Designation: B 888 – 98

Standard Specification for Copper Alloy Strip for Use in the Manufacture of Electrical Connectors or Spring Contacts[1]

This standard is issued under the fixed designation B 888; 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.

1. Scope

1.1 This specification covers the requirements for copper alloy strip for use in the manufacture of electrical connectors or spring contacts produced from one of the following Copper Alloy UNS Nos.[2]: C14530, C15100, C15500, C19400, C19500, C19700, C23000, C26000, C42200, C42500, C51000, C51100, C52100, C63800, C65400, C68800, C70250, C70260, C75200, and C76200.

1.2 The requirements for the other copper alloys such as beryllium copper UNS C17000, C17200, C17400, C17410, C17500, and C17510 shall be as prescribed in the current edition of Standards B 194, B 768 and B 534.

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in noncompliance with this specification.

2. Referenced Documents

2.1 *ASTM Standards:*

B 193 Test Method for Resistivity of Electrical Conductor Material[3]

B 194 Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar[4]

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar[4]

B 248M Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar [Metric][4]

B 534 Specification for Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar[4]

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast[4]

B 768 Specification for Copper-Cobalt-Beryllium Alloy Strip and Sheet[4]

B 820 Test Method for Bend Test for Formability of Copper Alloy Spring Material[4]

B 846 Terminology for Copper and Copper Alloys[4]

E 8 Test Methods for Tension Testing of Metallic Materials[5]

E 8M Test Methods for Tension Testing of Metallic Materials [Metric][5]

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes[6]

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Method)[6]

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys[6]

E 478 Test Methods for Chemical Analysis of Copper Alloys[6]

E 527 Test Practice for Numbering Metals and Alloys (UNS)[7]

2.2 *ISO Standards:*

ISO 4744 Copper and Copper Alloys—Determination of Chromium Content - Flame Atomic Absorption Spectrometric Method[8]

ISO 7602 Copper and Copper Alloys—Determination of Tellurium Content[8]

3. Terminology

3.1 *Definitions*—For definition of terms used in this specification, refer to Terminology B 846.

4. General Requirements

4.1 For product furnished under this specification in English units, the following sections of Specification B 248 must constitute a part of this specification. For product furnished under this specification in the SI units, the following sections of Specification B 248M must constitute a part of this specification.

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

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[2] The UNS system for copper and 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 02.03.

[4] *Annual Book of ASTM Standards*, Vol 02.01.

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

[6] *Annual Book of ASTM Standards*, Vol 03.05.

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

[8] Available from American National Standards Institute, 11 W. 42nd St., New York, NY 10036-8002.

4.1.1 Terminology,
4.1.2 Materials and Manufacture,
4.1.3 Dimensions, Weights, and Permissible Variations,
4.1.4 Workmanship, Finish, and Appearance,
4.1.5 Sampling,
4.1.6 Number of Tests and Retests,
4.1.7 Specimen Preparation,
4.1.8 Test Methods,
4.1.9 Significance of Numerical Limits,
4.1.10 Certification,
4.1.11 Test Reports, and
4.1.12 Packaging and Package Marking.

4.2 In the event of a conflict between this specification and Specification B 248 or B 248M, the requirements of this specification shall take precedence.

5. Classification

5.1 Product produced to this specification is classified as strip material to be used for spring contact or electrical and electronic connector applications only.

6. Ordering Information

6.1 Contract or purchase orders for product under this specification should include the following information:
6.1.1 ASTM designation and year of issue,
6.1.2 UNS alloy designation,
6.1.3 Dimensions, for example, thickness, width,
6.1.4 Quantity, and
6.1.5 Temper (Section 8).

6.2 The following options are available under this specification and shall be specified in the contract or purchase order when required:
6.2.1 Type of edge: slit, sheared, sawed, square corners, rounded corners, rounded edges, or full-rounded edges (Section 11),
6.2.2 Width and straightness tolerances, slit-metal tolerances, square-sheared metal tolerances, sawed metal tolerances, straightened or edge-rolled metal tolerances (Section 11),
6.2.3 Identification marking (Section 22),
6.2.4 Certification (Section 20),
6.2.5 Mill test report (Section 21), and
6.2.6 How packaged: coil wound in traverse or pancake style (Section 22).
6.2.6.1 Number of strip lengths per coil,
6.2.6.2 Size and weight of each coil, and
6.2.7 The electrical resistivity or any other physical and electrical properties (See Table X1.1).

7. Materials and Manufacture

7.1 *Material*—The material of manufacture shall be a cast bar, slab, cake, billet, or other form of the composition given in Table 1 for the specified alloy, suitable for processing into the product prescribed in this specification.

7.2 *Manufacture*—The product shall be produced by either hot- or cold-working operation. It shall be finished, unless otherwise specified, by such hot working, cold working, annealing, or heat treatment as may be necessary to meet the properties specified in Table 2.

7.3 *Edges*—The edges shall be slit or rolled edges as specified by the buyer. Slit edges shall be furnished unless otherwise specified or agreed upon between the purchaser and supplier or manufacturer.

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Elements Composition, %															
	Copper	Aluminum	Cobalt	Iron	Lead	Magnesium	Manganese	Nickel	Phosphorus	Tin	Zinc	Chromium	Zirconium	Silicon	Silver	Tellurium
C14530	99.90 min.								0.001-0.010	0.003-0.023						0.003-0.023[A]
C15100	99.82 min.	0.005 max.[B]		0.005 max.[B]			0.005 max.[B]						0.05-0.15			
C15500	99.75[C] min.					0.08-0.13			0.04-0.08						0.027-010	
C19400	97.0 min.			2.1-2.6	0.03 max.				0.015-0.15		0.05-0.20					
C19500	96.0 min.	0.02 max.	0.30-1.3	1.0-2.0	0.02 max.				0.01-0.35	0.10-1.0	0.20 max.					
C19700	remainder		0.05 max.	0.3-1.2	0.05 max.	0.01-0.20	0.05 max.	0.05 max.	0.10-0.40	0.20 max.	0.20 max.					
C23000	84.0-86.0			0.05 max.	0.05 max.						remainder					
C26000	68.5-71.5			0.05 max.	0.07 max.						remainder					
C42200	86.0-89.0			0.05 max.	0.05 max.				0.35 max.	0.8-1.4	remainder					
C42500	87.0-90.0			0.05 max.	0.05 max.				0.35 max.	1.5-3.0	remainder					
C51000	remainder			0.10 max.	0.05 max.				0.03-0.35	4.2-5.8	0.30 max.					
C51100	remainder			0.10 max.	0.05 max.				0.03-0.35	3.5-4.9	0.30 max.					
C52100	remainder			0.10 max.	0.05 max.				0.03-0.35	7.0-9.0	0.20 max.					
C63800	remainder	2.5-3.1	0.25-0.55	0.20 max.	0.05 max.		0.10 max.	0.20 max.			0.8 max.			1.5-2.1		
C65400	remainder[D]				0.05 max.					1.2-1.9	0.50 max	0.01-0.12		2.7-3.4		
C68800	remainder[D]	3.0-3.8[C]	0.25-0.55	0.20 max.	0.05 max.						21.3-24.1[C]					
C70250	remainder			0.20 max.	0.05 max.	0.05-0.30	0.10 max.	2.2-4.2[E]			1.0 max.			0.25-1.2		
C70260	remainder[F]							1.0-3.0[F]	0.005 max.[F]					0.20-0.70[F]		
C75200	63.5-66.5			0.25 max.	0.05 max.		0.50 max.	16.5-19.5[E]			remainder					
C76200	57.0-61.0			0.25 max.	0.10 max.		0.50 max.	11.0-13.5[E]			remainder					

[A]Includes Te + Se.
[B]Aluminum + iron + manganese not to exceed 0.01 %.
[C]Aluminum + zinc = 25.1 − 27.1.
[D]Including silver.
[E]Including cobalt.
[F]Copper + nickel + phosphorus + silicon 99.5 min.

TABLE 2 Mechanical Requirements

Temper Designation		Tensile Strength, ksi		Tensile Strength, MPa		Yield Strength (0.2 % Offset), ksi	Yield Strength (0.2 % Offset), MPa	Elongation, %
Standard	Former	Min.	Max.	Min.	Max.	Min.	Min.	Min.
			Copper Alloy UNS NO. C14530					
H01	¼ hard	35	45	240	310	26	180	7
H02	½ hard	40	50	275	345	33	230	5
H03	¾ hard	44	54	305	370	39	270	3
H04	hard	47	57	325	395	43	295	2
H06	extra hard	50	60	345	415	47	325	1
H08	spring	54	64	370	440	51	350	1
H10	extra spring	58	. . .	400	. . .	56	385	. . .
			Copper Alloy UNS NO. C15100					
O61	annealed	37	42	255	290	9	60	35
H01	¼ hard	40	45	275	310	26	180	11
H02	½ hard	43	51	295	350	35	240	3
H03	¾ hard	47	56	325	385	45	310	1
H04	hard	53	62	365	425	51	350	1
H06	extra hard	59	65	405	450	57	395	1
H08	spring	64	71	440	490	62	425	1
			Copper Alloy UNS NO. C15500					
O61	annealed	34	43	235	295	15	105	30
H02	½ hard	45	55	310	380	38	260	13
H04	hard	56	64	385	440	50	345	6
H06	extra hard	63	72	435	495	56	385	5
H08	spring	65	73	450	505	60	415	4
H10	extra spring	68	75	470	515	63	435	3
			Copper Alloy UNS NO. C19400					
O61	annealed	40	63	275	435	16	110	10
H02	½ hard	53	63	365	435	36	250	6
H04	full hard	60	70	415	485	53	365	3
H06	extra hard	67	73	460	505	64	440	2
H08	spring hard	70	76	485	525	67	460	2
H10	extra spring	73	80	505	550	70	485	1
			Copper Alloy UNS NO. C19500					
O61	annealed	50	60	345	415	21	145	22
H01	¼ hard	60	72	415	495	45	310	5
H02	½ hard	68	78	470	540	66	455	3
H03	¾ hard	75	85	515	585	72	495	2
H04	full hard	82	90	565	620	79	545	2
H08	spring	88	97	605	670	85	585	1
			Copper Alloy UNS NO. C19700					
O61	annealed	43	53	295	365	16	110	20
H02	½ hard	53	63	365	435	36	250	6
H04	full hard	60	70	415	485	53	365	2
H06	extra hard	67	73	460	505	64	440	2
H08	spring hard	70	76	485	525	67	460	2
H10	extra spring	73	80	505	550	70	485	1
			Copper Alloy UNS NO. C23000					
O61	annealed	39	47	270	325	8	55	43
H01	¼ hard	44	54	305	370	23	160	15
H02	½ hard	51	61	350	420	43	295	8
H03	¾ hard	57	67	395	460	51	350	4
H04	hard	63	72	435	495	57	395	4
H06	extra hard	72	80	495	550	65	450	3
H08	spring	78	86	540	595	69	475	3
H10	extra spring	82	90	565	620	73	505	2
			Copper Alloy UNS NO. C26000					
O61	annealed	45	61	310	420	10	70	40
H01	¼ hard	49	59	340	405	21	145	34
H02	½ hard	57	67	395	460	42	290	19
H03	¾ hard	64	74	440	510	55	380	8
H04	hard	71	81	490	560	67	460	6
H06	extra hard	83	92	570	635	79	545	2
H08	spring	91	100	625	690	82	565	1
H10	extra spring	95	104	655	715	86	595	1

TABLE 2 *Continued*

Temper Designation		Tensile Strength, ksi		Tensile Strength, MPa		Yield Strength (0.2 % Offset), ksi	Yield Strength (0.2 % Offset), MPa	Elongation, %
Standard	Former	Min.	Max.	Min.	Max.	Min.	Min.	Min.
				Copper Alloy UNS NO. C42200				
O61	annealed	41	49	285	340	12	85	43
H01	¼ hard	47	57	325	395	21	145	17
H02	½ hard	54	65	370	450	48	330	6
H03	¾ hard	60	72	415	495	58	400	4
H04	hard	67	79	460	545	67	460	3
H06	extra hard	75	85	515	585	72	495	2
H08	spring	82	92	565	635	77	530	2
H10	extra spring	88	. . .	605	. . .	82	565	1
				Copper Alloy UNS NO. C42500				
O61	annealed	41	47	285	325	13	90	47
H01	¼ hard	49	59	340	405	20	140	24
H02	½ hard	57	69	395	475	51	350	13
H03	¾ hard	62	74	425	510	58	400	10
H04	hard	70	82	485	565	66	455	6
H06	extra hard	76	88	525	605	73	505	5
H08	spring	84	94	580	650	81	560	3
H10	extra spring	92	. . .	635	. . .	87	600	. . .
				Copper Alloy UNS NO. C51000				
O61	annealed	46	56	315	385	19	130	48
H01	¼ hard	49	61	340	420	22	150	32
H02	½ hard	58	73	400	505	47	325	10
H03	¾ hard	68	79	470	545	61	420	10
H04	hard	76	91	525	625	74	510	9
H06	extra hard	88	103	605	710	85	585	2
H08	spring	95	110	655	760	92	635	1
H10	extra spring	100	114	690	785	98	675	1
				Copper Alloy UNS NO. C51100				
O61	annealed	46	54	315	370	16	110	45
H01	¼ hard	46	58	315	400	20	140	25
H02	½ hard	55	70	380	485	42	290	12
H03	¾ hard	67	82	460	565	64	440	6
H04	hard	72	87	495	600	70	485	2
H06	extra hard	84	99	580	685	81	560	1
H08	spring	91	105	625	725	88	605	1
H10	extra spring	96	109	660	750	92	635	1
				Copper Alloy UNS NO. C52100				
O61	annealed	56	65	385	450	23	160	60
H01	¼ hard	63	75	435	515	35	240	40
H02	½ hard	69	84	475	580	51	350	25
H03	¾ hard	80	92	550	635	70	485	18
H04	hard	85	100	585	690	78	540	12
H06	extra hard	97	112	670	770	92	635	10
H08	spring	105	119	725	820	100	690	3
H10	extra spring	110	122	760	840	105	725	2
				Copper Alloy UNS NO. C63800				
O61	annealed	77	87	530	600	45	310	27
H01	¼ hard	90	102	620	705	75	515	12
H02	½ hard	100	112	690	770	87	600	7
H03	¾ hard	105	117	725	805	93	640	5
H04	hard	114	126	785	870	102	705	3
H06	extra hard	118	130	815	895	106	730	2
H08	spring	123	134	850	925	111	765	2
H10	extra spring	130	. . .	. . .	. . .	119	820	. . .
				Copper Alloy UNS NO. C65400				
H01	¼ hard	75	90	515	620	45	310	21
H02	½ hard	86	101	595	695	66	455	11
H03	¾ hard	97	112	670	770	82	565	6
H04	hard	108	120	745	825	94	650	3
H06	extra hard	116	126	800	870	102	705	2
H08	spring	124	133	855	915	112	770	2
H10	extra spring	131	140	905	965	118	815	1

TABLE 2 *Continued*

Temper Designation		Tensile Strength, ksi		Tensile Strength, MPa		Yield Strength (0.2 % Offset), ksi	Yield Strength (0.2 % Offset), MPa	Elongation, %
Standard	Former	Min.	Max.	Min.	Max.	Min.	Min.	Min.
				Copper Alloy UNS NO. C68800				
O61	annealed	77	87	530	600	44	305	30
H01	¼ hard	87	101	600	695	63	435	10
H02	½ hard	97	112	670	770	82	565	3
H04	hard	106	120	730	825	95	655	2
H06	extra hard	113	127	780	875	102	705	2
H08	spring	123	133	850	915	111	765	1
H10	extra spring	130	. . .	895	. . .	117	805	1
				Copper Alloy UNS NO. C702500				
TM00	AM	90	110	620	760	65	450	10
TM02	½ HM	95	120	655	825	83	585	7
TM03	¾ HM	100	125	690	860	95	655	5
				Copper Alloy UNS NO. C702600				
TM00	AM	80	100	550	690	65	450	10
TM02	½ HM	90	110	620	760	85	585	4
				Copper Alloy UNS NO. C75200				
O61	annealed	53	63	365	435	18	125	29
H01	¼ hard	58	72	400	495	26	180	14
H02	½ hard	66	80	455	550	48	330	6
H03	¾ hard	74	86	510	595	69	475	4
H04	hard	78	91	540	625	75	515	3
H06	extra hard	86	98	595	675	85	585	3
H08	spring	90	101	620	695	88	605	1
H10	extra spring	96	. . .	660	. . .	95	655	1
				Copper Alloy UNS NO. C76200				
O61	annealed	57	75	395	515	21	145	32
H01	¼ hard	65	81	450	560	36	250	20
H02	½ hard	75	91	515	625	58	400	6
H03	¾ hard	83	98	570	675	73	505	4
H04	hard	90	105	620	725	82	565	3
H06	extra hard	101	114	695	785	93	640	1
H08	spring	109	122	750	840	101	695	1
H10	extra spring	114	. . .	785	. . .	102	705	1

8. Chemical Composition

8.1 The materials shall conform to the chemical compositional requirements in Table 1 for the corresponding Copper Alloy UNS Number designation specified in the ordering information.

8.2 These composition limits do not preclude the presence of other elements. Limits for unnamed elements may be established and analysis required by agreement between manufacturer or supplier and purchaser when required.

8.3 Copper, when given as the remainder, is determined as the difference between the sum of results for all elements determined and 100 %.

8.4 Zinc, when given as the remainder, is determined as the difference between the sum of results for all elements determined and 100 %.

8.4.1 For those copper alloys in which zinc is given as the remainder, copper may be determined by difference; however, when so determined, the result shall conform to the limits prescribed in Table 1.

8.5 When all elements listed in Table 1 for the Copper Alloy UNS Number specified in the ordering information are determined, the sum of results shall be 99.8 % minimum, except for UNS No. C26000 and C70260, which shall be 99.7 and 99.5 %, respectively.

9. Temper

9.1 Tempers, as defined in Practice B 601, available under this specification are as follows:

Temper Designation[9]

Standard	*Former*
O61	annealed
H01	¼ hard
H02	½ hard
H03	¾ hard
H04	hard
H06	extra hard
H08	spring
H10	extra spring
TM00	AM
TM02	½ HM

TM03	¾ HM

9.2 *Rolled (H) Material*—The standard tempers of rolled products are as designated in Table 2 with the prefix "H." Former designations and the standard designations as defined in Practice B 601 are shown.

NOTE 1—The properties for product in special or nonstandard tempers are subject to negotiation between the manufacturer and the purchaser.

10. Mechanical Property Requirements

10.1 Product ordered to this specification shall conform to the requirements prescribed in Table 2 for the alloy and temper specified in the contract or purchase order.

10.1.1 The ultimate tensile strength, 0.2 % offset minimum yield strength, and the minimum elongation properties shall be the basis for acceptance or rejection when tested in accordance with Test Methods E 8 or E 8M.

10.1.1.1 Product ordered to this specification in inch-pound units shall be tested in accordance with Test Methods E 8 and shall conform to tensile strength, 0.2 % offset minimum yield strength, and minimum elongation requirements prescribed in ksi units in Table 2.

10.1.1.2 Product ordered to this specification in SI units shall be tested in accordance with Test Methods E 8M and shall conform to tensile strength, 0.2 % offset minimum yield strength, and minimum elongation requirements prescribed in MPa units in Table 2.

11. Dimensions, Mass, and Permissible Variations

11.1 The dimensions and tolerances for product under this specification shall be as prescribed in Specifications B 248 or B 248M, with particular reference to Section 5 and the following tables of those specifications:

11.1.1 *Thickness*—see Paragraph 5.2 and Table 1.

11.1.2 *Width*:

11.1.2.1 *Slit Metal and Slit Metal with Rolled Edges*—see Paragraph 5.3 and Table 4.

11.1.2.2 *Square Sheared Metal*—see Paragraph 5.3 and Table 5.

11.1.2.3 *Sawed Metal*—see Paragraph 5.3 and Table 6.

11.1.3 *Length*:

11.1.3.1 *Specific and Stock Lengths with and without Ends*—see Paragraph 5.4 and Table 7.

11.1.3.2 *Schedule of Lengths (Specific and Stock) with Ends*—see Paragraph 5.4 and Table 8.

11.1.3.3 *Length Tolerances for Squared Sheared Metal*—see Paragraph 5.4 and Table 9.

11.1.3.4 *Length Tolerances for Sawed Metal*—see Paragraph 5.4 and Table 10.

11.1.4 *Straightness*:

11.1.4.1 *Slit Metal or Slit Metal Either Straightened or Edge Rolled*—see Paragraph 5.5 and Table 11.

11.1.4.2 *Square Sheared Metal*—see Paragraph 5.5 and Table 12.

11.1.4.3 *Sawed Metal*—see Paragraph 5.5 and Table 13.

[9] All tempers are subject to product limitations, and the manufacturer should be consulted.

12. Workmanship, Finish and Appearance

12.1 The product shall be free of defects, well cleaned, and free of dirt. A superficial film of residual light lubricant is normally present and is acceptable unless otherwise specified. The surface finish and appearance of the material shall be as prescribed in Specification B 248 unless otherwise specified.

13. Sampling

13.1 The lot size, portion size, and selection of sample pieces shall be as prescribed in the sampling section of Specification B 248 or B 248M.

14. Specimen Preparation

14.1 The specimen preparation procedure to be used for the products covered by this specification shall be as prescribed in the specimen preparation section of Specification B 248 or B 248M.

15. Test Methods

15.1 Test methods used for quality control or production control, or both, for determining conformance to product property requirements are discretionary.

15.1.1 Test methods used to obtain data for the preparation of certification or test report shall be made available to the purchaser on request.

15.2 *Chemical Analysis*—In case of disagreement, the test method to be followed for a specific element and range or maximum concentration shall be as indicated in Table 3 for alloys listed in Table 1.

15.2.1 The determination of magnesium and zirconium, for which no recognized test method is known to be published, shall be subject to agreement between the manufacturer or supplier and the purchaser.

15.3 *Tensile Strength*—The tensile strength must be determined in accordance with Test Methods E 8.

15.4 *Yield Strength*—The yield strength shall be determined in accordance with Test Methods E 8.

15.5 *Elongation*—The elongation shall be determined in accordance with Test Methods E 8.

TABLE 3 Chemical Test Methods

Element	Range or Max. %	Test Method
Aluminum (Al)	0.0-12.0	E 54
	2.0-12.0	E 478
Chromium (Cr)	0.003-2.0	ISO 4744
Cobalt (Co)	0.5	E 75
Copper (Cu)	50-99.99	E 478
Iron (Fe)	0.003-1.25	E 478
Lead (Pb)	0.002-15.0	E 478 Atomic Absorption
Magnesium (Mg)	0.01-2.0	. . .
Manganese (Mn)	6.0	E 62
Nickel (Ni)	50.0	E 478
Phosphorus (P)	1.2	E 62
Silicon (Si)	5.0	E 54
Silver (Ag)	0.01-0.12	E 478
Tellurium (Te)	0.003-0.05	ISO 7602 Part I E/F (ISO/TC26 N692)
Tin (Sn)	0.01-1.0	E 478 Photometric
	0.5-20.0	E 478 Titrimetric
Zinc (Zn)	2-40	E 478 Titrimetric
Zirconium (Zr)	0.01-0.30	. . .

16. Number of Tests and Retests

16.1 The number of tests and retests procedure to be used for the products covered by this specification shall be as prescribed in the Number of Tests and Retests section of Specification B 248 or B 248M.

17. Significance of Numerical Limits

17.1 For significance of numerical limits, refer to Specification B 248 or B 248M.

18. Inspection

18.1 The manufacturer or supplier shall inspect and make tests necessary to verify that the product furnished conforms to the requirements specified for the product.

19. Rejection and Rehearing

19.1 *Rejection*:

19.1.1 Product that fails to conform to the requirements of the product specification may be rejected.

19.1.2 The rejection shall be reported to the manufacturer or the supplier, promptly and in writing.

19.1.3 In case of disagreement or dissatisfaction with the results of the test upon which rejection was based, the manufacturer or supplier may make claim for a rehearing.

19.2 *Rehearing*:

19.2.1 As a result of product rejection, the manufacturer or supplier may make claim for retest to be conducted by the manufacturer or supplier and the purchaser. Samples of the rejected product shall be taken in accordance with the product specification and tested by both parties as directed in the product specification, or alternatively, upon agreement by both parties, an independent laboratory may be selected for the tests using the test methods prescribed in the specification.

20. Certification

20.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

21. Mill Test Report

21.1 When specified in the purchase order or contract, the manufacturer or supplier shall furnish to the purchaser a manufacturer's test report showing the results of the required tests.

22. Packaging and Package Marking

22.1 *Packaging*—The material shall be separated by size, composition, and temper and prepared for shipment in such manner as to ensure acceptance by common carrier for transportation and afford protection from normal hazards of transportation.

22.2 *Package Marking*—Each shipping unit shall be legibly marked with the purchase order number, specification number, alloy designation, temper, gross and net weight, and name of supplier.

22.3 Product shall be supplied in coils wound in traverse or pancake style as specified in the purchase order or contract.

22.3.1 Product supplied in coils wound in pancake style shall be with or without interleaf paper as required by the purchaser.

23. Keywords

23.1 coefficient of thermal expansion; density; electrical conductivity; electrical connectors; electrical resistivity; elongation; modulus of elasticity; spring contacts; thermal conductivity; yield strength; UNS No. C14530; UNS No. C15100; UNS No. C15500; UNS No. C19400; UNS No. C19500; UNS No. C19700; UNS No. C23000; UNS No. C26000; UNS No. C42200; UNS No. C42500; UNS No. C51000; UNS No. C51100; UNS No. C52100; UNS No. C63800; UNS No. C65400; UNS No. C68800; UNS No. C70250; UNS No. C70260; UNS No. C72900; UNS No. C75200; UNS No. C76200

APPENDIX

(Nonmandatory Information)

X1. Preferred Physical and Electrical Properties

X1.1 *Physical Properties*:

X1.1.1 Unless specified in the purchase order or contract, the modulus of elasticity, density, electrical conductivity, thermal conductivity, coefficient of thermal expansion, and the electrical resistivity data in Table X1.1 do not constitute a part of this specification. They will indicate to the purchaser the mechanical and physical properties that may be expected.

X1.1.2 Formability property of material usually determines if a spring material is capable of forming to a given radius. Bend test per Test Method B 820 will provide useful information as to the formability or the ability of copper alloy spring material to resist cracking when formed. This test method may be used in selecting a spring material that will safely form to the geometry of a given part.

X1.2 *Electrical Properties*:

X1.2.1 The value of 0.153 28 $\Omega \cdot g/m^2$ at 20°C (68°F) is the international standard for the resistivity of annealed copper equal to 100 % conductivity. The term means that a wire 1 m in length and weighing 1 g would have a resistance of 0.153 28 Ω. This is equivalent to a resistivity value of 875.20 $\Omega \cdot lb/mile^2$, which signifies the resistance of a wire 1 mile in length

TABLE X1.1 Preferred Physical Properties

	Density		Modulus of Elasticity		Electrical Conductivity	Electrical Resistivity ζ (max.)[A]		Thermal Conductivity		Coefficient of Thermal Expansion	
Copper Alloy UNS No.	lbs/in.^{3} at 68°F	g/cm^3 at 20°C	10^6 psi	GPa	% IACS (min.) at 68°F (20°C)	Ω·lb/mile^2 at 68°F	Ω·g/m^2 at 20°C	BTU/ft·h° F at 68°F	W/m·k at 20°C	in./in./°F × 10^{-6} from 68-572°F	m/m°C × 10^{-6} from 20-300°C
C14530	0.323	8.94	17	115	94	931.06	0.163 06	210	363	9.8	17.6
C15100	0.323	8.94	17	115	95	921.26	0.161 35	208	360	9.8	17.6
C15500	0.322	8.91	17	115	86	1 017.67	0.178 23	200	346	9.9	17.8
C19400	0.322	8.91	17	115	60	1 458.67	0.255 47	150	260	9.8	17.6
C19500	0.322	8.91	17	115	50	1 750.40	0.306 56	115	199	9.4	16.9
C19700	0.319	8.83	17	115	80	1 094.00	0.191 60	185	320	9.6	17.3
C23000	0.316	8.75	17	115	37	2 365.41	0.414 27	92	159	10.4	18.7
C26000	0.308	8.53	16	110	28	3 125.71	0.547 43	70	121	11.1	20.0
C42200	0.318	8.80	16	110	31	2 823.23	0.494 45	75	130	10.2	18.4
C42500	0.317	8.77	16	110	28	3 125.71	0.547 43	69	119	10.2	18.4
C51000	0.320	8.86	16	110	15	5 834.67	1.021 87	40	69	9.9	17.8
C51100	0.320	8.86	16	110	20	4 376.00	0.766 40	48	83	9.9	17.8
C52100	0.318	8.80	16	110	13	6 732.31	1.179 08	36	62	10.1	18.2
C63800	0.299	8.28	17	115	10	8 752.00	1.532 80	22	38	9.5	17.1
C65400	0.309	8.55	17	115	7	12 502 86	2.189 71	21	36	9.7	17.5
C68800	0.296	8.19	17	115	18	4 862.22	0.851 56	47	81	10.1	18.2
C70250	0.318	8.80	19	130	40	2 188.00	0.383 20	98	170	9.8	17.6
C70260	0.320	8.86	19	130	40	2 188.00	0.383 20	90	156	10.0	18.0
C75200	0.316	8.75	18	125	6	14 586.67	2.554 67	19	33	9.0	16.2
C76200	0.310	8.58	18	125	9	9 724.44	1.703 11	24	42	9.0	16.2

[A]The weight resistivity values in the table are calculated from the corresponding electrical conductivity per Test Method B 193 as follows: $R = 1/N\ (15.328)$, where R = wt. resistivity at 20°C in ohms × grams per square metre (Ω·g/m^2) and N = electrical conductivity in % IACS.

weighing 1 lb. The electrical resistivity (weight) values in Table X1.1 are calculated from the corresponding electrical conductivity per Specification B 193 as follows:

$$R = 1/N\ (15.328)\ \Omega\cdot g/m^2 = 1/N\ (875\ 20)\ \Omega\cdot lb/mile^2 \qquad (X1.1)$$

where:

R = wt. resistivity at 20°C in Ohms × grams per square metre or wt. resistivity at 68°F in Ohms × pounds per square mile and

N = electrical conductivity in % IACS.

X1.3 *Metric Equivalent*:

X1.3.1 The SI unit for strength properties now shown is in accordance with the International Systems 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 1 kg gives it an acceleration of 1 m/s^2 (N = kg × m/s^2). The derived SI unit for pressure or stress is the Newton per square meter (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.