. When the purchaser requires metric bar sizes it is recommended that he should initially consult BS 4229:Part 2. The use of sizes other than those given in BS 4229:Part 2 is not precluded, especially where an arrangement already exists between the purchaser and the supplier. Until British Standard requirements for metric tolerances for bars are published, these should be agreed between the purchaser and the supplier.

(c) that the values quoted for batch weights expressed in tons (applicable to product analysis and permitted variations) shall be regarded as applying to masses expressed in tonnes.

3. Information to be supplied by the purchaser

The following information shall be stated on the enquiry or order:

(a) that the steel is required to be supplied to the metric values given in part 6 of BS 970;

(b) whether it is required that the circular section tensile test pieces shall be to inch dimensions and, if not, the test piece size selected from BS 18:Part 2 (see note to 2(a)).

(c) whether the provisions for standard bar sizes and related tolerances given in imperial units in the appropriate parts 1 to 5 of BS 970 are required to be waived and, if so and subject to previous agreement, the requirements for metric bar size(s) and tolerances (see note 2 to 2(b)).

(d) the other information to be supplied by the purchaser as given in 1.3 of the appropriate parts 1 to 5 of BS 970.

4. Metric values of limiting ruling section, thickness and area

4.1 Limiting ruling section and thickness. The metric (mm) values specified in table 1 shall apply in place of the inch values specified in parts 1 to 5.

NOTE. Conversion basis : 1 in = 25.4 mm
Converted values have been rounded as follows:

to the nearest 1 mm for sections up to and including 3 in (76 mm);

to the nearest 5 mm for sections over 3 in up to and including 6 in (150 mm);

to the nearest 10 mm for a 10 in section.

Table 1. Metric values of limiting ruling section and thickness

in	mm	in	mm	in	mm
¼	6	1	25	2½	63
½	13	1⅛	29	3	76
⅝	16	1¼	32	4	100
¾	19	1½	38	6	150
⅞	22	1 9/16	40	10	250
		1¾	44		

NOTE. For conversion of various shapes in metric dimensions (mm) into metric (mm) equivalent diameters (ruling sections) see BS 5046 (in course of preparation).

4.2 Area. The metric (mm^2) value specification Table 2 shall apply in place of the in^2 value specified in parts 1 to 5.

NOTE. Conversion basis : 1 in^2 = 64516 mm^2
The converted value has been rounded to the nearest 1000 mm^2.

Table 2. Metric value for area

in^2	mm^2
100	65 000

5. Metric values of tensile strength

5.1 Where a minimum value is specified. (See 5.2 for conversions where a range is specified.) The metric values specified in table 3 shall apply in place of the tonf/in² values specified in parts 1 to 4.

NOTE. Conversion basis: Supplement No. 1 (1967) to BS 350 : Part 2 : 1962.
Converted values have been rounded to the nearest 10 N/mm² in accordance with agreed policy.

Table 3. Metric values of tensile strength where a minimum value is specified

R_m tonf/in² min.	R_m N/mm² (= MPa) min.	R_m tonf/in² min.	R_m N/mm² (= MPa) min.	R_m tonf/in² min.	R_m N/mm² (= MPa) min.
23	360	40	620	60	930
24	370	42	650		
		43	660	65	1000
25	390	44	680		
26	400			70	1080
27	420	45	690		
28	430	46	710	75	1160
29	450	47	730		
		48	740	80	1240
30	460	49	760		
32	490			85	1310
33	510	50	770		
34	530	51	790	90	1390
35	540	55	850	100	1540
36	560	56	860		
37	570				
38	590				
39	600				

5.2 Where a range is specified. (See 5.1 for where a minimum value is specified.) The metric values specified in table 4 shall apply in place of the tonf/in² values specified in parts 1 to 4.

NOTE. Conversion basis: Supplement No. 1 (1967) to BS 350 : Part 2 : 1962.
Converted values have been rounded to the nearest 10 N/mm² except where marked with an asterisk. Asterisked values have been adjusted to preserve a rational series.

Table 4. Metric values of tensile strength where a range is specified

Condition	R_m tonf/in²	R_m N/mm² (= MPa)	Condition	R_m tonf/in²	R_m N/mm² (= MPa)
P	35-45	550- 700*	V	65-75	1000-1150*
Q	40-50	620- 770	W	70-80	1080-1240
R	45-55	700* 850	X	75-85	1150*1300
S	50-60	770- 930	Y	80-90	1240-1400*
T	55-65	850-1000	Z	100 min	1540 min
U	60-70	930-1080			

* See Note to 5.2.

6. Metric values of yield stress and 0.2 % proof stress

The values specified in table 5 shall apply in place of the tonf/in^2 values specified in Parts 1 to 4.

NOTE. Conversion basis : Supplement No. 1 (1967) to BS 350 : Part 2 : 1962.
Converted values have been rounded to the nearest 5 N/mm^2 in accordance with agreed policy.

Table 5. Metric values of yield stress and 0.2 % proof stress

R_e or $R_{p0.2}$ tonf/in^2 min.	R_e or $R_{p0.2}$ N/mm^2 (= MPa) min.	R_e or $R_{p0.2}$ tonf/in^2 min.	R_e or $R_{p0.2}$ N/mm^2 (= MPa) min.
11	170	40	620
		41	635
12.5	195	42	650
13	200	43	665
13.5	210	44	680
14	215		
		45	695
15	230	47	725
16	245	48	740
17	265	49	755
18	280		
19	295	53	820
		54	835
20	310		
21	325	55	850
22	340	59	910
23	355		
24	370	60	925
		61	940
25	385		
26	400	65	1005
27	415	66	1020
28	430		
29	450	70	1080
		71	1095
30	465	72	1110
31	480	73	1125
32	495		
33	510	75	1160
34	525	78	1205
35	540	80	1235
36	555		
37	570		
38	585		
39	600		

7. Hardenability requirements

The values specified in tables 6, 7, 8 and 9 shall apply in place of those specified in parts 1, 2, 3 and 5, respectively.

NOTE. When specifying hardenability it is important that the distances selected should be clearly shown to be in mm (to avoid confusion with decimal inch, $^1/_{16}$ in distances), e.g. J39/7-13 mm.

Table 6. Hardenability requirements for carbon steels specified in BS 970:Part 1, Section 3

Distance from quenched end (mm)

Steel	Distance		1.25	2.00	2.75	3.50	4.25	5.00	5.75	6.50	7.25	9.00	10.50	12.00	15.00	20.00	25.00	40.00
080H36	HV 20 or 30	max.	700	675	645	615	575	525	455	385	340	305	295	285	275	265	255	240
		min.	550	520	440	290	250	238	232	227	222	216	212	208	204	195	188	167
080H41	HV 20 or 30	max.	750	730	700	665	615	550	475	410	365	330	315	305	295	285	270	250
		min.	600	550	485	355	285	255	245	240	237	233	230	225	225	220	210	180
080H46	HV 20 or 30	max.	800	770	735	695	650	580	500	440	390	340	325	315	310	300	290	270
		min.	650	590	500	355	295	270	260	255	250	245	240	235	228	220	210	205

Table 7. Hardenability requirements for direct hardening alloy steels specified in BS 970:Part 2, Section 3

Distance from quenched end (mm)

Steel	Distance		1.5	3	5	7	9	11	13	15	20	25	30	35	40	45	50
503H37	HRC values	max.	59	58	55	52	47	40	37	34	30	29	28	27	26	26	26
		min.	52	49	42	34	27	22	20	–	–	–	–	–	–	–	–
503H42	HRC values	max.	62	61	58	55	50	44	39	36	32	30	29	28	27	27	26
		min.	55	53	48	38	32	28	26	24	21	20	–	–	–	–	–
530H30	HRC values	max.	56	55	53	50	48	45	42	39	36	33	32	31	30	29	28
		min.	49	46	42	37	33	30	28	25	21	–	–	–	–	–	–
530H32	HRC values	max.	57	56	55	53	50	47	44	41	37	35	33	32	31	30	29
		min.	50	48	44	39	35	31	28	26	23	20	–	–	–	–	–
530H36	HRC values	max.	58	58	57	56	54	52	50	48	43	40	38	37	36	35	34
		min.	51	49	46	43	38	34	32	30	27	24	22	21	–	–	–
530H40	HRC values	max.	60	59	59	58	56	55	53	51	47	42	40	39	38	37	36
		min.	53	52	50	47	43	39	36	34	30	27	25	23	21	20	–
605H32	HRC values	max.	57	57	57	57	56	54	52	50	46	42	40	38	37	36	36
		min.	50	49	48	45	42	38	35	32	29	27	26	25	25	24	24
605H37	HRC values	max.	59	59	59	58	57	56	55	54	51	47	45	43	41	40	39
		min.	52	52	51	48	45	42	40	37	33	31	29	28	27	26	25
608H37	HRC values	max.	59	59	59	58	58	57	57	56	55	54	53	52	52	51	50
		min.	52	52	51	50	49	47	46	45	42	39	36	33	32	31	30
640H35	HRC values	max.	58	57	56	55	53	52	50	47	41	37	35	34	34	33	33
		min.	51	50	49	46	42	37	35	32	29	27	24	22	20	–	–
708H37	HRC values	max.	59	59	59	58	58	57	57	56	54	52	48	46	45	44	43
		min.	52	51	51	50	48	47	45	43	38	35	34	33	32	32	31
708H42	HRC values	max.	62	62	62	61	61	60	60	59	58	56	55	53	52	51	50
		min.	55	55	54	53	52	51	50	48	43	39	36	35	34	33	33

Table 8. Hardenability requirements for alloy steels for case hardening specified in BS 970:Part 3. Section 3

Distance from quenched end (mm)

Steel	Distance		1.5	3	5	7	9	11	13	15	20	25	30	35	40	45	50
635H15	HRC values	max.	45	43	40	36	33	30	28	26	24	23	22	20	–	–	–
		min.	38	32	26	23	21	–	–	–	–	–	–	–	–	–	–
637H17	HRC values	max.	46	45	44	42	40	37	35	33	31	30	29	28	28	27	26
		min.	39	37	34	29	27	24	23	21	20	–	–	–	–	–	–
655H13	HRC values	max.	44	44	44	43	42	41	40	39	37	35	34	33	32	32	31
		min.	37	36	34	32	30	28	27	25	23	22	21	–	–	–	–
659H15	HRC values	max.	45	45	45	45	45	45	45	45	45	45	45	44	44	43	43
		min.	38	38	38	38	38	38	38	38	37	36	35	34	33	31	30
665H17	HRC values	max.	46	44	41	36	31	28	25	24	22	21	20	–	–	–	–
		min.	39	33	24	21	–	–	–	–	–	–	–	–	–	–	–
665H20	HRC values	max.	48	45	41	37	32	29	27	25	23	21	20	–	–	–	–
		min.	41	35	26	22	20	–	–	–	–	–	–	–	–	–	–
665H23	HRC values	max.	51	49	46	43	39	34	31	29	27	25	24	23	22	22	22
		min.	44	40	33	28	26	23	22	21	20	–	–	–	–	–	–
805H17	HRC values	max.	46	44	40	36	32	28	27	25	23	21	20	–	–	–	–
		min.	39	33	26	22	20	–	–	–	–	–	–	–	–	–	–
805H20	HRC values	max.	48	47	44	40	35	32	30	28	25	24	23	23	23	22	22
		min.	41	37	31	25	22	20	–	–	–	–	–	–	–	–	–
805H22	HRC values	max.	50	49	46	43	38	34	32	30	27	25	25	24	24	24	24
		min.	43	39	33	28	25	22	20	–	–	–	–	–	–	–	–
805H25	HRC values	max.	52	51	48	45	41	37	35	33	29	27	26	26	26	25	25
		min.	45	41	35	31	28	25	23	21	–	–	–	–	–	–	–
815H17	HRC values	max.	46	46	45	45	44	43	42	41	38	35	34	34	33	33	33
		min.	39	37	35	33	32	30	29	27	25	22	20	–	–	–	–
820H17	HRC values	max.	46	46	46	46	45	45	44	44	42	40	38	38	37	37	36
		min.	39	39	38	37	35	33	32	30	28	26	25	25	24	24	24
822H17	HRC values	max.	46	46	46	46	45	45	45	45	45	44	43	43	42	42	41
		min.	39	39	39	38	38	37	37	36	35	33	32	31	30	29	28
832H13	HRC values	max.	44	44	44	44	44	44	44	43	42	40	38	36	35	34	33
		min.	37	37	37	36	34	32	30	28	26	23	22	21	21	21	20
835H15	HRC values	max.	45	45	45	45	45	45	45	45	45	45	44	44	44	43	43
		min.	38	38	38	38	38	38	38	38	37	36	35	34	33	32	30

Table 9. Hardenability requirements for spring steels specified in BS 970:Part 5. Section 3

Distance from quenched end (mm)

Steel	Distance		1.5	3	5	7	9	11	13	15	20	25	30	35	40	45	50
527H60	HRC values	max.	–	–	–	65	64	64	63	61	58	52	48	46	44	43	42
		min.	60	60	60	59	56	52	47	41	35	34	32	31	29	28	27
805H60	HRC values	max.	–	–	–	–	–	–	–	–	–	65	64	63	62	61	60
		min.	60	60	60	60	59	58	57	54	45	42	39	38	36	36	35

BSI publications referred to in this standard

This standard makes reference to the following British Standards:

BS 18	Methods for tensile testing of metals
	Part 2. Steel (general)
BS 350	Conversion factors and tables
	Part 2. Detailed conversion tables
	Supplement no. 1. Additional tables for SI conversions
BS 4229	Recommendations for sizes of non-ferrous and ferrous bars
	Part 2. Ferrous bars
BS 5046	Method for the estimation of equivalent diameters in the heat treatment of steel*

* In course of preparation

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