



Standard Specification for Commercial Bronze Strip for Bullet Jackets¹

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1. Scope

1.1 This specification establishes general requirements for Copper Alloy UNS No. C22000² (commercial bronze) strip for manufacture of bullet jacket cups and ammunition components.

1.2 The values stated in inch-pound units are to be regarded as the standard except for grain size which is stated in metric units.

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 Bar³

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

E 3 Methods of Preparation of Metallographic Specimens⁴

E 8 Test Methods for Tension Testing of Metallic Materials⁴

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁴

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification⁵

E 112 Test Method for Determining Average Grain Size⁴

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

3. Terminology

3.1 Refer to Specification B 248 for definition of terms.

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.

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² Refer to Practice E 527 for an explanation of the unified numbering system (UNS).

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 14.02.

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

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

4. Ordering Information

4.1 Order for product under this specification should include the following information:

4.1.1 Specification number and year of issue,

4.1.2 Quantity or weight for each size,

4.1.3 Temper (Section 7),

4.1.4 Grain size of annealed temper (optional) (Section 9),

4.1.5 Dimensions: thickness, width, length, (Section 10),

4.1.6 How furnished: straight lengths or coils,

4.1.7 Heat identification or traceability, if required,

4.1.8 Certification, if required, and

4.1.9 Mill test report, if required.

4.1.10 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 the Specification B 248.

5. Materials and Manufacture

5.1 The material shall be of such quality and purity that the finished product shall have the properties and characteristics prescribed in this specification.

5.2 The product shall be finished by the cold-rolling and the annealing process, and may be furnished in either cold-rolled or annealed tempers, as specified.

6. Chemical Composition

6.1 The material shall conform to the composition prescribed in Table 1.

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

6.3 Either copper or zinc may be taken as the difference between the sum of all elements analyzed and 100 %. When all elements in Table 1 are analyzed, their sum shall be 99.8 % min.

7. Temper

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

7.1.1 *Cold-Rolled Tempers*—For cold rolled strip a temper designation from Table 2 shall be specified.

7.1.2 *Annealed Tempers*—For annealed tempered strip, a temper designation from Table 3 shall be specified.

TABLE 1 Chemical Requirement

Copper Alloy UNS No. C22000	
Element	Composition
Copper	89.0–91.0
Lead, max	0.05
Iron, max	0.05
Zinc	remainder

8. Mechanical Properties

8.1 *Tensile Strength of Rolled Tempers*—The tension test shall be the standard test for all tempers of cold-rolled strip, and the acceptance or rejection shall depend only on the tensile strength which shall conform to the requirements prescribed in Table 2. Tension test specimens shall be taken so the longitudinal axis is parallel to the direction of rolling.

8.1.1 *Rockwell Hardness of Rolled Tempers*—Since a Rockwell hardness test offers a quick and convenient method of checking commercial bronze for general conformity to the requirements for tensile strength, the approximate Rockwell hardness values for each of the cold-rolled tempers are given in Table 2 for general information and assistance in testing.

8.2 *Tension Tests of Annealed Tempers*—Annealed strip shall conform to the tensile property requirements prescribed in Table 4. Tension test specimens shall be taken so the longitudinal axis is parallel to the direction of rolling.

9. Grain Size of Annealed Tempers

9.1 In addition to the tensile properties prescribed in Table 3 for strip over 0.020 in. (0.508 mm) in thickness, grain size may also be specified by the purchaser. When grain size is specified, the average grain size of the annealed strip shall be within the limits prescribed in Table 5. At a magnification of 75 \times , the average grain size of selected areas 79.8 mm in diameter of each of two samples of annealed strip shall be determined on a plane parallel to the surface of the strip.

10. Dimensions, and Permissible Variations

10.1 *Thickness*—The standard method of specifying thickness shall be in decimal fractions of an inch. The tolerances shall be as shown in Table 6.

NOTE 1—For material 0.021 in. (0.533 mm) and under in thickness, it is recommended that the nominal thickness be stated in the nearest half-thousandth of an inch. (For example, specify 0.006 or 0.0065) (0.152 or 0.165 mm), but not 0.0063 (0.158 mm)). For material over 0.021 in. in thickness, it is recommended that the nominal thickness be stated in the nearest thousandth of an inch. (For example, specify 0.128 or 0.129 (3.25 or 3.28 mm), but not 0.1285 (3.26 mm).)

10.2 *Width*—The width tolerances of strip metal shall be as prescribed in Table 7.

10.3 *Length*—The strip shall be furnished in straight lengths or in coils (Rolls), as specified. Rolls shall consist of not more than three lengths, no one of which shall be less than 10 ft (3.05 m) in length. The tolerances for straight lengths shall be as prescribed in Table 8.

10.3.1 *Stock Lengths*—When furnished in stock lengths with short lengths included, the schedule of short lengths shall be as prescribed in Table 9.

10.3.2 *Special Length*—When special lengths are required, they shall be specified in the order.

NOTE 2—For the purpose of determining conformance with the dimensional requirements prescribed in this specification, any measured value outside the specified limiting values for any dimension may be cause for rejection.

10.4 *Straightness Tolerances*—The straightness tolerances shall be as prescribed in Table 10.

11. Workmanship, Finish, and Appearance

11.1 The material shall be free of defects, but blemishes of a nature that do not interfere with normal commercial operations are acceptable. It shall be well-cleaned and free of dirt. A superficial film or residual light lubricant is normally present and is acceptable unless otherwise specified.

11.2 The surface finish and appearance shall be the normal commercial quality for the alloy, thickness, and temper ordered. When application information is provided with purchase order, the surface shall be that commercially producible for the application. Superficial films of discoloration, or lubricants, or tarnish inhibitors are permissible unless otherwise specified.

12. Sampling

12.1 *Sampling*—The lot size, portion size, and selection of sample pieces shall be as follows:

12.1.1 *Lot Size*—40 000 lb (18 144 kg) or less material of the same mill form, temper, and thickness, subject to inspection at one time.

12.1.2 *Portion Size*—Sample pieces shall be selected from eight individual pieces, and shall be taken so as to be representative of those pieces. If the lot consists of less than eight pieces, a sample shall be taken from each individual piece.

12.1.2.1 *Chemical analysis:*

12.1.3 When samples are taken at the time the castings are poured, at least one sample shall be taken for each group of castings poured simultaneously from the same source of molten metal.

12.1.4 When samples are taken from the semifinished product, a sample shall be taken to represent each 40 000 lb (18 144 kg) or fraction thereof, except that no more than one sample shall be required per piece.

12.2 *Chemical Analysis*—A sample for chemical analysis shall be taken and prepared in accordance with Practice E 255. Drillings, millings, etc. shall be taken in approximately equal weight from each of the sample pieces selected in accordance with 12.1.2 and combined into one composite sample. The minimum weight of the composite sample that is to be divided into three equal parts shall be 150 g.

12.2.1 In lieu of sampling in accordance with Practice E 255, the manufacturer shall have the option of determining conformance to chemical composition as follows: Conformance shall be determined by the manufacturer by analyzing samples taken at the time the castings are poured or samples taken from the semifinished product. If the manufacturer determines the chemical composition of the material during the course of manufacture, he shall not be required to sample and analyze the finished product.

12.2.1.1 Due to the discontinuous nature of the processing of castings into wrought products, it is not practical to keep

TABLE 2 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Cold-Rolled Strip

Rolled Temper Designation		Tensile Strength, ksi ^A (MPa ^B)		Approximate Rockwell Hardness ^C	
Standard	Former	Min	Max	B Scale	Superficial 30-T
H01	Quarter-hard	40 (275)	50 (345)	27–56	34–54
H02	Half-hard	47 (325)	57 (395)	50–66	50–61
H03	Three-quarter hard	52 (355)	62 (425)	59–71	55–64
H04	Hard	57 (395)	66 (455)	65–75	60–67
H06	Extra-hard	64 (440)	72 (495)	72–79	64–69
H08	Spring	69 (475)	77 (530)	76–81	67–70
H10	Extra-spring	72 (495)	80 (550)	78–83	68–71

^A ksi = 1000 psi.

^B See Appendix X1.

^C Rockwell hardness values apply as follows: The B scale applies to metal 0.020 in. (0.058 mm) in thickness and over; the 30-T scale applies to metal 0.012 in. (0.305 mm) in thickness and over.

TABLE 3 Annealed Temper

Temper Designation		Nominal Grain Size
Standard	Former	
OS015	Light anneal	0.015-mm diameter of average grain
OS025	Intermediate anneal	0.025-mm diameter of average grain
OS035	Drawing anneal	0.035-mm diameter of average grain

TABLE 4 Tension Test Requirements of Annealed Strip

Annealed Temper Designation		Thickness of Annealed Tempers, in. (mm)	Tensile Strength min. ksi ^A (MPa ^B)	Elongation in 2 in. (50.8 mm), min, %
Standard	Former			
OS015	Light anneal	0.005 to 0.010 (0.127 to 0.254), incl	38 (260)	15
		Over 0.010 to 0.050 (0.254 to 1.27), incl	38 (260)	25
		Over 0.050 to 0.100 (1.27 to 2.54), incl	38 (260)	27
		Over 0.100 (2.54)	38 (260)	30
		OS025	Intermediate anneal	0.005 to 0.010 (0.127 to 0.254), incl
		Over 0.010 to 0.050 (0.254 to 1.27), incl	36 (250)	30
		Over 0.050 to 0.100 (1.27 to 2.54), incl	36 (250)	32
		Over 0.100 (2.54)	36 (250)	35
OS035	Drawing anneal	0.005 to 0.010 (0.127 to 0.254), incl	34 (240)	25
		Over 0.010 to 0.050 (0.254 to 1.27), incl	34 (240)	35
		Over 0.050 to 0.100 (1.27 to 2.54), incl	34 (240)	38
		Over 0.100 (2.54)	34 (240)	40

^A ksi = 1000 psi.

^B See Appendix X1

specific casting analysis identified with a specific quantity of finished material.

12.2.2 In the event that heat identification or traceability is required, the purchaser shall specify the details desired.

13. Number of Tests and Retests

13.1 Test:

13.1.1 Chemical Requirements:

13.1.2 When samples are taken at the time the castings are poured, at least one sample shall be analyzed for each group of castings poured simultaneously from the same source of molten metal.

TABLE 5 Grain Size Requirements of Annealed Strip

Annealed Temper Designation		Grain Size, mm		
Standard	Former	Nominal Average	Min	Max
OS015	Light anneal	0.015	^A	0.025
OS025	Intermediate anneal	0.025	0.015	0.040
OS035	Drawing anneal	0.035	0.025	0.050

^A Although no minimum grain size is required this material must be fully recrystallized.

13.1.3 When samples are taken from the semifinished or finished product, at least one sample representative of the product of each cast bar from a single melt charge continuously processed with heat identity maintained shall be analyzed.

13.2 *Mechanical Properties and Grain Size*—Unless otherwise provided in the product specification, test specimens shall be taken from two of the sample pieces selected in accordance with 12.1.2. The required tests shall be made on each of the specimens so selected.

13.3 *Other Tests*—For other tests, test specimens shall be taken from four of the sample pieces selected in accordance with 12.1.2. The required tests shall be made on each of the specimens so selected.

13.4 Retests:

13.4.1 If the chemical analysis of the specimens prepared from samples selected in accordance with 12.1.2 fails to conform to the specified limits, analysis shall be made on a new composite sample prepared from the pieces selected in accordance with 12.1.2.

13.4.2 If one of the two tests made to determine any of the mechanical or grain size requirements fails to meet a specified limit, this test shall be repeated on the remaining pieces, maximum of two, selected in accordance with 12.1.2, and the results of both of these tests shall comply with the specified requirements.

13.4.3 If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

13.5 *Chemical analysis*—shall be determined as the average of at least two replicate determinations for each element specified.

14. Specimen Preparation

14.1 In the grain size test, all specimens shall be prepared as specified in Method E 3.

14.2 In the tension test, all strip less than 3/4" wide shall be pulled in full size when practicable. Machined test specimens