~~Designation:B740–02~~ Designation: B 740 – 09

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 establishes requirements for copper-nickel-tin alloy strip in the following alloys:

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

1.2 *Units*—~~The values stated in inch-pound units and the values stated in SI units in Table 5 are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units and are provided for information only and are not considered standard.~~ —The values stated in inch-pound units and the values stated in SI units in Table 5 are to be regarded as standard, except for grain size which is stated in metric units only. The values given in parentheses are mathematical conversions to SI units and are provided for information only and are not considered standard.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

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:*[2]

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

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

B 601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

B 820 ~~Test Method for Bend Test for Formability of Copper Alloy Spring Material~~[2] Test Method for Bend Test for Determining the Formability of Copper and Copper Alloy Strip

B 846 Terminology for Copper and Copper Alloys

E 3 Guide for Preparation of Metallographic Specimens

E 8 Test Methods for Tension Testing of Metallic Materials

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys

E 290 Test Methods for Bend Testing of Material for Ductility

E 478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B 248 constitute a part of this specification:

3.1.1 Terminology,

3.1.2 Materials and Manufacture,

3.1.3 Dimensions and Permissible Variations,

3.1.4 Workmanship, Finish, and Appearance,

3.1.5 Sampling,

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[1] This specification is under the ASTM Committee B05on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.01 on Plate, Sheet, and Strip.
~~Current edition approved July 10, 2002. Published September 2002. Originally published as B740–84. Last previous edition B740–96.~~
Current edition approved Aug. 15, 2009. Published September 2009. Originally approved in 1984. Last previous edition approved in 2002 as B 740 – 02.

[2] 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* ~~, Vol 02.01.~~volume information, refer to the standard's Document Summary page on the ASTM website.

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

3.1.6 Significance of Numerical Limits,
3.1.7 Inspection,
3.1.8 Rejection and Rehearing,
3.1.9 Certification,
3.1.10 Test Reports, and
3.1.11 Packaging and Package Marking.

3.2 In addition, when a section with a title identical to that referenced in 3.1 above appears in this specification, it contains additional requirements that supplement those appearing in Specification B 248.

4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology B 846.

5. Ordering Information

~~5.1Include the following information in orders for products:~~
~~5.1.1Specification number and date,~~
5.1 Include the following information when placing orders for product under this specification, as applicable:
5.1.1 ASTM designation and year of issue,
5.1.2 Quantity,
5.1.3 Copper Alloy UNS ~~number~~No. (see 1.1),
5.1.4 Form of material: strip,
5.1.5 Temper (see ~~7.1~~8.1),
5.1.6 Dimensions: thickness and width, and length if applicable,
5.1.7 How furnished: rolls or coils, stock lengths with or without ends, specific lengths with or without ends, ~~and~~
5.1.8 Type of edge other than slit, for example, rounded corners, rounded edges, or full-rounded edges.
5.1.9 When material is purchased for agencies of the U.S. ~~g~~Government, this shall be specified in the contract or purchase order, and the material shall conform to the Supplementary Requirements Section as defined in the current edition of Specification B 248.
5.2 The following options are available and should be specified at the time of placing of the order when required:
~~5.2.1Width and straightness tolerances, if different from those required in Specification B248.~~
~~5.2.2Special thickness tolerances if required,~~
~~5.2.3Certification if required,~~
~~5.2.4Mill test report if required, and~~
~~5.2.5Special tests or exceptions, if any.~~
5.2.1 Certification if required,
5.2.2 Mill test report if required,

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements specified in Table 1 ~~.~~

~~6.2These 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.~~ for the copper alloy UNS No. designation specified in the ordering information.

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

6.3 Copper may be given as remainder and taken as the difference between the sum of all the elements analyzed and 100%. When all the elements in the table including copper are analyzed, their sum shall be 99.7% min.

7. Materials and Manufacture

7.1 *Manufacture*—Spinodal Heat Treatment.

7.1.1 Solution-heat-treatment or solution-heat-treated and cold-worked material is normally spinodal hardened by the purchaser after forming or machining.

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	0.10	0.10	7.0–8.0	4.5–5.5	0.10	...	...
C72700	Cu-9Ni-6Sn	remainder	0.02[B]	0.50	0.50	8.5–9.5	5.5–6.5	0.05-0.30	0.10	0.15
C72900	Cu-15Ni-8Sn	remainder	0.02[B]	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, Nb, and Mg not to exceed 0.7 %.
[B] 0.005 % Pb, max for hot rolling.

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

8. Temper

~~7.1The standard tempers of material are as designated in Table 2~~

8.1 The standard tempers for products described in this specification are given in Tables 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).~~

~~7.2Other tempers are available and shall be subject to agreement between supplier or manufacturer and purchaser.~~

~~8.~~4

8.1.1 TB00 (Solution Heat Treated)
8.1.2 TD01 to TD 12 (Solution Heat Treated with varying degrees of cold working)
8.1.3 TX00 (Spinodal Hardened)
8.1.4 TS01 to TS12 (Hard and Spinodal Hardened)
8.1.5 TM00 to TS08 (mill hardened)
8.2 Other tempers are available and shall be subject to agreement between supplier or manufacturer and purchaser.

TABLE 2 Tensile Property Requirements

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

Copper Alloy UNS No.	Temper Designations		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., %
	~~Stan~~Co~~dard~~[E]~~e~~	~~For~~Name~~r~~			
C72650	TB00	Solution HT	55–70 (380—480)	21—32 (145–220)	32
C72650	TD01	Solution HT and Cold Worked ¼ Hard	60–75 (415–515)	45–60 (310–415)	18
C72650	TD02	Solution HT and Cold Worked ½ Hard	75—85 (515—585)	55–75 (380–515)	5
C72650	TD03	Solution HT and Cold Worked ¾ Hard	80–90 (550–620)	68–82 (470–565)	4
C72650	TD04	Solution HT and Cold Worked Hard	85–95 (585–655)	77–90 (530–620)	2
C72700	TB00	Solution HT	60–80 (410–550)	23–33 (160–230)	30
C72700	TD01	Solution HT and Cold Worked ¼ Hard	72–95 (500–660)	48–64 (330–440)	12
C72700	TD02	Solution HT and Cold Worked ½ Hard	82–108 (570–740)	57–80 (390–550)	6
C72700	TD04	Solution HT and Cold Worked Hard	97–125 (670–860)	77–100 (530–690)	3
C72700	TD08	Solution HT and Cold Worked Spring	110–140 (760–970)	95–115 (660–790)	2
C72700	TD12	Solution HT and Cold Worked Special Spring	115–150 (790–1030)	105–125 (720–860)	...
C72900	TB00	Solution HT	64–85 (440–585)	24–40 (165–275)	32
C72900	TD01	Solution HT and Cold Worked ¼ Hard	75–100 (515–690)	50–66 (345–455)	18
C72900	TD02	Solution HT and Cold Worked ½ Hard	85–110 (585–760)	65–84 (450–580)	8
C72900	TD03	Solution HT and Cold Worked ¾ Hard	95-120 (655-825)	80-100 (550-690)	3
C72900	TD04	Solution HT and Cold Worked Hard	100–130 (690–895)	85–108 (585–745)	...
C72900	TD08	Solution HT and Cold Worked Spring	122–145 (840–1000)	100–125 (690–860)	...
C72900	TD12	Solution HT and Cold Worked Special Spring	135–155 (930–1070)	110–130 (760–895)	...

[A] 1 ksi = 1000 psi.
[B] See Appendix X1.
[C] Max for reference.
[D] As per Practice B 598~~.~~
~~[E] As per Classification B601~~.

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., %
	~~Stan~~Cod~~ard~~[F]~~e~~	~~For~~Name~~r~~			
C72650	TX00	Spinodal HT	120–140 (825—965)	60—95 (415–655)	6
C72650	TS01	¼ Hard and Spinodal HT	130–140 (900–965)	90–115 (620–790)	8
C72650	TS02	½ Hard and Spinodal HT	135–145 (930—1000)	100–125 (690–860)	6
C72650	TS03	¾ Hard and Spinodal HT	140–150 (965–1035)	105–130 (725–895)	6
C72650	TS04	Hard and Spinodal HT	140–155 (965–1070)	110–135 (760–930)	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	120–150 (825–1035)	95–120 (655–825)	6
C72900	TS01	¼ Hard + Spinodal HT	130–160 (895–1105)	105–130 (725–895)	4
C72900	TS02	½ Hard + Spinodal HT	145–175 (1000–1205)	125–150 (860–1035)	3
C72900	TS03	¾ Hard + Spinodal HT	155–185 (1070–1275)	135–160 (930–1105)	2
C72900	TS04	Hard + Spinodal HT	165–195 (1140–1345)	145–170 (1005–1170)	2
C72900	TS08	Spring + Spinodal HT	175–205 (1205–1415)	155–185 (1070–1275)	...
C72900	TS12	Special Spring + Spinodal HT	180–225 (1240–1550)	160–200 (1105–1380)	...

[A] 662 ± 9°F (350 ± 5°C) for 1½ h ± 5 min (C72700, C72900); 725 ± 9°F (385 ± 5°C) for 2 h ± 5 min (C72650).
[B] 1 ksi = 1000 psi.
[C] See Appendix X1.
[D] Max for reference.
[E] As per Practice B 598.
~~[F] As per Classification B601.~~

9. Grain Size for Annealed Tempers

~~8~~9.1 Product over 0.010 in. (0.25 mm) in thickness shall have an average grain-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.~~

10. Mechanical Property Requirements

~~9.1~~

10.1 *Tensile Strength Requirements* :

~~9.1.1The~~10.1.1 The solution heat-treated or solution heat-treated and cold-worked material shall conform to the tensile property requirements specified in Table 2, when tested in accordance with Test Methods E 8.

~~9.1.2The~~10.1.2 The spinodal heat-treated material shall conform to the tensile property requirements specified in Table 3~~. Spinodal heat-treatment parameters are given in 11.1~~.

~~9.1.3The mill-hardened material shall conform to the tensile property requirements specified in~~

10.1.2.1 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.

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