



Designation: B 694 – 95

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Copper, Copper-Alloy, and Copper-Clad Stainless Steel (CCS), and Copper-Clad Alloy Steel (CAS) Sheet and Strip for Electrical Cable Shielding¹

This standard is issued under the fixed designation B 694; 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 describes selected copper, copper alloy, copper-clad stainless steel (CCS), and copper-clad alloy steel (CAS) materials, sheet and strip, in various thicknesses, for use as electrostatic or electromagnetic shielding for insulated power, control, instrumentation, and communication cables.

NOTE 1—See Specification B 736, for related standards for aluminum-based shielding materials.

1.2 The materials covered are the following:

Copper or Copper Alloy UNS No. ⁴	Type of Material
C11000	copper
C19400	copper-iron alloy
C22000	copper-zinc alloy (commercial bronze)
C66400	copper-zinc-iron-cobalt alloy
C66410	copper-zinc-iron alloy
C71000	cupro-nickel 20 %
...	copper-clad stainless steel (CCS)
...	copper-clad alloy steel (CAS)

⁴ Refer to Practice E 527 for an explanation of the Unified Numbering System (UNS).

1.3 The values stated in inch-pound units are the standard, except for temperature and grain size which are given in SI units. Values 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 specified herein:

2.2 *ASTM Standards*:

A 176 Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip²

A 505 Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for²

B 152 Specification for Copper Sheet, Strip, Plate, and Rolled Bar³

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

Current edition approved Feb. 15, 1995. Published April 1995. Originally published as B 694 – 81. Last previous edition B 694 – 86.

² *Annual Book of ASTM Standards*, Vol 01.03.

³ *Annual Book of ASTM Standards*, Vol 02.01.

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar³

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast³

B 736 Specification for Aluminum, Aluminum Alloy and Aluminum-Clad Steel Cable Shielding Stock⁴

E 3 Methods of Preparation of Metallographic Specimens⁵

E 8 Test Methods for Tension Testing of Metallic Specimens⁵

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronze⁶

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

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys⁶

E 112 Test Methods for Determining Average Grain Size⁵

E 255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition⁶

E 478 Test Methods for Chemical Analysis of Copper Alloys⁶

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

2.3 *International Standards Organization (ISO) Standards*:
ISO/DIS 3110/2 Determination of Aluminum; Flame Atomic Absorption Spectrometric Method (TC/26 Ref. No. N698 E/F)⁸

3. Terminology

3.1 *Definitions*:

3.1.1 *cladding ratio, n*—ratio by percent thickness of the component layers, for example, 16/68/16.

4. Ordering Information

4.1 Orders for material should include the following information:

4.1.1 ASTM designation and year of issue,

4.1.2 Quantity: total for each item, pounds (or kilograms),

⁴ *Annual Book of ASTM Standards*, Vol 02.02.

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., 13th Floor, New York, NY 10036.

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- 4.1.3 Name of material: cable shielding (or “cable wrap”),
 4.1.4 Form of material: strip,
 4.1.5 Type of material: copper, copper-zinc alloy (commercial bronze), etc. (see 1.2),
 4.1.6 Alloy number when appropriate (see 1.2),
 4.1.7 Temper (see Section 7),
 4.1.8 Dimensions: thickness and width (see Section 10),
 4.1.9 How furnished: coils (rolls), traverse wound on reels or spools, etc.,
 4.1.10 Whether the resistivity test is required for any item (Section 8),
 4.1.11 Coil dimension: inner or outer coil diameter limitation, or both, if required,
 4.1.12 Weight of coils: coil weights or coil size limitations, if required,
 4.1.13 Cladding ratio when appropriate (see 6.5.3),
 4.1.14 Certification, if required, (see Section 17),
 4.1.15 Mill test report, if required,
 4.1.16 Specification designation and year of issue, and
 4.1.17 Special tests or exceptions, if any.

5. Materials and Manufacture

5.1 The material shall be of such quality that it conforms to the properties and characteristics prescribed in the specification.

5.2 Cladding metals as appropriate may be bonded to the specified base metal by any method that will produce a clad material that will conform to this specification.

6. Chemical Composition

6.1 Homogeneous copper and copper-alloy materials shall conform to the requirements prescribed in Table 1 for the particular material.

6.2 Copper cladding shall be, unless otherwise specified, a copper conforming in chemical composition to that covered by Specification B 152. The exact grade is typically not specified provided that the final strip meets the conductivity and mechanical properties of this specification. Some typical coppers used are:

C10920
 C11000
 C11020
 C12000

6.3 These specification limits do not preclude the possible presence of other unnamed elements. Limits may be established and determination required for unnamed elements by agreement between the manufacturer and the purchaser.

6.4 Except for copper C11000, copper may be taken as the difference between all the elements analyzed and 100 %.

6.4.1 *Alloys C19400 and C22000*—When all elements specified in Table 1 are determined, the sum of the results shall be 99.8 % min.

6.4.2 *Alloys C66400, C66410, and C71000*—When all elements specified in Table 1 are determined, the sum of the results shall be 99.5 % min.

6.5 Clad Metal:

6.5.1 For stainless steel clad cores, the stainless shall conform in chemical composition to any of those covered by Specification A 176. Unless otherwise specified, stainless in accordance with UNS No. S43000 (Type 430) shall be supplied.

6.5.2 For alloy steel clad cores, the steel shall conform in chemical composition to any of those covered by Specification A 505. Unless otherwise specified, alloy steel in accordance with UNS No. G41300 shall be supplied.

6.5.3 Unless otherwise stated (4.1.12), the cladding ratio shall be one of the standard ratios listed in Table 2 and Table 3, and shall be expressed as XX/XX/XX, copper/stainless steel/copper or copper/alloy steel/copper as appropriate.

7. Temper

7.1 As described in Practice B 601, tempers furnished to this specification shall be:

- 7.1.1 Copper C11000 — H00, H01, H02, and O61.
 7.1.2 Copper alloy C19400 — H02, O61, and O50.
 7.1.3 Copper alloy C22000 — H01, H02, and O81.
 7.1.4 Copper alloy C66400 and C66410 — O60.
 7.1.5 Copper alloy C71000 — H01, H02, OS035, and OS015.
 7.1.6 Copper-Clad Steel — O61.

8. Physical Properties

8.1 Annealed material shall conform to the requirements of Table 4.

9. Mechanical Properties

9.1 *Grain Size:*

TABLE 1 Chemical Requirements

Element	Composition, %					
	Copper or Copper Alloy UNS No.					
	C11000	C19400	C22000	C66400	C66410	C71000
Copper (incl silver)	99.90 min	97.0 min	89.00–91.0	remainder	remainder	74.0 min
Iron	...	2.1–2.6	0.05 max	1.3–1.7	1.8–2.3	1.0 max
Lead, max	...	0.03	0.05	0.015	0.015	0.05
Tin	...	...	...	0.05 max	0.05 max	...
Zinc	...	0.05–0.20	remainder	11.0–12.0	11.0–12.0	1.0 max
Nickel (incl cobalt)	...	...	...	...	0.05 max	19.0–23.0
Manganese	...	...	...	...	0.05 max	1.0 max
Phosphorus	...	0.0015–0.15	...	...	0.02 max	...
Cobalt	...	...	...	0.30–0.7	...	...
Silver	...	...	...	...	0.05 max	...
Silicon	...	...	...	...	0.05 max	...
Aluminum	...	...	...	...	0.05 max	...