



Designation: B115 – 10 (Reapproved 2016)

Standard Specification for Electrolytic Copper Cathode¹

This standard is issued under the fixed designation B115; 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 establishes the requirements for electrolytic copper cathode; electrorefined and electrowon.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

NOTE 1—Cathode produced to this specification corresponds to the designation “Cath” as defined in Classification B224 and may be used to produce all other coppers listed in Classification B224 that are normally produced from “Cath” copper.

NOTE 2—Grade 1 cathode conforms to the chemical compositional requirements of Copper UNS No. C11040, except for oxygen, and is suitable for the manufacture of wire rod as designated in Specification B49.

1.3 The following hazard caveat applies to the test methods described in Annex A2 of this specification: *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 ASTM Standards:²

- B49 Specification for Copper Rod for Electrical Purposes
- B193 Test Method for Resistivity of Electrical Conductor Materials
- B224 Classification of Coppers
- B846 Terminology for Copper and Copper Alloys
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

¹ This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.07 on Refined Copper.

Current edition approved April 1, 2016. Published May 2016. Originally approved in 1938. Last previous edition approved in 2010 as B115 – 10. DOI: 10.1520/B0115-10R16.

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* volume information, refer to the standard's Document Summary page on the ASTM website.

E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry

3. Terminology

3.1 For definition of general terms related to copper and copper alloys, refer to the current editions of Classification B224 and Terminology B846.

4. Ordering Information

4.1 Orders for product shall include the following information, as applicable:

- 4.1.1 ASTM designation and year of issue (for example, B115 – XX),
- 4.1.2 Cathode grade (Table 1),
- 4.1.3 Size; full cathode or cut,
- 4.1.4 Total weight of each size.

5. Chemical Composition

5.1 The cathode furnished shall conform to the requirements of Table 1 for the grade specified in the contract or purchase order.

5.2 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the supplier and the purchaser and such agreement shall be part of the contract or purchase order.

6. Physical Property Requirements

6.1 Electrical Resistivity:

6.1.1 The maximum electrical resistivity for product produced from Grade 2 cathode shall be $0.153\ 28\ \Omega\cdot\text{g}/\text{m}^2$ (conductivity 100.0 % minimum IACS) at 20°C (68°F) annealed³ when tested in accordance with Test Method B193. Measurement error is not included in the maximum/minimum limit.

7. Dimensions, Mass, and Permissible Variations

7.1 Full-size cathodes or cathodes cut to size may be supplied as agreed upon between supplier and purchaser.

³ NBS Notebook 100 available from National Technical Information Service (NTIS), 5301 Shawnee Rd, Alexandria, VA 22312, http://www.ntis.gov.

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



TABLE 1 Chemical Composition

| Element | Grade 1 ^A | Grade 2 ^A |
|-------------------------|-------------------------|----------------------|
| | Percent, % | |
| Copper | 99.95, min ^B | |
| | ppm ^C | |
| Selenium, max | 2 | 10 |
| Tellurium, max | 2 | 5 |
| Bismuth, max | 1.0 | 3 |
| Group total, max | 3 | ... |
| Antimony, max | 4 | 15 |
| Lead, max | 5 | 40 |
| Arsenic, max | 5 | 15 |
| Iron, max | 10 | 25 |
| Nickel, max | 10 | 20 |
| Tin, max | 5 | 10 |
| Sulfur, max | 15 | 25 |
| Silver, max | 25 | 70 |
| Maximum allowable total | 65 | ... |

^A Measurement error is not incorporated in the maximum limits, refer to 10.1.1.

^B Including silver.

^C Determined from a melted sample.

8. Workmanship, Finish, and Appearance

8.1 Cathodes shall withstand ordinary handling without breakage or excessive separation of nodules. They shall be substantially free of all foreign material; for example, copper sulfate, dirt, grease, and oil.

9. Sampling

9.1 For routine sampling of cathodes for analysis, the method of sampling shall be at the discretion of the sampler.

9.2 In case of dispute concerning sampling for chemical composition, or electrical resistivity, or both, the method of sampling shall be in accordance with Annex A1.

9.3 In case of special requirements specified in the purchase order or contract, the method of sampling shall be as agreed between the supplier and the purchaser.

10. Number of Tests and Retests

10.1 Tests:

10.1.1 Chemical composition shall be determined as the per element mean of at least two replicate analyses of each sample.

10.1.2 Electrical resistivity shall be determined as the mean of results from four specimens.

10.2 Retests:

10.2.1 In the case of compositional or resistivity dispute, retests may be made under the conditions of 9.2.

10.3 Umpire Test:

10.3.1 In the case in which retest does not settle the dispute, further retest may be made by a qualified third-party laboratory agreeable to both parties. This provision does not preclude other contractual agreements.

11. Specimen Preparation

11.1 For routine testing, specimen preparation shall be at the discretion of the preparer.

11.2 In the case of special requirements specified in the purchaser order or contract, specimen preparation shall be as agreed between the supplier and the purchaser.

11.3 In the case of dispute concerning specimen preparation for chemical composition specified in Table 1 or electrical resistivity, specimen preparation shall be in accordance with Annex A1.

12. Test Methods

12.1 Chemical Composition:

12.1.1 For routine analysis of Grade 1 and Grade 2 cathode, the methods of analysis used shall be at the discretion of the analyst.

12.1.2 In the case of dispute concerning the chemical composition, the methods of analysis shall be in accordance with Annex A2, except for copper in Grade 2 cathode.

12.1.3 In the case of dispute concerning copper content of Grade 2 cathode, the method of analysis shall be in accordance with Test Methods E53.

12.1.4 In the case of dispute concerning special requirements stated in the purchase order or contract, the methods of analysis used shall be as agreed between the supplier and the purchaser.

12.2 Electrical Resistivity:

12.2.1 In the case of dispute concerning electrical resistivity, the method of testing shall be in accordance with Test Method B193.

13. Significance of Numerical Limits

13.1 Calculated values shall be rounded to the desired number of places as directed in Practice E29.

14. Inspection

14.1 The producer shall inspect the product and conduct such tests as are necessary to verify that the requirements of this specification are met.

15. Rejection and Rehearing

15.1 Rejection:

15.1.1 Product that fails to conform to the requirements of this specification may be rejected.

15.1.2 Rejection shall be reported to the producer or supplier promptly and in writing.

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

15.2 Rehearing:

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

16. Packaging and Package Marking

16.1 Packaging:

16.1.1 Cathodes, whether full size or cut, shall be assembled in bundles or containers of suitable weight for handling and

shall be prepared for shipment in such a manner as to ensure acceptance by common carrier for transportation and to afford protection from normal hazards of transportation.

16.2 *Package Marking:*

16.2.1 Each cathode bundle or container shall be marked to identify source and grade.

16.2.2 When used, metallic identifying markers shall be firmly attached only to the strapping or shipping container.

17. Keywords

17.1 cathode; copper; electrolytic copper; electrorefined copper; electrowon copper

ANNEXES

(Mandatory Information)

A1. SAMPLING AND SPECIMEN PREPARATION OF ELECTROLYTIC CATHODE COPPER FOR DETERMINATION OF COMPLIANCE WITH SPECIFICATION REQUIREMENTS

A1.1 Scope

A1.1.1 This practice establishes a procedure for the sampling and specimen preparation of electrolytic copper cathodes, Grades 1 and 2, for the determination of conformance with specification requirements.

A1.1.2 *Units*—The values stated in inch-pound units are the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

A1.1.3 *This standard does not purport to address 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.*

A1.2 Terminology

A1.2.1 *Definitions of Terms Specific to This Standard:*

A1.2.1.1 *lot*—One shipment, or part of one shipment, produced by one refiner. For use other than continuous cast rod production, shipments greater than 200 tons short shall be subdivided into lots not exceeding 200 tons each for sampling purposes.

A1.2.1.2 *gross sample*—The total number of test pieces selected from a lot and considered representative of the lot.

A1.2.1.3 *test piece*—An individual cathode, or cathode part, randomly selected from the lot.

A1.2.1.4 *sample*—A portion prepared from the gross sample and considered representative of the gross sample.

A1.2.1.5 *specimen*—Representative fraction taken from the sample for test.

A1.3 Selection of Cathode

A1.3.1 Nodules shall not be considered a sample representative of the lot.

A1.3.2 *Cathodes for Continuous Rod Casting:*

A1.3.2.1 The cathodes shall be available in the original packing for examination.

A1.3.2.2 The quantity of cathodes required shall be that necessary to flush the system plus 1 hour of melting furnace operation.

A1.3.2.3 All cathode bundles shall be numbered and a random number generator shall be used to determine which bundles shall be selected for the gross sample.

A1.3.2.4 Should there be an insufficient quantity of cathodes to comply with A1.3.2.2, then the procedure described in A1.3.3 shall apply.

A1.3.3 *Cathodes for Other Uses:*

A1.3.3.1 Not less than 25 % of the original lot weight or 25 tons, whichever is the larger, shall be available in the original packing for examination.

A1.3.3.2 A gross sample of 24 cathodes, or the equivalent in sheared cathode pieces, shall be selected from a lot. To guarantee random selection, all cathodes, or sheared cathode pieces, of the lot shall be individually numbered, and a random number generator shall be used to select the individual test pieces.

A1.3.3.3 In the case of sheared cathodes, 24 full cathodes; 48 half-plate cathodes, 24 each of tops and bottoms; 96 quarter-plate cathodes, and 24 each of the four quarters, shall be selected.

A1.3.3.4 The selection of test pieces of cathode sheared smaller than quarter plate shall be by agreement between the producer, or the supplier, and the purchaser.

A1.3.3.5 Alternatively, to avoid individual numbering of cathodes, or sheared cathode pieces, in the case of large lots, provided both parties agree, individual bundles, or containers, may be selected on a random basis, and then individual cathodes, or sheared cathode pieces, within each bundle, or container, shall be numbered and test pieces selected, using a random number generator as just described.

A1.4 Sample Preparation

A1.4.1 *Cathode for Continuous Rod Casting:*

A1.4.1.1 The portion used for flushing the system shall not be used for sampling.

A1.4.1.2 The remaining gross sample, minimum of one hour's cast, shall be charged to the melting furnace. The rod coils produced from the caster shall be sequentially numbered, excluding any coils with obvious defects normally attributed to the rod casting process.

A1.4.1.3 *Chemical Composition*—Each party shall select 2 coils from which a segment of rod approximately 16 in.

(406 mm) in length shall be cut at the trailing ends of the coils. Each rod segment shall be cut into 4 portions of approximate equal lengths. The 16 portions shall be divided into 4 groups; each group shall contain one portion from each of the 4 original rod segments. The 4 groups of rod portions shall be placed in separate noncontaminating containers, then sealed and identified for the supplier, the purchaser, contingency, and umpire if necessary.

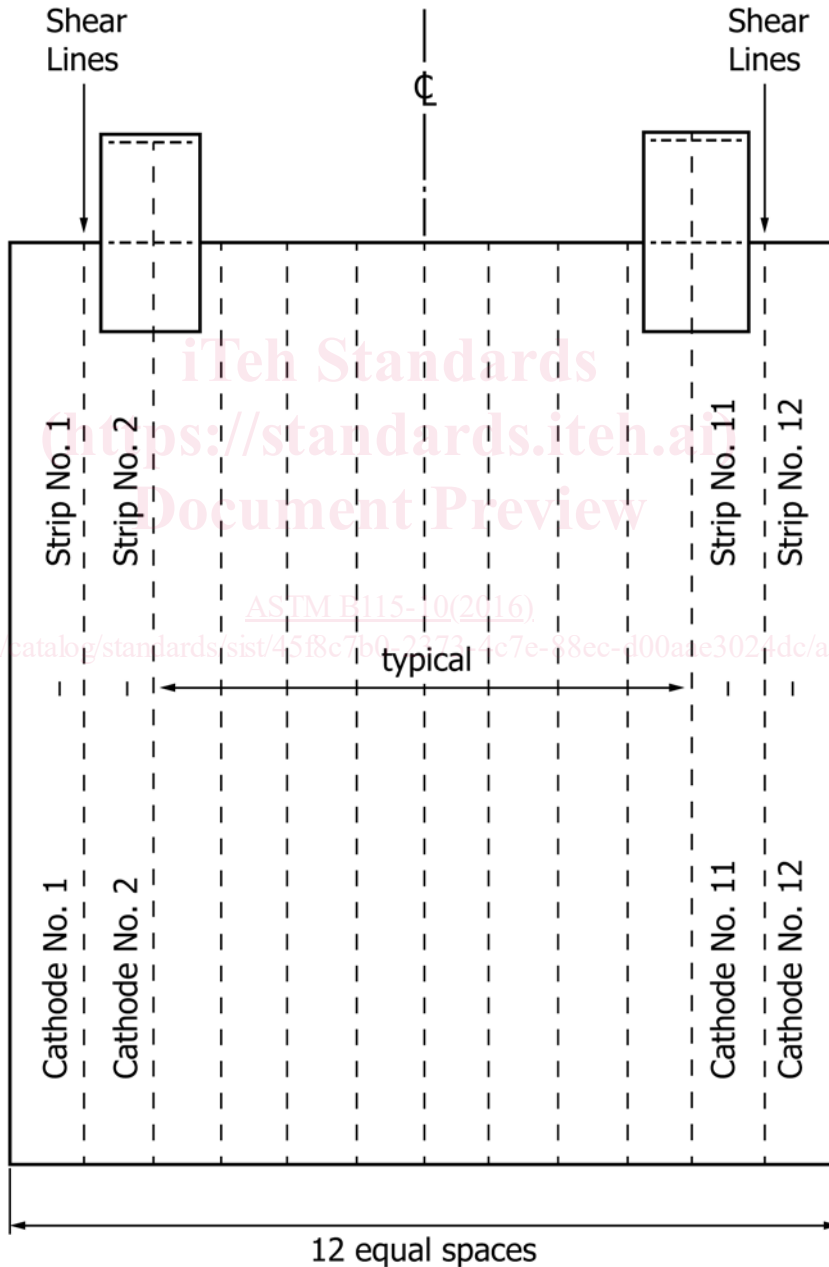
A1.4.1.4 *Electrical Resistivity*—Each party shall select 2 coils from which a rod segment of sufficient length for test shall be taken from the trailing ends of the coils. Each rod segment shall be cold drawn into a wire about 0.080 in.

diameter (2.0 mm) and at least 160 in. in length (4 m). Each wire coil shall be cut into 4 portions of approximately equal length, and the 16 portions shall be individually identified. The 16 wires shall be divided into 4 groups of 4 wires each, one from each of the 4 original rod segments; one group each for the producer, the purchaser, and the umpire, if necessary.

A1.4.2 *Cathodes for Other Uses:*

A1.4.2.1 *Chemical Composition:*

(a) From each cathode, or sheared cathode piece, of the gross sample a vertical strip shall be cut in such a position (see Fig. A1.1) that the collection of the strips so cut represents all



NOTE 1—Repeat for second set of twelve cathodes.

FIG. A1.1 Vertical Strip Sampling Pattern (Refer to A1.4.2.1(a) of text)