

Tentative Specification for

LAKE AND OTHER FIRE REFINED HIGH CONDUCTIVITY COPPER WIRE BARS,
CAKES, SLABS, BILLETS, INGOTS AND INGOT BARS¹

ASTM Designation: B4-53T

Adopted 1911
Revised 1913, 1927, 1942, 1953

This Standard of the American Society for Testing Materials is issued under the fixed designation B 4; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

Scope

1. (a) This specification covers lake copper and other fire refined, high conductivity, copper wire bars, cakes, slabs, billets, ingots and ingot bars regardless of place of origin.

Note. Copper under this specification corresponds to the designations "FRHC" and "FRTP" as shown in the Tentative Classification of Coppers (A.S.T.M. Designation: B 224)². This copper may also be used to produce copper corresponding to designations "ATP", "STP", "SATP", "SETP", "TETP", "DHP", "DLP", "DPS", "DPA", and "DPTE".

(b) In order to be classified as lake copper, the copper must originate on the northern peninsula of Michigan, U.S.A.

Chemical Composition

2. The copper in all shapes shall conform to the following requirements as to chemical composition:

Copper plus silver, min., per cent.....	99.900
Bismuth, max., per cent.....	0.001
Lead, max., per cent.....	0.004
Total metallic impurities exclusive of silver.....	0.03

Note. By agreement between the manufacturer and the purchaser the addition of silver up to 30 ounces per ton will be considered within the specification, silver being counted as copper in the chemical analysis.

¹ Under the standardization procedure of the Society this specification is under the jurisdiction of the A.S.T.M. Committee B-2 on Non-Ferrous Metals and Alloys.

² Reference location.

Chemical Analysis

3. Analysis for determining minimum purity of the copper shall be made in accordance with the Standard Method for Chemical Analysis of Copper (Electrolytic Determination of Copper) (A.S.T.M. Designation: E 53).³ Analysis for elements other than copper may be made either chemically or spectrographically.

Resistivity

4. The copper shall have a resistivity at a temperature of 20C. (68F.) (annealed) not to exceed the following values:

	Resistivity, max., international ohm (meter, gram)
Wire bars.....	0.15328
Cakes slabs, and billets	when specified for electrical use at time of purchase..... 0.15328 other uses..... 0.15694
Ingot bars.....	0.15694

Note. "Resistivity" is used in place of "conductivity." The value of ohm (meter, gram) at 20 C. (69F.) is the International Annealed Copper Standard for the resistivity of annealed copper equal to 100 per cent conductivity.

Remainder of Specification unchanged; it agrees with B 5.

³ Reference Location

Tentative Specifications for
FIRE-REFINED CASTING COPPER

ASTM Designation: B 72 - T

SCOPE

1. The specifications cover two grades of fire-refined casting copper for cast alloys. (We have used the term 'grade' as indicating that there is a difference in quality between these two analyses which are listed below. It is possible that some other description may be considered better by the Committee as a whole, and we would suggest that the matter be considered by them.)

NOTE. -- Copper under these specifications corresponds to the designation "Cast" as shown in the Standard Classification of Coppers (A.S.T.M. Designation: B 224).

CHEMICAL COMPOSITION

2. The copper in all shapes shall conform in the two grades specified to the following requirements for chemical composition.

	<u>Grade 99.75</u>	<u>Grade 99.50</u>
Cu / Ag	99.75	99.50
Oxygen	.10	.10
Lead	.10	.30
Arsenic	.0075	0.10
Antimony	.012	.012
Bismuth	.003	.003
Iron	.010	.010
Nickel	.10	.10
Tin	.025	.05
Sulphur	.01	.01
Selenium	.040	.040
Tellurium	.014	.014

(Section 5. covering Marking we feel can be left as is, although it might be desired by some to have the grade indicated in some way on the ingots. This has not been considered by the Task Group as part of their problem, and we are simply pointing out that consideration should be given to this question.)

Submitted by the Task Group:
R.S.Pratt J.W.Claypool
L.Halpern G.H.Clamer
J.Hatch J.Mayer

June 5, 1953

CERRO DE PASCO COPPER CORPORATION

40 WALL STREET, NEW YORK 5, N. Y.

May 22, 1950

Memorandum to: A. R. Mers

From: R. P. Koenig

Subject: Antimony Content of Cathode Copper

1. I have been advised that antimony assays of recent production of refined copper are reported as follows:

	<u>Max.</u>	<u>Min.</u>	<u>Average</u>
March 1950	0.0060	0.0020	0.0035
April 1-10 1950	0.0040	0.0020	0.0030
April 11-20 1950	0.0040	0.0020	0.0025
April 21-30 1950	0.0030	0.0010	0.0021

2. The improvement, particularly that in the last 10 days of April, is marked and is highly pleasing to us here. Now that copper with an Sb content of 0.0010 has been made and that the installation of the new filters in the slime circuit has made the operation more fool-proof it is earnestly hoped that the lift in "morale" of the supervisory personnel immediately responsible for the performance of the copper refinery results in, among other things, constant attention to all the conditions which are a prerequisite of success. That good copper can be produced must now, at long last, be accepted by all. That good copper will be consistently produced with proper discipline, interest, and realization by all that eternal vigilance is the price of turning this well built and equipped refinery to account, must be the watchwords in the future.
3. While no periodic information is at hand, or has been reported, on conductivity (or any other physical and/or chemical characteristics affecting marketability) these must be available to you and your staff. We would be interested in receiving copies thereof. We appreciate, of course, that samples of cathodes must be viewed with caution because of possible iron contamination during preparation of the sample (as compared with samples sawed from finished wirebar production). Thus cathode samples will not be as reliable as the latter, but perhaps an approximate correlation can be worked out between cathode sample conductivity and samples of wire bars (if they were made - as we all realize the undesirability of making wire bars out of chemically unsatisfactory copper) to the end that conductivity of cathode samples could tell how far below acceptable standards any particular lot may be. Over a period of time it will then be possible

CERRO DE PASCO COPPER CORPORATION

40 WALL STREET, NEW YORK 5, N. Y.

Memo. 5/22/50 p.2

for you to see how the plant is doing and our sales department can then work more intelligently with our Sales Agent.

4. At the risk of becoming repetitious and of being considered to be carping I again emphasize that one's product is known in the market not by average grade but by the grade of the worst lot. With bad copper coming through, the establishment of market acceptability is virtually an impossible task, and once when established one bad lot can do immeasurable damage.

Original Signed By
ROBERT P. KOENIG

RPK:AF
cc:ARM
JDS
bcc:LA
WAMB
HB

COPPER

Memorandum to: R. P. Koenig *A-61* Date: May 26, 1950
From: Lawrence Addicks
Subject: Copper Quality

I had a long discussion this afternoon with Mr. Smith about our copper quality. The conclusions are briefly as follows:

1. We are not sampling an adequate number of cathodes.
2. We are guilty at times of allowing material to be shipped out of the plant before the laboratory results are known.
3. Our sampling method is probably inadequate but on the safe side for us.

LA

LA:wbg

A-60

Memorandum to: R. P. Koenig
From: Lawrence Addicks
Subject: Copper Quality

Date: May 24, 1950

In your note dated May 20 you ask for information on copper quality market requirements. I shall secure leaflet reprints covering A.S.T.M. latest specifications of all the grades of refined copper and send them along in due course.

In the meantime the two of immediate interest--cathode and electrolytic wirebar--are very simple. 100% conductivity (annealed) and 99.90% copper plus silver apply to both. Cathodes must be "hard enough to stand ordinary handling without excessive breakage or excessive separation of nodules, and shall be substantially free from all foreign material, for example, copper sulfate, dirt, grease and oil." Wirebars must be substantially free from shrink holes, cold sets, pits, sloppy edges, concave tops and similar defects in set or casting. Ingot bars may have lower conductivity and physical defects are immaterial. I had a chat this morning with W. E. Kennedy, Vice President of Anaconda Sales Company, who personally handles the Chile Copper production. He says they ship principally to France, Italy and Switzerland (Sweden now out on account of exchange situation) and that they stand rigidly on A.S.T.M. specifications and will entertain no complaint of any kind if outside of these requirements. A threat to buy elsewhere does not move them. Any weakening would start a flood of claims. Belgium seems to be a fussy place but they have to take it and like it--rather an Anaconda attitude and perhaps not for newcomers.

The theory of the conductivity umbrella is that nearly all of the impurities in copper would drive the conductivity below 100% before they would affect working properties, and others such as bismuth are seldom met with. If the competitive refineries are doing far better than specification, we have to consider that angle.

My personal view as to operations is that we should reject every sheet that is not a grade "A" cathode, sending it back to the holding furnace at the smelter. This will discipline the crew while not actually costing money as the cost of re-electrolyzing (disentangled from the overhead of the non-producing electric furnace) plus the \$2.50 "cathode allowance" will probably about balance out against the \$14 Carteret charge for blending such material with their product. Incidentally, the circulating product will lower the impurities in our anodes pro rata and ease the difficulties a little. (This recommendation will, of course, not survive a reductio ad absurdum if we make hardly any grade "A" cathodes.) All else aside, I don't like to see us forever wet-nursed by the American Metal Company.

Mr. Koenig

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May 24, 1950

Finally, I suggest not trying to make too low an anode
scrap figure until we are well on our feet.

Cady

LA:wbg



TENTATIVE
CLASSIFICATION OF COPPER¹

A.S.T.M. Designation B - 47 T

Issued, 1947.

SCOPE.

1. This is a classification of the various types of copper currently available in refinery shapes and wrought products in commercial quantities. It is not a specification for the various types.

BASIS OF CLASSIFICATION.

2 (a). Existing A.S.T.M. Specifications for refinery copper and for wrought copper products, as they are written, may cover more than one of the types herein given or cover only part of the range covered by one of the types shown in the classification.

(b). Table I shows the refinery shapes and fabricators' products currently produced. In each type, the specific coppers are not necessarily available in a complete range of sizes in the forms shown, nor from any one supplier in all forms.

DEFINITIONS.

3. Definitions appended to this classification cover the terms used in defining the various types of copper but do not define the types, as such. Definitions are also given for refinery shapes and fabricators' forms.

NOTE: Definition of the term "copper" as applied to castings will be found in the standard classification of cast copper-base alloys, A.S.T.M. Designation B 119 - 45.

¹Under the standardization procedure of the Society, this classification is under the joint jurisdiction of A.S.T.M. Committees B-1, B-2 and B-5.

TABLE I

TENTATIVE CLASSIFICATION OF COPPERS

Designation	Type of Copper	FORMS IN WHICH AVAILABLE*							
		From Refiners				From Fabricators			
		Wire Bars	Bill-ets	Cakes	Ingots & Ingot Bars	Flat Products	Pipe & Tube	Rod & Wire	Shapes
CATH	Electrolytic Cathode	Available in Cathodes only							
TOUGH PITCH COPPERS									
ETP	Electrolytic Tough Pitch (Note 1)	X	X	X	X	X	X	X	X
FRHC	Fire-Refined High Conductivity Tough Pitch (Note 1)	X	X	X	X	X	X	X	X
FRTP	Fire-Refined Tough Pitch		X	X	X	X	X		X
ATP	Arsenical, Tough Pitch		X	X		X	X	X	
STP	Silver Bearing Tough Pitch (Note 1)	X	X	X	X	X	X	X	X
SATP	Silver Bearing Arsenical, Tough Pitch		X	X		X	X		
SETP	Selenium Bearing, Tough Pitch							X	X
TETP	Tellurium Bearing, Tough Pitch								X
CAST	Casting				X				
OXYGEN-FREE COPPERS									
OF	Oxygen-Free without Residual Deoxidants (Note 1)	X	X	X	#	X	X	X	X
OFS	Oxygen-Free, Silver Bearing (Note 1)	X	X	X		X		X	X
OPTF	Oxygen-Free, Tellurium Bearing					X		X	X
DEOXIDIZED COPPERS									
DHP	Phosphorized High Residual Phosphorus	X	X	X		X	X	X	X
DLP	Phosphorized Low Residual Phosphorus (Note 2)		X	X		X	X		X
DPS	Phosphorized Silver Bearing		X	X		X	X		X
DFA	Phosphorized Arsenical		X			X	X		
DPTE	Phosphorized Tellurium Bearing							X	X

* The "X" in the table indicates commercial availability.

Croppings of other shapes available and can be used as ingots.

Note 1 Types ETP, FRHC, STP, OF and OFS are high conductivity coppers.

Note 2 Type DLP can be furnished as a high conductivity copper if agreed upon between producer and consumer.

APPENDIX I

DEFINITIONS OF TERMS USED IN CLASSIFICATION

A. General

Copper.---For the purpose of this classification, copper containing less than 1/2 of one percent (0.5%) alloying elements has been included in the term "copper".

B. Terms Relating to Method of Refining

Electrolytic Copper.---Copper which has been refined by electrolytic deposition, including cathodes which are the direct product of the refining operation, refinery shapes cast from melted cathodes, and, by extension, fabricators' products made therefrom. Usually when this term is used alone, it refers to Electrolytic Tough Pitch Copper without elements other than oxygen being intentionally added.

Fire Refined Copper.---Copper which has been refined by the use of a furnace process only, including refinery shapes, and, by extension, fabricators' products made therefrom. Usually when this term is used alone, it refers to Fire Refined Tough Pitch Copper without elements other than oxygen being intentionally added.

C. Terms Relating to Characteristics Determined by Method of Casting or Processing

Tough Pitch Copper.---Copper either electrolytically or fire refined, cast in the form of refinery shapes, containing a controlled amount of oxygen for the purpose of obtaining a level set in the casting. By extension, the term is also applicable to fabricators' products made therefrom.

Oxygen-Free Copper.---Electrolytic Copper free from cuprous oxide produced without the use of residual metallic or metalloidal deoxidizers. By extension, the term is also applicable to fabricators' products made therefrom.

Deoxidized Copper.---Copper cast in the form of refinery shapes, free from cuprous oxide through the use of metallic or metalloidal deoxidizers. By extension, the term is also applicable to fabricators' products made therefrom.

D. Terms Relating to Specific Kinds of Copper

High Conductivity Copper.---Copper which, in the annealed condition, has a minimum electrical conductivity of 100% I.A.C.S. as determined in accordance with A.S.T.M. Methods of Test.

Casting Copper.---Fire Refined Tough Pitch Copper usually cast from melted secondary metal into ingot& ingot bars only, and used for making foundry castings, but not wrought products.

Phosphorized Copper.---General term applied to copper deoxidized with phosphorus. The most commonly used deoxidized copper.

High Residual Phosphorus Copper.---Deoxidized copper with residual phosphorus present in amounts (usually 0.013 to 0.040%) generally sufficient to decrease appreciably the conductivity of the copper.

Low Residual Phosphorus Copper.---Deoxidized copper with residual phosphorus present in amounts (usually 0.004 to 0.012%) generally too small to decrease appreciably the conductivity of the copper.

Arsenical Copper-Selenium Bearing Copper-Silver Bearing Copper-Tellurium Bearing Copper.---Copper containing the designated element in amounts as agreed upon between producer and consumer. Any of these alloyed coppers can be produced as Tough Pitch, Oxygen-Free, or Deoxidized varieties. For the ones commonly supplied see Table I.

APPENDIX II

DEFINITIONS OF REFINERY SHAPES

Wire Bar.---Refinery shape for rolling into rod (and subsequent drawing into wire), strip or shape.

Approximately 3-1/2" to 5" square cross-section, usually from 38" to 54" in length and weighing from 135 to 420 pounds. Tapered at both ends when used for rolling into rod for subsequent wire drawing and may be unpointed when used for rolling into strip. Cast either horizontally or vertically.

Cake.---Refinery shape for rolling into plate, sheet, strip or shape.

Rectangular in cross-section of various sizes. Cast either horizontally or vertically, with range of weights from 140 to 4000 pounds or more.

Billet.---Refinery shape primarily for tube manufacture.

Circular in cross-section, usually 3 to 10 inch diameter and in lengths up to 52 inches; weight from 100 to 1500 pounds.

Ingot and Ingot Bar.---Refinery shapes employed for alloy production (not fabrication).

Both used for remelting. Ingots usually weigh from 20 to 35 pounds and ingot bars from 50 to 70 pounds. Both usually notched to facilitate breaking into smaller pieces.

Cathode.---Unmelted flat plate produced by electrolytic refining.

The customary size is about 3 feet square and about 1/2 inch to 7/8 inch thick, weighing up to 280 pounds.

APPENDIX III

DEFINITIONS OF FABRICATORS' COPPER PRODUCTS

Flat Product.---A rectangular or square solid section of relatively great length in proportion to thickness.

Included in the designation "flat product", depending on the width and thickness, are plate, sheet, strip and bar. Also included is the product known as "flat wire".

Rod.---A round, hexagonal or octagonal solid section. Round rod for further processing into wire (known as "hot-rolled rod", "wire-rod" or "redraw wire") is furnished coiled. Rod for other uses is furnished in straight lengths.

Wire.---A solid section, other than strip, furnished in coils or on spools, reels or bucks.

Tube.---A hollow product of round or any other cross-section, having a continuous periphery.

Pipe.---Seamless tube conforming to the particular dimensions commercially known as "Standard Pipe Sizes".

Shape.---A solid section, other than rectangular, square or standard rod and wire sections, furnished in straight lengths.

Shapes are usually made by extrusion but may also be fabricated by drawing.

Tentative Specifications for
Fire-Refined Primary Copper for Wrought Products and Alloys.

A.S.T.M. Designation: B 216-47 T

Scope

1. These specifications cover fire-refined primary copper for rolling into flat products, not intended for electrical purposes, and for alloying in cast and wrought alloys.

Chemical Composition

2. The copper in all shapes shall conform to the following requirements as to chemical composition:

Copper plus silver, min., per cent-----	99.88.
Arsenic, max., per cent-----	0.012
Antimony, max., per cent-----	0.003
Selenium, plus tellurium, max., per cent-----	0.025
Nickel, max., per cent-----	0.05
Bismuth, max., per cent-----	0.003
Lead, max., per cent-----	0.004

Chemical Analysis

3. The chemical analysis shall be made in accordance with the Tentative Method of Chemical Analysis of Copper (Electrolytic Determination Of Copper) (A.S.T.M. Designation: E 53). Analysis for elements other than copper may be made either chemically or spectrographically.

Physical Defects

4. Cakes, intended for rolling, shall be substantially free from shrink holes, cold sets, pits, sloppy edges, concave tops, and similar defects in set or casting. This requirement shall not apply to ingot bars, intended for remelting, in which physical defects are of no consequence.

Permissible Variations in Weights and Dimensions

5. A permissible variation of plus or minus 5% in weight, and plus or minus $\frac{1}{4}$ in. in any dimension from the manufacturer's published list or the purchaser's specified size shall be considered good delivery; provided however that cakes may vary plus or minus 3 per cent from the listed or specified size in any dimension greater than 8 in. The weight of copper in ingots and ingot bars shall not exceed that specified by more than 10 per cent, but otherwise its variation is not important.

Markings

6. All cakes shall be stamped with the manufacturer's brand and furnace charge mark. Ingots and ingot bars shall have a brand stamped or cast in but need have no furnace charge mark.

Lots

7. The manufacturer shall arrange carloads or lots so that as far as possible, each shall contain shapes from but one furnace charge, in order to facilitate testing by the customer.

Claims

8. (a) Claims shall be made in writing within 30 days of receipt of the copper by the purchaser, and the results of the tests made by the purchaser shall accompany such claims. The manufacturer shall be given one week from the date of receipt of the complaint to investigate his records, and shall then either agree to satisfy the claim or send a representative to the purchaser's mill. Claims shall be considered only when made as above stated and when the copper in question,

unused, can be shown to the representative of the manufacturer.

(b) Claims against quality will be considered as follows:

- (1) Chemical composition by furnace charges, ingot lots, or ingot-bar lots,
- (2) Physical defects by individual pieces, and
- (3) Variations in weight or dimension by individual pieces.

Investigation of Claims

9. (a) Chemical Composition.- Each party shall select a sample of three pieces from the consignment or lot to be investigated. These shall be sampled in the presence of both parties by drilling five holes, approximately $\frac{1}{2}$ in. in diameter, at points equally spaced between the ends of the pieces. With ingots and ingot bars these holes should be along a middle line, and with cakes on a diagonal line projected between opposite corners. The drilling shall be from top to bottom and completely through each piece. Scale from set and any surface dirt shall be rejected. No lubricant shall be used, and drilling shall not be forced sufficiently to cause oxidation of the chips. In the case of sections more than 5 in. in thickness, drillings may be made from both top and bottom for a depth not less than 2 in. in each direction instead of completely through each piece, but in other respects the drilling shall be conducted as previously described. The resulting sample shall be cut up, mixed, and separated into three equal portions, each of which shall be placed in a sealed package, one for the manufacturer, one for the purchaser, and one for an umpire, if necessary. Each party shall make an analysis in accordance with Section 3 and if results do not establish or dismiss the claim to the satisfaction of both parties concerned, the third sample shall be submitted to a mutually agreeable umpire, who shall determine the question of fact and whose determination shall be final.

(b) Variations in Weight and Dimensions.- The Representative of the manufacturer shall inspect all pieces where physical defects or variation in weight or dimension are claimed. If agreement is not reached, the question of fact shall be submitted to a mutually agreeable umpire, whose decision shall be final.

Settlement of Claims

10. The expenses of the manufacturer's representative and of the umpire shall be paid by the loser, or divided in proportion to the concession made in case of compromise. In case of rejection being established, the damages shall be limited to payment of freight both ways by the manufacturer for the substitution of an equivalent weight of copper conforming to these specifications.

May 22, 1947

Standard Specifications for
FIRE-REFINED SECONDARY COPPER

A.S.T.M. Designation: B 72-47T

Scope

1. These specifications cover fire-refined secondary copper for making into cast alloys.

Chemical Composition

2. The copper in all shapes shall conform to the following requirements as to chemical composition:

Copper plus silver, min., per cent	99.70
Arsenic, max., per cent	0.100
Antimony, max., per cent	0.012
Bismuth, max., per cent	0.002
Iron, max., per cent	0.010
Lead, max., per cent	0.010
Nickel, max., per cent	0.100
Oxygen, max., per cent	0.075
Selenium, max., per cent	0.040
Tellurium, max., per cent	0.014
Tin, max., per cent	0.050

Chemical Analysis

3. The chemical analysis shall be made in accordance with the Tentative Method of Chemical Analysis of Copper (Electrolytic Determination of Copper) (A.S.T.M. Designation: E 53).

Permissible Variations in Weight and Dimensions

4. A permissible variation of plus or minus 5 per cent in weight, or plus or minus 1/4 in. in any dimension from the manufacturer's published list or the purchaser's specified size shall be considered good delivery.

Marking

5. Ingots and ingot bars shall have a brand stamped or cast in, but need have no furnace charge mark.

Lots

6. The manufacturer shall arrange the carloads or lots so that, as far as possible, each shall contain shapes from but one furnace charge, in order to facilitate testing by the purchaser.

Claims

7. Claims to be considered shall be made to the manufacturer in writing within 30 days of receipt of the material at the purchaser's plant and the results of the tests made by the purchaser shall accompany such claims. The manufacturer shall be given one week from the date of receipt of the complaint to investigate his records, and shall then either agree to satisfy the claim or send a representative to the purchaser's plant. No claims shall be considered if the material in question, unused, cannot be shown to the manufacturer's representative.

Claims against quality will be considered as follows:

- (a) Chemical composition by furnace charges, ingot lots, or ingot-bar lots,
- (b) Variations in weight or dimension by individual pieces.

Investigation of Claims

8. (a) The manufacturer's representative shall inspect all pieces where variations in weight or dimension are claimed. If agreement is not reached, the question of fact shall be submitted to a mutually agreeable umpire, whose decision shall be final.
- (b) In a question of chemical composition each party shall select three shapes from the consignment or lot to be investigated. These shapes shall be sampled in the presence of both parties by drilling five holes approximately 1/2 in. in diameter at points equally spaced between the ends of each piece. Ingots and ingot bars shall be sampled along a center line. The drilling shall be made from top to bottom and completely through each piece. Scale from set and any surface dirt shall be rejected. No lubricant shall be used and the drilling shall not be forced sufficiently to cause oxidation of the chips. The resulting sample shall be cut up, thoroughly mixed, and separated into three equal portions, each of which shall be placed in a sealed package, one for the manufacturer, one for the purchaser, and one for an umpire, if necessary. Each party shall make an analysis in accordance with Section 3 and if the results do not establish or dismiss the claim to the satisfaction of both parties concerned, the third sample shall be submitted to a mutually agreeable umpire, who shall determine the question of fact and whose determination shall be final.

Settlement of Claims

9. The expenses of the manufacturer's representative and of the umpire shall be paid by the loser, or divided in proportion to the concession made in case of compromise. In the case of rejection being established, the damages shall be limited to payment of freight both ways by the manufacturer for substitution of an equivalent weight of copper conforming to these specifications.

Chairman of Committee B-2:

Sub-Committee 1 of Committee B-2 has by letter ballot indicated their approval of all items respecting the revision of Specification B 216-46T and Specification B 72-33 as indicated by the two previous copies. In view of these changes specifically in B 216-46T and the importance of the material covered by this specification as source material for the products specified under Specification B 152-46T, this Sub-Committee has by letter ballot affirmed their belief that some revision of the latter specification appears to be in order. It is believed this requirement would be solved by revision of the scope clause 1 in the following manner.

Type A-1 Electrolytic tough pitch copper

Type A-2 Fire-Refined tough pitch primary copper

This would involve a slight revision in Basis of Purchase 2, under 3, in the phrase "for either Type A or C", write A1 for A. Again under manufacture 3, first paragraph, page 423, substitution of present title and designation would appear to be in order. Further revision under Chemical Composition 4, the first item would read A1 and a new item A2, with the figure 99.88 in the second column.

These suggestions, if authorized by Committee B-2, would seem to adequately cover the opinion of Sub-Committee 1, for submittal to Committee B-5.

1946 PREPRINT.—This is a preliminary printing of a report to be presented at the Forty-ninth Annual Meeting of the **American Society for Testing Materials**, 1916 Race St., Philadelphia 3, Pa., to be held in Buffalo, N. Y., June 24 to 28, 1946. Written discussion may be transmitted to the Executive Secretary for presentation at the meeting. The report is subject to modification and is not to be republished as a whole or in part pending its release by the Society through the Executive Secretary.



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Preprints of reports should be retained for reference subsequent to the annual meeting in connection with the 1946 Letter Ballot on Standards.

REPORT OF COMMITTEE B-2 ON NON-FERROUS METALS AND ALLOYS

Committee B-2 on Non-Ferrous Metals and Alloys because of travel restrictions and in line with Government request to limit meetings has not held a meeting of the committee as a whole since June 29, 1944. During this period, business of the committee and subcommittees has been conducted by correspondence. Subcommittees assigned work to task groups, and the reports of these groups were submitted by letter and letter ballot to the subcommittees. Final action of the committee as a whole in these matters was as usual by letter ballot, which letter ballot was accompanied by letter of explanation.

Proposed Tentative Specifications for Fire-Refined Copper for Wrought Alloys¹ have been prepared by Subcommittee I to supersede Emergency Specifications for Fire-Refined Copper for Wrought Products and Alloys (ES-7). The withdrawal of Standard Specifications for Fire-Refined Copper Other Than Lake (B 72-33) is being considered because of apparent lack of necessity. It is expected that Committee B-2 will be able to act on both of these proposals prior to publication of the 1946 Book of A.S.T.M. Standards.

Revisions of the Standard Specifications for White Metal Bearing Alloys (B 23-—) and Specifications for Soft Solder Alloys (B 23-—) are in preparation in Subcommittee III. The revised specifications are to be published as tentative and will supersede the present standard specifications and their emergency alter-

nate provisions. The task group is completing its work and plans to send recommendations to the subcommittee promptly. It is expected that Committee B-2 will be able to act on both proposed tentative specifications prior to publication of the 1946 Book of Standards.

Acceptance of the before mentioned three proposed tentative specifications would remove the last of war-time emergency alternate provisions and emergency specifications under jurisdiction of Committee B-2.

The Advisory Committee held a meeting in New York, N.Y., on March 25, 1946. Mr. Sidney Rolle was appointed chairman, *pro tem*, of Subcommittee II on Refined Lead, Tin, Antimony and Bismuth. Changes in membership were approved and business before the subcommittees discussed. The chairmen of subcommittees outlined their plans to complete any work relating to standards in order that revised specifications may appear in the new Book of A.S.T.M. Standards to be issued this year.

Committee B-5 on Copper and Copper Alloys, Cast and Wrought, had suggested that the work of Subcommittee I be transferred to its jurisdiction; that is, Committee B-5 wishes to extend its scope to cover not only the fabrication of copper and copper alloys but to include jurisdiction over the production of copper.

It was the expression of the Advisory Committee that unless arguments advanced by Committee B-5 were cogent,

¹ See p. 4.

the work of Subcommittee I should continue in Committee B-2. It was decided to submit the question to the members of Subcommittee I and their opinion would guide the action of the members of the Advisory Committee before the Society. At a meeting of Subcommittee I, on April 19, 1946, in New York, the subcommittee was definitely not in favor of the transfer of its functions to Committee B-5.

There had been an inquiry by a consumer of lead as to sampling procedure. The Chairman of Subcommittee II was furnished with copies of the correspondence. The Subcommittee will recommend whether any revision of the sampling procedure is necessary.

It was decided to determine whether at this time it is necessary or desirable to propose specifications for tin and specifications for antimony.

REVISION OF STANDARD, IMMEDIATE ADOPTION

The committee recommends for immediate adoption that in the Standard Specifications for Special High-Grade Zinc (B 6-27) the requirements for Chemical Composition of special high-grade zinc be revised to read as follows:

	Special High-Grade Zinc
Lead, max., per cent.....	0.006
Iron, max., per cent.....	0.005
Cadmium, max., per cent.....	0.004
Aluminum, max., per cent.....	none
Sum of lead, iron, and cadmium, max., per cent.....	0.010

NOTE.—Analysis shall not regularly be made for tin but when used for die castings, if found by the purchaser, tin shall not exceed 0.003 per cent. Greater amounts may constitute cause for rejection.

This recommendation has been submitted to letter ballot of the committee, which consists of 134 members; 77 members returned their ballots, of whom 49 have voted affirmatively, 1 negatively, and 18 members marked their ballots "not voting."

ACTIVITIES OF SUBCOMMITTEES

Subcommittee I on Refined Copper (J. L. Christie, chairman) has prepared Proposed Tentative Specifications for Fire-Refined Copper for Wrought Alloys to supersede Emergency Specifications for Fire-Refined Copper for Wrought Products and Alloys ES-7. The subcommittee is considering recommending the withdrawal of Standard Specifications for Fire-Refined Copper Other than Lake (B 72-33) because of lack of necessity. The subcommittee in its work on preparing Classification of Coppers requests that the Coordinating Committee on Non-Ferrous Metals and Alloys determine if such a classification is needed and if so, to suggest how the need could best be filled.

Subcommittee II on Refined Lead, Tin, Antimony and Bismuth (Sidney Rolle, chairman) is considering the sampling procedure in the Standard Specifications for Pig Lead (B 29-43) to determine whether any changes are necessary. The subcommittee is also considering whether it is necessary or desirable to prepare tentative specifications for tin and tentative specifications for antimony.

Subcommittee III on White Metal Alloys (G. H. Clamer, chairman) through its task group has under completion the revised specifications for white metal bearing alloys and for soft solder alloys as mentioned earlier in this report. The task group in preparing these specifications sought to include the soft solders and white metal bearing alloys designated by the Society of Automotive Engineers and Federal Specifications.

Subcommittee IV on Refined Zinc and Wrought Zinc (E. H. Bunce, chairman) has reaffirmed the Standard Specifications for Rolled Zinc (B 69-39).

Committee B-2 has accepted the subcommittee's proposed revision of Standard Specifications B 6 as given earlier in this report.

A request for specifications for zinc-base sheets for mechanically grained lithoplates has been received and the subcommittee is considering whether specifications are necessary or desirable.

Subcommittee V on Precious Metals and Alloys (R. H. Leach, chairman) has reviewed and reaffirmed the Standard Specifications for Silver Solder (B 73-29).

Subcommittee VI on Coated Metals.—A chairman is to be appointed for this subcommittee in the near future and the subcommittee will review the Standard Specifications for Lead-Coated Copper Sheet (B 101-40) and consider any other work which may come before the subcommittee.

Subcommittee VII on Refined Nickel and High-Nickel Alloys, Cast And Wrought (O. B. J. Fraser, chairman) is reviewing the specifications under its jurisdiction for the purpose of determin-

ing whether any revisions are necessary.

Subcommittee VIII on Miscellaneous Refined Metals and Alloys (E. E. Schumacher, chairman) has requested that the Coordinating Committee on Non-Ferrous Metals and Alloys decide what committee has jurisdiction over Standard Specifications for Brazing Solder (B 64-43).

This report has been submitted to letter ballot of the committee, which consists of 134 members; 00 members returned their ballots, of whom 00 have voted affirmatively and 0 negatively.

Respectfully submitted on behalf of the committee,

E. E. THUM,
Chairman.

G. HOWARD LEFEVRE,
Secretary.

PROPOSED

*Tentative Specifications for*FIRE-REFINED COPPER FOR WROUGHT ALLOYS¹

A.S.T.M. Designation: B — — 46 T

ISSUED, 19—.²

These Tentative Specifications have been approved by the sponsoring committee and accepted by the Society in accordance with established procedures, for use pending adoption as standard. Suggestions for revisions should be addressed to the Society at 1916 Race St., Philadelphia 3, Pa.

Scope

1. These specifications cover fire-refined primary copper for alloying in cast and wrought alloys.

Chemical Composition

2. The copper in all shapes shall conform to the following requirements as to chemical composition:

Copper plus silver, min., per cent.	99.88
Arsenic, max., per cent.	0.012
Antimony, max., per cent.	0.003
Selenium plus tellurium, max., per cent.	0.025
Nickel, max., per cent.	0.05
Bismuth, max., per cent.	0.0003
Lead, max., per cent.	0.004

Chemical Analysis

3. The chemical analysis shall be made in accordance with the Tentative Method of Chemical Analysis of Copper (Electrolytic Determination of Copper) (A.S.T.M. Designation: E 53).³ Analysis for elements other than copper

¹ Under the standardization procedure of the Society, these specifications are under the jurisdiction of the A.S.T.M. Committee B-2 on Non-Ferrous Metals and Alloys.

² Accepted by the Society at annual meeting, June, 19—.

Prior to their publication as tentative, these specifications were issued June, 1942 to June 19—, as Emergency Specifications ES-7.

³ 1946 Book of A.S.T.M. Methods of Chemical Analysis of Metals.

may be made either chemically or spectrographically.

Permissible Variations in Weights and Dimensions

4. A permissible variation of plus or minus 5 per cent in weight, and plus or minus $\frac{1}{4}$ in. in any dimension from the manufacturer's published list or the purchaser's specified size shall be considered good delivery.

Marking

5. Ingots and ingot bars shall have a brand stamped or cast in but need have no furnace charge mark.

Lots

6. The manufacturer shall arrange carloads or lots so that as far as possible, each shall contain shapes from but one furnace charge, in order to facilitate testing by the purchaser.

Claims

7. (a) Claims shall be made in writing within 30 days of receipt of the copper by the purchaser, and the results of the tests made by the purchaser shall accompany such claims. The manufacturer shall be given one week from the

date of receipt of the complaint to investigate his records, and shall then either agree to satisfy the claim or send a representative to the purchaser's mill. Claims shall be considered only when made as above stated and when the copper in question, unused, can be shown to the representative of the manufacturer.

(b) Claims against quality will be considered as follows:

- (1) Chemical composition by furnace charges, ingot lots, or ingot-bar lots,
- (2) Physical defects by individual pieces, and
- (3) Variations in weight or dimension by individual pieces.

Investigation of Claims

8. (a) *Chemical Composition.*—Each party shall select a sample of three pieces from the consignment or lot to be investigated. These shall be sampled in the presence of both parties by drilling five holes, approximately $\frac{1}{2}$ in. in diameter, at points equally spaced between the ends of the pieces. With ingots and ingot bars, these holes should be along a middle line. The drilling shall be from top to bottom and completely through each piece. Scale from set and any surface dirt shall be rejected. No lubricant shall be used, and drilling shall not be forced sufficiently to cause oxidation of the chips. In the case of sections more than 5 in. in thickness, drillings may be made from both top and bottom for a depth not less than

2 in. in each direction instead of completely through each piece, but in other respects the drilling shall be conducted as previously described. The resulting sample shall be cut up, mixed, and separated into three equal portions, each of which shall be placed in a sealed package, one for the manufacturer, one for the purchaser, and one for an umpire, if necessary. Each party shall make an analysis in accordance with Section 3 and if the results do not establish or dismiss the claim to the satisfaction of both parties concerned, the third sample shall be submitted to a mutually agreeable umpire, who shall determine the question of fact and whose determination shall be final.

(b) *Variations in Weight and Dimensions.*—The representative of the manufacturer shall inspect all pieces where physical defects or variation in weight or dimension are claimed. If agreement is not reached, the question of fact shall be submitted to a mutually agreeable umpire, whose decision shall be final.

Settlement of Claims

9. The expenses of the manufacturer's representative and of the umpire shall be paid by the loser, or divided in proportion to the concession made in case of compromise. In case of rejection being established, the damages shall be limited to payment of freight both ways by the manufacturer for the substitution of an equivalent weight of copper conforming to these specifications.

2 in in each direction instead of com-
 pactly through each piece, but in other
 respects the drilling shall be conducted
 as previously described. The resulting
 sample shall be cut up, mixed, and sep-
 arated into three equal portions, each of
 which shall be placed in a sealed package,
 one for the manufacturer, one for the
 purchaser, and one for an umpire. If
 necessary, each party shall make an
 analysis in accordance with section 3
 and if the results do not establish or
 dismiss the claim to the satisfaction of
 both parties concerned, the third sample
 shall be submitted to a mutually agree-
 able umpire who shall determine the
 question of fact and whose determi-
 nation shall be final.

(b) **Variations in Weight and Dimen-**
sions—The representative of the manu-
 facturer shall inspect all pieces where
 physical defects or variation in weight or
 dimensions are claimed. If agreement is
 not reached, the question of fact shall
 be submitted to a mutually agreeable
 umpire whose decision shall be final.

Settlement of Claims

(c) **Expenses of the Umpire**—The expenses of the umpire shall
 be paid by the loser, or divided in pro-
 portion to the concessions made in case
 of compromise. In case of settlement
 being established, the damages shall be
 limited to payment of freight both ways
 by the manufacturer for the substitution
 of an equivalent weight of copper, or
 payment to the purchaser for the substitution
 of an equivalent weight of copper.

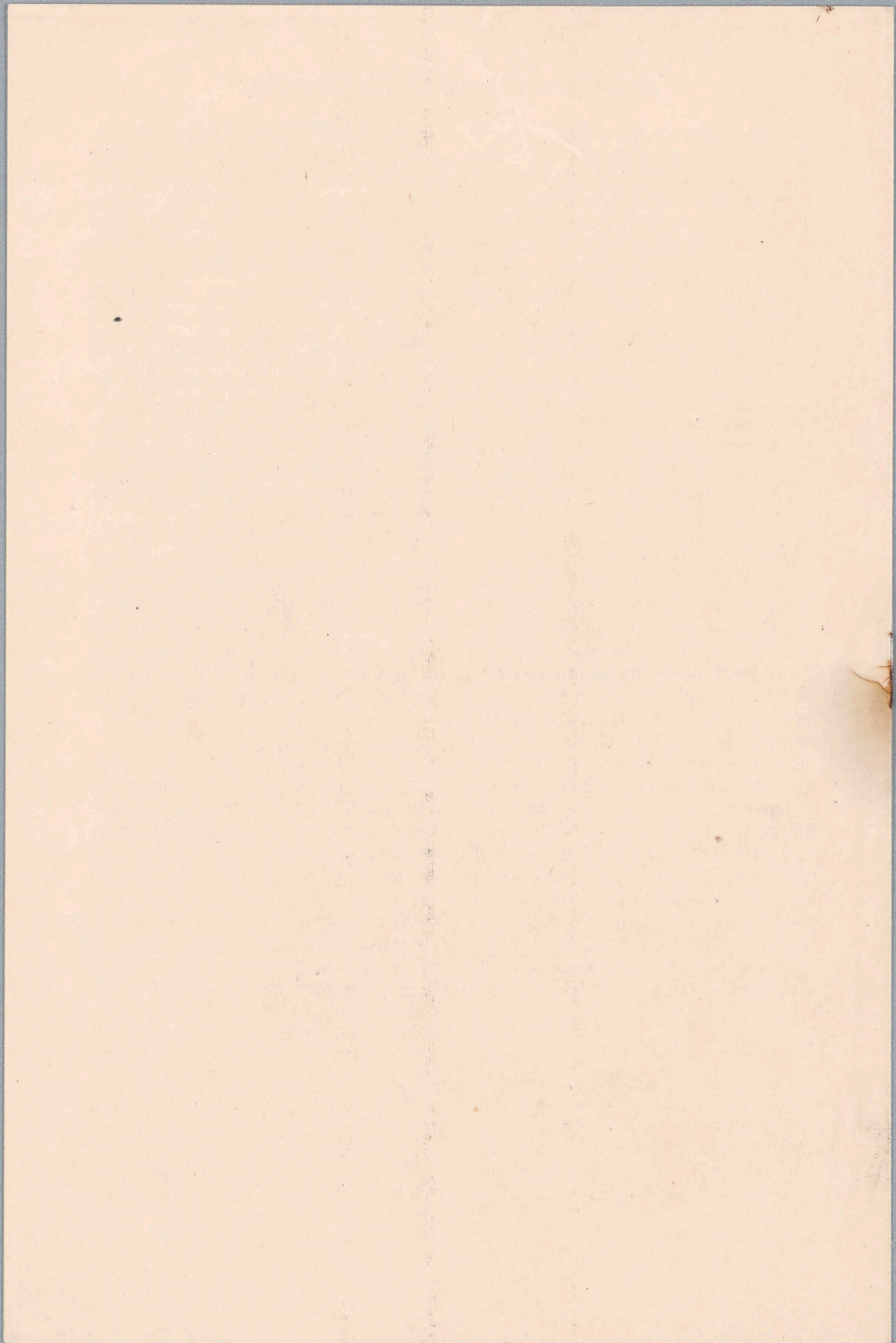
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 175 Broadway, New York, N. Y.

half of receipt of the sample, and to in-
 vestigate his records, and shall then
 either agree to satisfy the claim or send
 a representative to the purchaser's mill.
 Claims shall be considered only when
 made as above stated and when the
 copper in question (unless can be
 shown to the representative of the
 manufacturer—
 (a) Claims against quality will be
 considered as follows:
 (1) Chemical composition by furnace
 charges, ingot lots, or ingot bar
 lots.
 (2) Physical defects by individual
 pieces, and
 (3) Variations in weight or dimension
 by individual pieces.

Investigation of Claims

(a) **Chemical Composition**—Each
 party shall select a sample of three
 pieces from the consignment or lot to
 be investigated. These shall be sampled
 in the presence of both parties by drilling
 five holes, approximately $\frac{1}{2}$ in in diam-
 eter at points equally spaced between
 the ends of the piece. With ingots and
 ingot bars, these holes should be along
 a middle line. The drilling shall be
 from top to bottom and completely
 through each piece. Scabs from set and
 any surface dirt shall be rejected. No
 ingot or bar shall be used, and drilling
 shall not be forced sufficiently to cause
 oxidation of the chips. In the case of
 sections more than 2 in in thickness,
 sections may be made from both top
 and bottom for a depth not less than
 2 in.

(b) **Physical Defects**—The representative of the manufacturer shall inspect all pieces where physical defects or variation in weight or dimensions are claimed. If agreement is not reached, the question of fact shall be submitted to a mutually agreeable umpire whose decision shall be final.



6/27/46

*Note: We are pleased to state that Professor Milligan is now a member of the Society and has begun his work as chairman of Subcommittee I.

Investigation has shown that there is no further need of continuing Specification B 72-33, Fire-Refined Copper Other Than Lake and the subcommittee has voted recommendation to abandon the specification. Action to abandon the specification to be by the same letter ballot of both Committee B-2 as a whole, and Sub-committee I.

The subcommittee recommended that Emergency Specification ES-7, Fire-Refined Copper For Wrought Products and Alloys be abandoned and replaced by a Tentative Specification B-46T, Fire-Refined Copper for Wrought Alloys. Action to abandon the emergency specification and to replace by the suggested tentative specification to be by the same letter ballot of both Committee B-2 as a whole, and Subcommittee I.

Committee B-1 On Wires For Electrical Conductors and Committee B-5 On Copper And Copper Alloys, Cast And Wrought, are to be notified of the action of the committee on the recommendations of Subcommittee I.

The Coordinating Committee On Non-Ferrous Metals And Alloys on inquiry from your committee as to necessity for further consideration concerning a classification of coppers replied that a necessity existed and directed that your committee prepare such a classification.

*Note: Following the meeting of Committee B-2, a conference was held between the officers and interested members of Committee B-2 with the officers of both Committee B-1 and Committee

April 24, 1946

PROPOSED TENTATIVE SPECIFICATION
FOR
FIRE REFINED COPPER FOR WROUGHT ALLOYS

A.S.T.M. DESIGNATION _____

SCOPE

1. These specifications cover fire-refined primary copper for alloying in cast and wrought alloys.

CHEMICAL COMPOSITION

2. The copper in all shapes shall conform to the following requirements as to chemical composition:

Copper plus silver, min., per cent.....	99.88
Arsenic, max., per cent.....	0.012
Antimony, max., per cent.....	0.003
Selenium plus tellurium, max., per cent.....	0.025
Nickel, max., per cent.....	0.05
Bismuth, max., per cent.....	0.0003
Lead, max., per cent.....	0.004

CHEMICAL ANALYSIS

3. The chemical analysis shall be made in accordance with the Tentative Methods of Battery Assay of Copper (A.S.T.M. Designation: B-34) of the American Society for Testing Materials. Analysis for elements other than copper may be made either chemically or spectrographically.

PERMISSIBLE VARIATIONS IN WEIGHTS AND DIMENSIONS

4. A permissible variation of plus or minus 5 per cent in weight, or plus or minus 1/4 in. in any dimension from the manufacturer's published list or the purchaser's specified size shall be considered good delivery.

MARKING

5. Ingots and ingot bars shall have a brand stamped or cast in but need have no furnace charge mark.

LOTS

6. The manufacturer shall arrange carloads or lots so that as far as possible, each shall contain shapes from but one furnace charge, in order to facilitate testing by the purchaser.

CLAIMS

7. (a) Claims shall be made in writing within 30 days of receipt of the copper by the purchaser, and the results of the tests made by the purchaser shall accompany such claims. The manufacturer shall be given one week from the date of receipt of

the complaint to investigate his records, and shall then either agree to satisfy the claim or send a representative to the purchaser's mill. Claims shall be considered only when made as above stated and when the copper in question, unused, can be shown to the representative of the manufacturer.

(b) Claims against quality will be considered as follows:

- (1) Chemical composition by furnace charges, ingot lots, or ingot-bar lots.
- (2) Physical defects by individual pieces, and
- (3) Variations in weight or dimension by individual pieces.

INVESTIGATION OF CLAIMS

8. (a) Chemical Composition. - Each party shall elect a sample of three pieces from the consignment or lot to be investigated. These shall be sampled in the presence of both parties by drilling five holes, approximately $\frac{1}{8}$ in. in diameter, at points equally spaced between the ends of the pieces. With ingots and ingot bars, these holes should be along a middle line. The drilling shall be from top to bottom and completely through each piece. Scale from set and any surface dirt shall be rejected. No lubricant shall be used, and drilling shall not be forced sufficiently to cause oxidation of the chips. In the case of sections more than 5 in. in thickness, drillings may be made from both top and bottom for a depth not less than 2 in. in each direction instead of completely through each piece, but in other respects the drilling shall be conducted as previously described. The resulting sample shall be cut up, mixed, and separated into three equal portions, each of which shall be placed in a sealed package, one for the manufacturer, one for the purchaser, and one for an umpire, if necessary. Each party shall make an analysis in accordance with Section 3 and if the results do not establish or dismiss the claim to the satisfaction of both parties concerned, the third sample shall be submitted to a mutually agreeable umpire, who shall determine the question of fact and whose determination shall be final.

(b) Variations in Weight and Dimensions. The representative of the manufacturer shall inspect all pieces where physical defects or variation in weight or dimension are claimed. If agreement is not reached, the question of fact shall be submitted to a mutually agreeable umpire, whose decision shall be final.

SETTLEMENT OF CLAIMS

9. The expenses of the manufacturer's representative and of the umpire shall be paid by the loser, or divided in proportion to the concession made in case of compromise. In case of rejection being established, the damages shall be limited to payment of freight both ways by the manufacturer for the substitution of an equivalent weight of copper conforming to these specifications.

February 22, 1945

MEMBERS OF SUB-COMMITTEE I,
COMMITTEE B-2, ON REFINED COPPER

Gentlemen:

A meeting of Sub-Committee I of B-2 on Refined Copper is called for 2 P. M. on Tuesday, March 6, in the rooms of the Copper & Brass Research Association, 420 Lexington Avenue, New York, for the following purposes.

To receive a report of the Sub-sub-committee appointed following the meeting last June 29 to draw up and submit a tentative specification covering the type of copper now covered by Emergency Specification ES-7 (Fire Refined Copper for Wrought Products and Alloys)

To decide what action the Sub-committee should take with respect to the list of available coppers containing small additions of various elements such as silver, arsenic, and phosphorus.

To act on any other matters that might properly come before the meeting.

Sincerely,

John L. Christie

Chairman
Sub-committee I of B-2

JLChristie:M

99 Cu

Ni 0.05

Zn - 0.025

March 17, 1945

Minutes of Meeting of Sub-committee 1 of B-2 held at Copper
& Brass Research Association, New York, 2:00 P. M., March 6, 1945

Present:

Lawrence Addicks
C. H. Davis (for J. R. Freeman)
J. L. Christie
W. H. Finkleday (for Laurence Griffith)
Alan Morris
B. H. McGar (for D. K. Crampton)
Sidney Rolle
D. L. Ogden
S. Skowronski

Carter S. Cole -- A.S.T.M. Staff
G. Howard LeFevre -- Secretary Committee B-2

* * * * *

Membership

The Chairman read a letter, dated February 1, 1945, from Mr. Rittenhouse, announcing the return of Mr. L. L. Wyman to the General Electric Company from the War Metallurgy Committee. Without objection, Mr. Wyman is to be listed as a consumer member of Sub 1 of B-2.

* * * * *

Specification for Fire Refined Copper for Wrought
Products and Alloys

For the Sub sub-committee, Dr. Morris submitted for comment a progress report in the form of a draft, dated February 26, 1945, of a Proposed Tentative Specification for Fire Refined Copper for Wrought Products and Alloys to supplant ES-7.

There was considerable discussion. There appeared to be general agreement that the kind of copper which the Emergency Specification was intended to cover, and the Proposed Tentative Specification is intended to cover, is satisfactory for the production of cartridge brass; millions of pounds had been used with satisfaction. There was some question whether or not this kind of copper is suitable for rolling into sheets and shapes for mechanical purposes. There was general agreement that neither the Emergency Specification nor the draft of the Proposed Tentative Specification precisely describes the copper it is intended to cover.

It was pointed out that for selenium and tellurium the draft lists the maximum of 0.025% while the Emergency Specification listed 0.015%.

Several suggestions were offered: the inclusion of the requirement that the copper come direct from ore and not come from remelted scrap; the inclusion of limits, under chemical composition, for lead and for bismuth; the elimination, from the scope, of the implication that the copper will satisfactorily roll (in this connection it was stated that less pure copper is regularly rolled in Great Britain and on the European Continent). Mention was made also of the possibility that the specification under discussion be combined with Specification B 72-33, Fire Refined Copper Other Than Lake.

* * * * *

List of Available Coppers

In introducing the subject of the List of Available Coppers containing small additions of various elements such as silver, arsenic, and phosphorus, the Chairman read a letter dated February 28, 1945, from Mr. G. H. Hernden, Chairman of Committee B-5, in which the need for the list was stated.

Mr. Davis also expressed the existence of the need of the classification and referred particularly to the B 119-40T (Tentative Classification of Cast Copper-Base Alloys -- issued 1939, Revised 1940) which might serve as a pattern. Various opinions were expressed some of which were:

The classification is good as a classification for information only; there may logically follow a demand for a large number of specifications. It was suggested that the classification should contain a strong statement that it is not either a specification or the beginning of one.

The classification should be made as simple as possible. Whereas there could be several bases for the classification of various types of copper, it was pointed out that the one drawn up by Major Stout was the result of long study and mature consideration.

It was decided that copies of the classification in the latest form should be sent to the members of the committee with the request that they submit their comments and suggestions.

JLChristie:M

AMERICAN SOCIETY FOR TESTING MATERIALS

March 9, 1942

Mr. L. S. Ward
Mr. R. S. Pratt Special Sub-Committee on Types of
Mr. A. Morris Copper
Mr. A. J. Phillips

Majjor C. H. Greenall
Mr. E. S. Bunn
Mr. G. H. Clamer
Mr. C. S. Cole
Mr. C. H. Davis
Lt. Col. L. S. Fletcher
Mr. G. H. Harnden
Mr. G. C. Holder
Mr. E. L. Hollady
Mr. J. J. Kanter
Mr. R. R. Kennedy
Mr. H. V. Schlacks
Mr. W. H. Swanger
Mr. R. G. Thompson
Mr. L. A. Ward

Gentlemen:

Attached please find a copy of the tentative classification of coppers, issue of March 9, 1942. You will note that a Type A-3 has been added. This has been inserted at the request of a producer. The note 1 covering this Type A-3 I feel is sufficiently definitive for purposes of classification.

The status of the proposed classification has been somewhat indeterminate due to the matter of jurisdiction between committees B2 and B5. The following quotation from a letter written by Mr. Greenall to Mr. Hess will serve to clarify this matter:

"These data when prepared by Mr. Stout's sub-committee are to be presented to the Advisory Committee of Committee B5 for comments and approval for submission of the data to Committee B2. When the Advisory Committee has commented upon the proposed requirements and their comments have been correlated Mr. Stout then plans to submit the information to Mr. Christie of Committee B2 with the request that Committee B2 develop and publish, if possible, requirements comparable to the requirements which Committee B5 feel desirable. At such time that Committee 2 can publish ASTM

page 2

Designations covering these types of copper Committee B5 will then have to reconsider the designations as promulgated by Committee B2 for inclusion in the Committee B5 Specifications."

A letter ballot is attached requesting the joint approval of the Sub-subcommittee and the Advisory Committee to forward the proposed classification in its present form to Mr. Christie in line with the above quotation from Mr. Greenall's letter.

Please note that the vote is not on the question of adoption as standard, but for presentation to Committee B2 requesting consideration and development.

Kindly return the letter ballot at your earliest convenience.

Very truly yours,

H. H. STOUT, JR.

H. H. Stout, Jr., Chairman
Sub-Subcommittee

med/

CC: Mr. C. H. Christie
R. E. Hess
J. H. Foote
E. E. Thum
C. S. Harloff

TENTATIVE CLASSIFICATION OF

COMMERCIAL COPPERS

A.S.T.M. DESIGNATION B---T

March 9, 1942

1. The following classification has been prepared in order to clarify and set forth under a simple heading the nomenclature and certain characteristics of the available Commercial Coppers:

2. Twenty coppers of four basic types are recognized, as follows:

Type A - Coppers for Remelting

- A1 - Casting Copper
- A2 - Electrolytic Cathode Copper
- A3 - Ingot and Ingot Bar (See Note 1)

Type B - Tough Pitch Coppers

- B1 - Electrolytic Tough Pitch Copper
- B2 - Fire Refined High Conductivity Tough Pitch Copper
- B3 - Fire Refined Low Conductivity Tough Pitch Copper
- B4 - Tough Pitch, Silver Bearing Copper
- B5 - Tough Pitch Arsenical Copper
- B6 - Tough Pitch Silver Bearing Arsenical Copper
- B7 - Fire Refined Low Conductivity Tough Pitch Copper, Emergency Grade.

Type C - Oxygen Free Coppers

- C1 - Oxygen-Free Copper without Residual Deoxidants
- C2 - Oxygen-Free Silver Bearing Copper
- C3 - Oxygen-Free Arsenical Copper
- C4 - Oxygen-Free Silver Bearing Arsenical Copper

Type D - Deoxidized Coppers

- D1 - Phosphorized Copper, High Residual Phosphorous
- D2 - Phosphorized Copper, Low Residual Phosphorous
- D3 - Phosphorized Silver Bearing Copper
- D4 - Phosphorized Arsenical Copper
- D5 - Phosphorized Silver Bearing Arsenical Copper
- D6 - Deoxidized Copper containing Residual Deoxidants other than Phosphorus

Note 1: Ingot and Ingot Bar are shape designations only and are normally available in Types B1, B2, B3, B6, and B7.

3. The materials conform to the following chemical compositions.

No.	Copper	Phosphorous		Arsenic		Silver	A.S.T.M. Specification having Original Jurisdiction
	% Min. 1.	% Min.	% Max.	% Min.	% Max.	Oz/Ton Min. 2	
A1							
A2	99.90						ASTM B-115
A3							See Par. 1, Note 1
B1	99.90						ASTM B-5
B2	99.90						Inc. under ASTM B4, Low Resist Lake
B3	99.70				.10		ASTM B-72
B4	99.90					² 7.0	
B5	99.40			.15	.50		
B6	99.40			.15	.50	² 7.0	Inc. under ASTM B4, High Resist Lake
B7	99.88				.015		ASTM B-72 Emer. Grade
C1	99.92						ASTM B _____ T
C2	99.92					² 7.0	
C3	99.40			.15	.50		
C4	99.40			.15	.50	² 7.0	
D1	99.90	.015	.040				
D2	99.90	.004	.010				
D3	99.90	.015	.040			² 7.0	
D4	99.40	.015	.040	.15	.50		
D5	99.40	.015	.040	.15	.50	² 7.0	
D6	99.90						

1. Silver being counted as copper.

2. Troy ounces per Avordupois ton. The amount of Silver in Silver Bearing Copper is not standard, but is agreed upon by producer and consumer at the time of placing the order. The figures given for Minimum Silver are typical and not mandatory.

4. Applications

- a) All types except A1, A2, and A3 are suitable for mechanical applications.
- b) Types A1 and A2 are suitable only for melting.
- c) Types B1, B2, B4, C1, and C2 are suitable for electrical conductors (see par. 5). If agreed upon by purchaser and consumer at the time of placing the order, types D2 and D6 may be included in this group.
- d) All coppers of Types C and D are suitable for applications where substantial freedom from cuprous oxide is desired. (See Par. 6)
- e) All coppers of Types C and Types D1, D3, D4, and D5 are, under the conditions of paragraph 4(f), suitable for exposure to reducing atmospheres at elevated temperatures. The test outlined in paragraph 7 is an accelerated performance test and is not to be construed as recommending the metal for service at the temperature indicated. If agreed upon by purchaser and consumer at the time of placing the order, Types D2 and D6 may be included in this group.
- f) For all Types of copper if service is contemplated at elevated temperature, the producer should be consulted.
- g) Coppers of Types C and D are preferable for welding.
- h) The coppers listed as containing Silver in particular, as well as those containing Arsenic or Phosphorous, require a somewhat longer time and/or higher temperature to effect recrystallization. The producer should be consulted if this characteristic is to be utilized in engineering design.

5. Electrical Resistivity

When ordered for electrical purposes the following values apply to the types named in paragraph 4-c above:

<u>Condition</u>	<u>Maximum Electrical Resistivity Ohm (Meter, gram) @ 20°C</u>	<u>Equiv. Elect. Resistivity Ohm (Mil, ft.) @20°C</u>	<u>Electrical Conductivity % IACS, Min.</u>
Soft 32000 Psi - 40000 Psi	0.15328	10.371	100.0
Medium Hard - over 40000 to 53000 Psi	0.15775	10.674	97.16
Hard Over 53000 Psi	0.15940	10.785	96.16

6. Microscopic Examination

All types enumerated in paragraph 4-d shall be free from cuprous oxide as determined by microscopic examination at a magnification of 75 diameters.

7. Embrittlement Test

It is to be expected that all types enumerated in paragraph 4-e will pass the following test. Actual performance of the test, however, is not normally mandatory unless specifically required.

Suitable samples shall be heated to a temperature of 800°C for a period of 20 minutes in a furnace containing an atmosphere of hydrogen. The samples shall then be removed from the furnace, polished, etched, and examined at a magnification of 75 diameters. The samples shall not show gassing or open grain structure characteristic of embrittlement.

June 29, 1944

REPORT OF SUB-COMMITTEE I OF B-2

Under date of May 29 the sub-committee was canvassed by letter ballot on the question of advancing to standard Tentative Specification 170-43T, Oxygen-Free Electrolytic Copper Wire Bars, Billets, and Cake; and on the question of approving as Tentative Standard, Emergency Specification ES-7, Fire-Refined Copper for Wrought Products and Alloys. While the result of the letter ballot was predominately in favor of both actions, to each action there was raised objection of sufficient force to warrant further consideration.

A meeting of the sub-committee was held on June 28, 1944 and the following steps were taken:

It was regularly moved, seconded and passed to maintain Tentative Specification 170-43T as tentative, thereby rescinding the letter ballot vote, and to change paragraph 6(a) to read

6(a) Test Specimens prepared from samples forged or hot rolled and cold drawn down into wire of #6 B&S gage (0.162") to #12 B&S gage (0.080") shall be annealed in an atmosphere of hydrogen for 20 minutes at 80°C (1472°F) to 875°C (1607°F) and shall withstand the bend test specified in paragraph (b).

It was regularly moved, seconded and passed to rescind the letter ballot vote approving ES-7 as a tentative standard; to authorize the chairman to appoint a sub sub-committee to draw up and submit a tentative specification covering the type of copper now covered by ES-7; and to so notify committee B-5. The chairman appointed Messrs. Crampton, Sircois, and Morris, the latter as chairman.

A letter from Mr. D. R. Evans, Chairman of Division B of Committee E-3 on Chemical Analysis of Metals pointed out that the chemical composition listed in Specification B 72-53, Fire Refined Copper Other Than Lake is given to four decimal places, implying an unobtainable degree of analytical precision. It was regularly moved, seconded and passed to recommend as an editorial change the deletion of two zeros in the case of the copper requirement, and one zero in the case of each of the impurities listed, thus making paragraph 2 read:

The copper in all shapes shall conform to the following requirements as to chemical composition.

Copper plus silver, minimum percent			99.70
Arsenic	maximum	"	6.100
Antimony	"	"	0.012
Bismuth	"	"	0.002
Iron	"	"	0.010
Lead	"	"	0.010
Nickel	"	"	0.100
Oxygen	"	"	0.075
Selenium	"	"	0.040
Tellurium	"	"	0.014
Tin	"	"	0.050

At a meeting of the Coordinating Committee on Non-Ferrous Metals and Alloys held on June 28, 1944, it was decided that various coppers containing small additions of various elements such as silver, arsenic and phosphorous fall within the province of committee B-2 rather than of committee B-5. Sub-committee I of B-2, therefore, will sponsor a list of such available coppers.

The various steps enumerated will be submitted to the sub-committee for letter ballot.

J. L. Christie
Chairman

JLChristie:M