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INTERNATIONAL

Designation: B103/B103M - 15 B103/B103M - 19

Standard Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar¹

This standard is issued under the fixed designation B103/B103M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification establishes the requirements for copper-tin alloy (phosphor bronze), copper-tin-lead alloy (leaded phosphor bronze), and copper-tin-lead-zinc alloy (bearing bronze), plate, sheet, strip, and rolled bar. The phosphor bronzes commonly are used for deep drawing into bellows and stamping and forming into spring devices and into terminals and connectors for electrical apparatus because they combine high strength with high elongation. The leaded phosphor bronzes are used where strength, corrosion resistance, and machinability are required. The bearing bronze is used in bushings, bearings, and load-bearing thrust washers. The following alloys are covered:

Copper Alloy		Previously Used			
UNS No.2	Copper	Tin	Zinc	Lead	Designation
C51000	95	5			A1
C51100	96	4			A
C51180	96	4			
C51900	94	6			
C52100 ^A	92		andarda		С
C52180	92		aiiuaius		
C52400	90	10			D
C53400	94	/ 5			B1
C54400	88	os://atan		en.241)	B2

^A SAE Specification CA 521 conforms to the requirements of UNS No. C52100.

Note 1-All of the above alloys contain small amounts of phosphorus, used as a deoxidant in melting, and to enhance the mechanical properties.

1.2 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system mayare not benecessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other. Combiningother, and values from the two systems may result in non-conformance with the standard.shall not be combined.

1.3 The following safety hazard caveat pertains only to the test method(s) described in this specification.

1.3.1 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety safety, health, and healthenvironmental practices and determine the applicability of regulatory limitations prior to use.

<u>1.4 This international standard was developed in accordance with internationally recognized principles on standardization</u> established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:³

B248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar

*A Summary of Changes section appears at the end of this standard

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¹ This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.01 on Plate, Sheet, and Strip.

Current edition approved May 15, 2015 Oct. 1, 2019. Published June 2015 October 2019. Originally approved in 1936. Last previous edition approved in 2010 2015 as B103/B103M-15. DOI: 10.1520/B0103_B0103M-15.10.1520/B0103_B0103M-19.

 $^{^{2}}$ The UNS system for copper and copper alloys (see Practice E527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix "C" and a suffix "00." The suffix can be used to accommodate composition variations of the base alloy.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's standard's Document Summary page on the ASTM website.



B248M Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar (Metric)

B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

B846 Terminology for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)⁴

E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)⁴

E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition E478 Test Methods for Chemical Analysis of Copper Alloys

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

3. General Requirements

3.1 The following sections of Specifications B248 and B248M constitute a part of this specification. specification:

- 3.1.1 Terminology, Terminology;
- 3.1.2 Materials and Manufacturing, Manufacturing;
- 3.1.3 Workmanship, Finish, and Appearance; Appearance;
- 3.1.4 Sampling, Except for Chemical Analysis, Analysis;
- 3.1.5 Number of Tests and Retests, Retests;
- 3.1.6 Specimen Preparation, Preparation;
- 3.1.7 Test Methods, Except for Chemical Analysis, Analysis;
- 3.1.8 Significance of Numerical Limits, Limits;
- 3.1.9 Inspection, Inspection;
- 3.1.10 Rejection and Rehearing, Rehearing;
- 3.1.11 Certification, Certification;
- 3.1.12 Test Reports, Reports;
- 3.1.13 Packaging and Package Marking, Marking; and Standards
- 3.1.14 Supplementary Requirements.

3.2 In addition, when a section with a title identical to that referenced in 5.1 appears in this specification, it contains additional requirements, which supplement those appearing in Specifications B248 and B248M

4. Terminology

Document Preview

4.1 Definitions—For definitions of terms used in this specification, refer to Terminology B846.

5. Ordering Information

ASTM B103/B103M-19

5.1 Include the following specified choices when placing orders for product under this specification, as applicable: 3m-19 5.1.1 ASTM designation and year of issue (for example, B103/B103M – 04);

- 5.1.2 Copper [Alloy] UNS No. designation (for example, C51000);
- 5.1.3 Temper;
- 5.1.4 Dimensions: thickness, width, length, and so forth;
- 5.1.5 Form: plate, sheet, strip, or rolled bar;
- 5.1.6 How furnished: coils, specific length or stock lengths, with or without ends;
- 5.1.7 Quantity: total weight each form, temper, and size; and,
- 5.1.8 When material is purchased for agencies of the U.S. Government.

5.2 The following options are available but may not be included unless specified at the time of placing of the order when required; required; required;

5.2.1 Type of edge: slit, sheared, sawed, square corners, round corners, rounded edges, or full rounded edges;

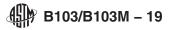
- 5.2.2 Width and straightness tolerances;
- 5.2.3 Heat identification or traceability details;
- 5.2.4 Certification, Certification; and
- 5.2.5 Mill-Test Report.

6. Materials and Manufacture

6.1 Materials:

6.1.1 The material of manufacture shall be a cast bar, cake, slab, of Copper Alloy UNS No. C51000, C51100, C51180, C51900, C52100, C52180, C52400, C53400, or C54400 of such purity and soundness as to be suitable for processing into the products prescribed herein.

⁴ The last approved version of this historical standard is referenced on www.astm.org.



6.1.2 When specified in the contract or purchase order, order that heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 2—Due to the discontinuous nature of the processing of castings into wrought products, it is not always practical to identify a specific casting analysis with a specific quantity of finished material.

6.2 Manufacture:

6.2.1 The product shall be manufactured by such hot working, cold working, and annealing processes as to produce a uniform wrought structure in the finished product.

6.2.2 The product shall be hot or cold worked to the finished size and subsequently annealed, when required, to meet the temper properties specified.

6.2.3 Edges—Slit edges shall be furnished unless otherwise specified in the contract or purchase order.

7. Chemical Composition

7.1 The materials shall conform to the chemical composition requirements specified in Table 1 for the copper alloy UNS No. designation specified in the ordering information.

7.2 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and purchaser, limits may be established and analysis required for unnamed elements.

7.3 Copper, specified as the "remainder," may be taken as the difference between the sum of results of all the elements determined and 100 %. When all the elements in Table 1 are determined, the sum of results for each alloy shall be 99.5 % min.

8. Temper

8.1 The standard tempers for products described in this specification are given in Table 2.

8.1.1 *M20 (as Hot-Rolled Material)*—The standard temper of sheet and plate produced by hot rolling asis designated in Table 2.

8.1.2 *H* (*Rolled Material*)—The standard tempers of rolled material are as designated in Table 2 with prefix "H." Former designations and the standard designations as defined in Classification B601 are shown.

NOTE 3—The properties of special and nonstandard tempers are subject to agreement between the manufacturemanufacturer and purchaser.

8.1.3 *O60* (*Annealed*)—The standard temper is O60 (soft), as indicated in Table 2.

9. Grain Size of Annealed Tempers

9.1 Other than O60 (soft) temper, as indicated in Table 2, annealed tempers are special, and the material shall conform to grain size requirements agreed upon between the manufacturer and purchaser as defined in Classification B601.

10. Mechanical Property Requirements rds/sist/8ceccc31-b441-4b85-ab6f-8201bec2e42e/astm-b103-b103m-19

10.1 Tensile Strength Requirements:

10.1.1 Product furnished under this specification in inch-pound units shall conform to tensile requirements prescribed in ksi units in Table 2, when tested in accordance with Test Methods E8/E8M.

			TAE	BLE 1 Chemic	al Requireme	ents			
					Composition,	%			
Element	Copper Alloy UNS No.								
	C51000	C51100	C51180	C51900	C52100	C52180	C52400	C53400 ^A	C54400 ^A
					Composition,	%			
Element				e	Copper Alloy UN	S No.			
	C51000	C51100	C51180	C51900	C52100	C52180	C52400	C53400^A	C54400^A
	4.2-5.8	3.5-4.9	3.5-4.9	5.0-7.0	7.0-9.0	7.0-9.0	9.0-11.0	3.5-5.8	3.5-4.5
Tin	4.2-5.8	3.5-4.9	3.5-4.9	5.0-7.0	7.0-9.0	7.0-9.0	9.0-11.0	3.5-5.8	3.5-4.5
Phosphorus	0.03-0.35	0.03-0.35	0.01-0.35	0.03-0.35	0.03-0.35	0.01-0.35	0.03-0.35	0.03-0.35	0.01-0.50
Phosphorus	0.03-0.35	0.03-0.35	0.01-0.35	0.03-0.35	0.03-0.35	0.01-0.35	0.03-0.35	0.03-0.35	0.01-0.50
Iron, max	0.10	0.10	0.05-0.20	0.10	0.10	0.05-0.20	0.10	0.10	0.10
Iron, max	0.10	0.10	0.05-0.20	0.10	0.10	0.05-0.20	0.10	0.10	0.10
Lead	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.8-1.2	3.0-4.0
Lead	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.8-1.2	3.0-4.0
Zine	0.30 max	0.30 max	0.30 max	0.30 max	0.20 max	0.30 max	0.20 max	0.30 max	1.5-4.5
Zinc	0.30 max	0.30 max	0.30 max	0.30 max	0.20 max	0.30 max	0.20 max	0.30 max	1.5-4.5
Nickel			0.05-0.20			0.05-0.20			
Nickel Copper	remainder	<u></u> remainder	0.05–0.20 remainder	remainder	<u></u> remainder	<u>0.05–0.20</u> remainder	remainder	remainder	remainder

^A When specified for bearings, the phosphorus content shall be maintained from 0.01 to 0.15 %.



TABLE 2 Tensile Strength Requirements and Approximate Rockwell Hardness Values

Note 1—Plate is generally available in only the as hot-rolled (M20) temper. Required properties for other tempers shall be agreed upon between the manufacturer <u>and</u> purchaser at the time of placing the order.

Temper Designation ^A		Thickness, in. [mm]	Tensile Strength, ksi ^B [MPa]		Approximate Rockwell Hardness	
Code	Name		Min	Max	B Scale	Superficial 30
		Copper Alloy UNS No. C				
M20 O60	as hot-rolled soft	Over 0.188 [4.775]	40 [275]	60 [415]		
Solution	Over 0.039 [0.991] Over 0.029 [0.737]	43 [295]	58 [400]	16-64	32-59	
	Over 0.020 [0.508] to 0.039 [0.991] incl			12-60		
		Over 0.010 [0.254] to 0.029 [0.737] incl				24-53
1.100		0.003 [0.076] to 0.010 [0.254] incl	50 [400]	70 (505)	04.05	
H02	half-hard	Over 0.039 [0.991] Over 0.029 [0.737]	58 [400]	73 [505]	64-85	59-73
		Over 0.02 [0.737] Over 0.02 [0.508] to 0.039 [0.991] incl			60-82	
		Over 0.010 [0.254] to 0.029 [0.737] incl				53-69
		0.003 [0.076] to 0.010 [0.254] incl				
H04 hard	hard	Over 0.039 [0.991]	76 [525]	91 [625]	86-93	
		Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl			84-91	73-78
		Over 0.010 [0.254] to 0.029 [0.737] incl				71-75
		0.003 [0.076] to 0.010 [0.254] incl				
H06	extra-hard	Over 0.039 [0.991]	88 [605]	103 [710]	92-96	
		Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl			89-95	77-81
		Over 0.010 [0.254] to 0.029 [0.737] incl				74-78
		0.003 [0.076] to 0.010 [0.254] incl				
H08	spring	Over 0.039 [0.991]	95 [655]	110 [760]	94-98	
		Over 0.029 [0.737]				79-82
		Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl			92-97	76-80
		0.003 [0.076] to 0.010 [0.254] incl				10.00
H10	extra-spring	Over 0.039 [0.991]	100 [690]	114 [785]	96-99	
		Over 0.029 [0.737]				80-83
		Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl			94-98	77-81
		0.003 [0.076] to 0.010 [0.254] incl				77 01
		Copper Alloy UNS Nos. C51100, C5				
M20	as hot-rolled	Over 0.188 [4.775]	40 [275]	58 [400]		
O60	soft	Over 0.039 [0.991] Over 0.029 [0.737]	40 [275]	55 [380]	7-50	24-50
					0-45	
		Over 0.010 [0.254] to 0.029 [0.737] incl			alastm b10	16-46
H02 stan	half-hard al/cata		+00055 [380] 02	70 [485]	60-81	3-010311F1
		Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl				57-73
H04 h					53-78	52-71
H04	hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991]	72 [495]	87 [600]	53-78 82-90	52-71
H04	hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737]	72 [495]	87 [600]	82-90	52-71
H04	hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl	72 [495]	87 [600]	82-90 80-86	52-71 71-77
		Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl			82-90 80-86	52-71 71-77 69-75
H04 H06	hard extra-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991]	72 [495] 84 [580]	87 [600] 99 [685]	82-90 80-86	52-71 71-77 69-75
		Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl			82-90 80-86	52-71 71-77 69-75
H06	extra-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.020 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl	84 [580]	99 [685]	82-90 80-86 88-94 86-92 	52-71 71-77 69-75 75-80
		Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991]			82-90 80-86 88-94 86-92 90-98	52-71 69-75 75-80 73-78
H06	extra-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.030 [0.991] Over 0.039 [0.991] Over 0.029 [0.737]	84 [580]	99 [685]	82-90 80-86 88-94 86-92 90-98 	52-71 69-75 75-80 73-78 77-81
H06	extra-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991]	84 [580]	99 [685]	82-90 80-86 88-94 86-92 90-98	52-71 69-75 75-80 73-78
H06	extra-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991]	84 [580]	99 [685]	82-90 80-86 88-94 90-98 86-94	52-71 71-77 69-75 75-80 73-78 77-81 75-79
H06 H08	extra-hard spring	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737]	84 [580] 91 [625]	99 [685] 106 [730]	82-90 80-86 88-94 86-92 86-94 92-97 	52-71 69-75 75-80 73-78 77-81 75-79 78-82
H06 H08	extra-hard spring	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737]	84 [580] 91 [625]	99 [685] 106 [730]	82-90 80-86 88-94 90-98 86-92 86-94 92-97 89-94	52-71 69-75 75-80 73-78 73-78 75-79 78-82
H06 H08	extra-hard spring	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737]	84 [580] 91 [625] 96 [660]	99 [685] 106 [730]	82-90 80-86 88-94 86-92 86-94 92-97 	52-71 69-75 75-80 73-78 77-81 75-79 78-82
H06 H08	extra-hard spring	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991]	84 [580] 91 [625] 96 [660]	99 [685] 106 [730]	82-90 80-86 88-94 90-98 86-92 86-94 92-97 89-94	52-71 69-75 75-80 73-78 77-81 75-79 78-82 76-80
H06 H08 H10	extra-hard spring extra-spring	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.029 [0.737] incl Over 0.020 [0.508] to 0.029 [0.737] incl Copper Alloy UNS No. C Over 0.039 [0.991] Over 0.039 [0.991]	84 [580] 91 [625] 96 [660]	99 [685] 106 [730] 108 [745]	82-90 80-86 88-94 90-98 90-98 86-94 92-97 89-94 89-94 	52-71 69-75 75-80 73-78 73-78 75-79 78-82
H06 H08 H10	extra-hard spring extra-spring	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991]	84 [580] 91 [625] 96 [660]	99 [685] 106 [730] 108 [745]	82-90 80-86 86-92 90-98 86-94 92-97 89-94 	52-71 71-77 69-75 73-78 73-78 73-78 75-79 78-82 76-80
H06 H08 H10	extra-hard spring extra-spring	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.029 [0.737] incl Over 0.020 [0.508] to 0.029 [0.737] incl Copper Alloy UNS No. C Over 0.039 [0.991] Over 0.039 [0.991]	84 [580] 91 [625] 96 [660] 251180 69 [475]	99 [685] 106 [730] 108 [745] 84 [580]	82-90 80-86 88-94 90-98 90-98 86-94 92-97 89-94 89-94 	52-71 69-75 75-80 73-78 77-81 75-79 78-82 76-80
H06 H08 H10 H02	extra-hard spring extra-spring half-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.9	84 [580] 91 [625] 96 [660]	99 [685] 106 [730] 108 [745]	82-90 80-86 88-94 90-98 90-98 86-92 86-94 89-94 89-94 89-94 	52-71 71-77 69-75 73-78 73-78 73-78 75-79 78-82 76-80
H06 H08 H10 H02	extra-hard spring extra-spring half-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.029 [0.737] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] <td>84 [580] 91 [625] 96 [660] 251180 69 [475]</td> <td>99 [685] 106 [730] 108 [745] 84 [580]</td> <td>82-90 80-86 88-94 90-98 90-98 86-92 86-94 89-94 89-94 89-94 </td> <td>52-71 69-75 75-80 73-78 75-80 75-79 76-80 69-75 67-73 71-77</td>	84 [580] 91 [625] 96 [660] 251180 69 [475]	99 [685] 106 [730] 108 [745] 84 [580]	82-90 80-86 88-94 90-98 90-98 86-92 86-94 89-94 89-94 89-94 	52-71 69-75 75-80 73-78 75-80 75-79 76-80 69-75 67-73 71-77
H06 H08 H10 H02	extra-hard spring extra-spring half-hard	Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.039 [0.991] Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.010 [0.254] to 0.029 [0.737] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.029 [0.737] Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.020 [0.506] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.039 [0.991] Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.020 [0.508] to 0.039 [0.991] incl Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.039 [0.991] Over 0.029 [0.737] Over 0.029 [0.737] Over 0.029 [0.737] <td>84 [580] 91 [625] 96 [660] 251180 69 [475]</td> <td>99 [685] 106 [730] 108 [745] 84 [580]</td> <td>82-90 80-86 88-94 90-98 86-94 92-97 89-94 89-94 80-90 78-88 84-92</td> <td>52-71 69-75 75-80 73-78 78-82 76-80 69-75 67-73</td>	84 [580] 91 [625] 96 [660] 251180 69 [475]	99 [685] 106 [730] 108 [745] 84 [580]	82-90 80-86 88-94 90-98 86-94 92-97 89-94 89-94 80-90 78-88 84-92	52-71 69-75 75-80 73-78 78-82 76-80 69-75 67-73