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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Copper-Nickel-Tin Spinodal Alloy Strip[1]

This standard is issued under the fixed designation B 740; 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 Department of Defense.

1. Scope

1.1 This specification covers copper-nickel-tin alloy strip. The following alloys are covered:[2]

Copper Alloy UNS No.[2]	Nominal Composition Weight %		
	Copper	Nickel	Tin
C72700	85	9	6
C72900	77	15	8
C72650	87.5	7.5	5

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar[3]

B 598 Practice for Determining Offset Yield Strength in Tension for Copper Alloys[3]

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast[3]

E 3 Methods of Preparation of Metallographic Specimens[4]

E 8 Test Methods of Tension Testing of Metallic Materials[4]

E 290 Test Method for Semi-Guided Bend Test for Ductility of Metallic Materials[4]

E 527 Practice for Numbering Metals and Alloys (UNS)[5]

3. Ordering Information

3.1 Orders for materials under this specification should include the following information:

3.1.1 Quantity,

3.1.2 Copper Alloy UNS number (see 1.1),

3.1.3 Form of material: strip,

3.1.4 Temper (see 5.1),

3.1.5 Dimensions: thickness and width, and length if applicable,

3.1.6 How furnished: rolls or coils, stock lengths with or without ends, specific lengths with or without ends,

3.1.7 Type of edge other than slit, for example, rounded corners, rounded edges, or full-rounded edges (see Section 10).

3.1.8 Width and straightness tolerances, if different from those required in Specification B 248 (see Section 10).

3.1.9 Special thickness tolerances if required (see Section 10),

3.1.10 Certification if required,

3.1.11 Mill test report if required,

3.1.12 Specification number and date, and

3.1.13 Special tests or exceptions, if any.

3.2 When material is purchased for agencies of the U.S. Government, this shall be specified in the contract or purchase order, and the material shall conform to the Supplementary Requirements as defined in the current issue of Specification B 248.

4. Chemical Composition

4.1 The material shall conform to the requirements specified in Table 1.

4.2 These specification limits do not preclude the presence of other elements. Limits for unnamed elements may be established by agreement between manufacturer or supplier and purchaser. Copper may be given as remainder and taken as the difference between the sum of all elements analyzed and 100 %. When all the elements in the table including copper are analyzed, their sum shall be 99.7 % min.

5. Temper

5.1 The standard tempers of material are as designated in Table 2, Table 3, and Table 4. Tempers are as follows: TB00 (solution heat treated), or with varying additional degrees of cold rolling TD01 to TD12 (solution heat treated with varying degrees of cold rolling); spinodal hardened from these appropriate tempers TX00 or TS01 to TS12 (spinodal hardened from the appropriate solution heat treated or solution heat treated and cold rolled temper); or: Mill Hardened TM00 to TM08 (mill hardened).

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[1] This specification is under the ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.01 on Plate, Sheet, and Strip.

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[2] The UNS system for copper alloys (see Practice E 527) 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] *Annual Book of ASTM Standards*, Vol 02.01.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

[5] *Annual Book of ASTM Standards*, Vol 01.01.

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Previous Designation	Composition, %: Copper, incl Silver	Lead[A], max	Iron[A], max	Zinc[A], max	Nickel, incl Cobalt	Tin	Manganese[A], max	Niobium[A], max	Magnesium[A], max
C72650	Cu-7.5Ni-5Sn	remainder	0.01	0.50	0.20	7.0–8.0	4.5–5.5	0.10	...	...
C72700	Cu-9Ni-6Sn	remainder	0.02	0.50	0.50	8.5–9.5	5.5–6.5	0.30	0.10	0.15
C72900	Cu-15Ni-8Sn	remainder	0.02	0.50	0.50	14.5–15.5	7.5–8.5	0.30	0.10	0.15

[A] The total of the elements Pb, Fe, Zn, Mn, Cb, and Mg not to exceed 0.7 %.

TABLE 2 Tensile Property Requirements

Tempers: Solution Heat-Treated
Solution Heat-Treated and Cold Worked

Copper Alloy UNS No.	Temper Designations: Standard[E]	Temper Designations: Former	Tensile Strength, ksi[A] (MPa)[B] min–max[C]	Yield[D] Strength (0.05 % Offset), ksi[A] (MPa)[B] min–max[C]	Elongation in 2 in., %
C72650	TB00	Solution HT	55–70 (379—482)	21—32 (145–220)	32
C72650	TD01	¼ Hard	60–75 (413–517)	45–60 (310–413)	18
C72650	TD02	½ Hard	75—85 (517—586)	55–75 (379–516)	5
C72650	TD03	¾ Hard	80–90 (551–620)	68–82 (468–565)	4
C72650	TD04	Hard	85–95 (586–655)	77–90 (530–620)	2
C72700	TB00	Solution HT	60–80 (410–550)	23–33 (160–230)	30
C72700	TD01	¼ Hard	72–95 (500–660)	48–64 (330–440)	12
C72700	TD02	½ Hard	82–108 (570–740)	57–80 (390–550)	6
C72700	TD04	Hard	97–125 (670–860)	77–100 (530–690)	3
C72700	TD08	Spring	110–140 (760–970)	95–115 (660–790)	2
C72700	TD12	Special Spring	115–150 (790–1030)	105–125 (720–860)	...
C72900	TB00	Solution HT	64–85 (440–590)	24–40 (170–280)	32
C72900	TD01	¼ Hard	74–100 (510–690)	50–66 (340–460)	18
C72900	TD02	½ Hard	85–110 (590–760)	65–84 (450–580)	8
C72900	TD04	Hard	100–130 (690–900)	85–108 (590–740)	...
C72900	TD08	Spring	122–145 (840–1000)	100–125 (690–860)	...
C72900	TD12	Special Spring	135–155 (930–1070)	110–130 (760–900)	...

[A] 1 ksi = 1000 psi.
[B] See Appendix.
[C] Max for reference.
[D] As per Practice B 598.
[E] As per Practice B 601.

5.2 Special or nonstandard tempers are available and are subject to agreement between supplier or manufacturer and purchaser.

6. Tensile Property Requirements

6.1 The solution heat-treated or solution heat-treated and cold-worked material shall conform to the tensile property requirements specified in Table 2.

6.2 The spinodal heat-treated material shall conform to the tensile property requirements specified in Table 3. Spinodal heat-treatment parameters are given in 9.1.

6.3 The mill-hardened material shall conform to the tensile property requirements specified in Table 4.

7. Bend Test Requirements

7.1 The bend test is a method for evaluating the ductility of mill-hardened copper-nickel-tin spinodal alloy strip in thicknesses of 0.004 to 0.020 in. (0.102 to 0.508 mm), inclusive.

7.1.1 Material in tempers TM00, TM02, TM04, and TM06 shall conform to the bend test requirements specified in Table 4 when tested in accordance with 7.2.

7.2 Three specimens, ½ ± 1⁄16 in. (12.70± 1.59 mm) in width of any convenient length, with the rolling direction perpendicular to the ½ in. dimension shall be prepared and tested in accordance with Test Method E 290. The axis of the bend shall be at an angle of 90° to the direction of rolling

TABLE 3 Tensile Property Requirements

Tempers: Solution Heat Treated and Spinodally Hardened;[A]
Solution Heat Treated, Cold Worked and Spinodally Hardened[A]

Copper Alloy UNS No.	Temper Designations		Tensile Strength, ksi[B] (MPa)[C] min–max[D]	Yield[E] Strength (0.05 % Offset), ksi[B] (MPa)[C] min–max[D]	Elongation in 2 in., %
	Standard[F]	Former			
C72650	TX00	Spinodal HT	120–140 (827—965)	60—95 (413–655)	6
C72650	TS01	¼ Hard and Spinodal HT	130–140 (898–965)	90–115 (620–792)	8
C72650	TS02	½ Hard and Spinodal HT	135–145 (930—999)	100–125 (689–861)	6
C72650	TS03	¾ Hard and Spinodal HT	140–150 (965–1034)	105–130 (723–896)	6
C72650	TS04	Hard and Spinodal HT	140–155 (965–1068)	110–135 (758–930)	4
C72700	TX00	Spinodal HT	100–130 (690–900)	55–99 (380–680)	15
C72700	TS01	¼ Hard + Spinodal HT	115–140 (790–970)	85–112 (590–770)	10
C72700	TS02	½ Hard + Spinodal HT	125–150 (860–1030)	100–123 (690–850)	6
C72700	TS04	Hard + Spinodal HT	135–160 (930–1100)	115–135 (790–930)	4
C72700	TS08	Spring + Spinodal HT	145–179 (1000–1230)	125–150 (860–1030)	3
C72700	TS12	Special Spring + Spinodal HT	150–180 (1030–1240)	130–160 (900–1100)	2
C72900	TX00	Spinodal HT	105–135 (720–930)	60–102 (410–700)	10
C72900	TS01	¼ Hard + Spinodal HT	120–146 (830–1010)	90–117 (620–810)	8
C72900	TS02	½ Hard + Spinodal HT	130–154 (900–1060)	105–128 (720–880)	5
C72900	TS04	Hard + Spinodal HT	145–172 (1000–1190)	130–152 (900–1050)	3
C72900	TS08	Spring + Spinodal HT	160–184 (1100–1270)	145–166 (1000–1140)	2
C72900	TS12	Special Spring + Spinodal HT	165–197 (1140–1360)	152–175 (1050–1210)	...

[A] 662 ± 9°F (350 ± 5°C) for 1 ½ (C72700, C72900); 725 ± 9°F (385 ± 5°C) for 2h (C72650).
[B] 1 ksi = 1000 psi.
[C] See Appendix.
[D] Max for reference.
[E] As per Practice B 598.
[F] As per Practice B 601.

unless otherwise specified. The test specimens shall be bent 90 ± 5° around the test radius. To pass the test, all three specimens tested from a lot must withstand the 90° bend without visible cracks or fracture when observed on the convex surface of the bend at a magnification of 10 × . The test radius shall be within ±6 % of the nominal radius up to 0.010 in. (0.254 mm), and within ±4 % for radii 0.010 in. and over.

8. Grain Size

8.1 Material over 0.010 in. (0.25 mm) in thickness shall have an average size not exceeding the limits prescribed in Table 5. The determinations are made on the separate samples and in a plane perpendicular to the surface.

9. Spinodal Heat Treatment

9.1 Solution-heat-treated or solution-heat-treated and cold-worked material is normally spinodal hardened by the purchaser after forming or machining. For the purpose of determining conformance to the mechanical properties of Table 3, a sample of the as-supplied strip of alloys C72700 and C72900 material shall be heat treated at 662 ± 9°F (350± 5°C) for 1|n$ h and a sample of the as-supplied strip of alloy C72650 shall be heat treated at 725 ± 9°F (385 ± 5°C) for 2h. Other heat treating temperatures and times may be preferred for end products of this material.

9.2 Special combinations of properties such as increased ductility, electrical conductivity, dimensional accuracy, endurance life, improved stress relaxation resistance, resistance to elastic drift and hysteresis in springs may be obtained by special spinodal-hardening treatments. The mechanical requirements of Table 3 do not apply to such special heat treatments.

9.3 Mill-hardened products have been spinodal heat treated by the manufacturer. Further thermal treatment is not normally required.

10. Dimensions and Permissible Variations

10.1 The dimensions and tolerances for material covered by this specification shall be as prescribed in the current edition of Specification B 248.

TABLE 4 Mechanical Property Requirements Copper Alloy UNS Nos. C72650 and C72900—Mill Hardened Tempers

Copper Alloys UNS No.	Tempers		Tensile Strength, ksi[A] (MPa)[B] min–max	Yield Strength (0.2 % offset)[C], ksi[A] (MPa)[B] min–max	Yield Strength[D] (0.05 % offset) ksi[A] (MPa)[B] min–max[E]	Elongation in 2 in., % min	Bend Test Radius[F]
	Designation[G] Standard	Formerly					
C72650	TM00	AM	100–120 (689–827)	70–90 (482–620)	65–85 (448–556)	18	...
C72650	TM02	½ HM	115–135 (792–930)	90–110 (620–758)	85–105 (586–723)	10	...
C72650	TM04	HM	115–135 (792–930)	100–120 (689–727)	95–115 (655–792)	10	...
C72650	TM06	XHM	120–140 (827–965)	105–125 (723–861)	100–120 (689–827)	10	...
			130–145	115–135	105–125	6	...
C72900	TM00	AM	110–125 (760–860)	75–95 (520–660)	72–90 (500–620)	26	...
C72900	TM02	½ HM	120–133 (830–920)	90–110 (620–760)	86–104 (590–720)	20	...
C72900	TM04	HM	130–142 (900–980)	105–125 (720–860)	99–117 (680–810)	14	...
C72900	TM06	XHM	140–155 (970–1070)	120–145 (830–1000)	113–135 (780–930)	8	...
C72900	TM08	XHMS	130–145 (895–1010)	115–135 (790–930)	100–120 (690–825)	6	...

[A] 1 ksi = 1000 psi.
[B] See Appendix.
[C] For reference.
[D] As per Practice B 598.
[E] Max for reference.
[F] The t equals the measured average strip thickness to be tested.
[G] As per Practice B 601.

TABLE 5 Grain Size Requirements for Copper Alloy UNS Nos. C72700 and C72900—Tempers TB00, TX00, and TM00

Thickness, in. (mm)[A]	Maximum Average Grain Size, mm[B]
Up to 0.030 (0.762)	0.035
Over 0.030 to 0.090 (0.762 to 2.28)	0.045
Over 0.090 to 0.188 (2.28 to 4.78)[C]	0.060

[A] See Appendix.
[B] Although no minimum grain size is required, this material must be fully recrystallized.
[C] As per Practice B 601.

11. General Requirements

11.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 248.

12. Test Specimen

12.1 Tension test specimens shall be prepared as specified in Test Methods E 8. The longitudinal axis of the specimen shall be parallel to the direction of rolling unless otherwise specified.

12.2 Specimens for the determination of grain size shall be prepared in accordance with Methods E 3.

13. Retests

13.1 If any lot of material fails to conform to the requirements of this specification due to inadequate heat treatment, new samples of material may be resubmitted for test after heat treatment. Only two such reheat treatments shall be permitted.

13.2 If any lot of material fails to conform to the bend test requirements of this specification, one retest is permitted if only one of the three specimens fails the test. No retest is permitted if two or more specimens fail this test.

14. Inspection

14.1 The manufacturer shall inspect and make the tests

15. Keywords

15.1 age hardening; copper-nickel-tin; spinodal; strip

APPENDIX

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.