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## Standard Terminology for Copper and Copper Alloys<sup>1</sup>

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### 1. Scope

1.1 The terms defined in this terminology standard are applicable to copper and copper alloy products specifications, test methods, practices, and other documents within the jurisdiction of Committee B05 on Copper and Copper Alloys.

### 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

**B 153** Test Method for Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing

**B 170** Specification for Oxygen-Free Electrolytic Copper—Refinery Shapes

**B 379** Specification for Phosphorized Coppers—Refinery Shapes

**E 8** Test Methods for Tension Testing of Metallic Materials

**E 10** Test Method for Brinell Hardness of Metallic Materials

**E 18** Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

**E 23** Test Methods for Notched Bar Impact Testing of Metallic Materials

### 3. Significance and Use

3.1 This terminology is not intended to apply to any standard, test method, practice, or other document not within the jurisdiction of Committee B05 on Copper and Copper Alloys.

### 4. Terminology

*acid dip*—see **dip solution**.

*acid dipped-dry rolled finish*—see **finish, acid dipped-dry rolled**.

*air stain*—see **stain, air**.

**anneal (annealing)**—a thermal treatment to change the properties or grain structure of the product. When applied to a

cold-worked product having a single phase: to produce softening by recrystallization or recrystallization and grain growth, with the accompanying changes in properties. When applied to a product having two or more phases: to produce softening by changes in the phase relationship that may include recrystallization and grain growth.

**arc welding**—a group of welding processes wherein coalescence is produced by heating with an arc or arcs, with or without the application of pressure, and with or without the use of filler metal.

**as-welded condition**—a condition created as a result of forming annealed sheet or plate into tubular form and welding without subsequent heat treatment or cold work.

**average diameter (for round tubes only)**—the average of the maximum and minimum outside diameters or the maximum and minimum inside diameters, whichever is applicable, as determined at any one cross section of the tube.

**bar**—a solid rectangular section, or one with two plane parallel surfaces and round or other simple regularly shaped edges, up to and including 12 in. (300 mm) in width and over 0.188 in. (5 mm) in thickness, furnished in straight lengths or in rolls and with finished edges, either rolled, drawn, or extruded.

**bar, bus stock**—high-conductivity copper bar stock of any dimension intended for use as an electrical conductor.

**bar, cast**—a flat casting for rolling into sheet and strip, or round casting for rolling and drawing into wire.

**bar, commutator segment stock**—a bar for use in making commutators of electric motors and generators, the cross-section of the bar being a trapezoid or truncated sector or segment of a circle.

**base metal**—the sheet or plate from which the pipe is formed.

*bend test*—see **test, bend**.

**billet**—refinery shape used for piercing or extrusion into tubular products or for extrusion into rods, bars, and shapes. Circular in cross section, usually 3 to 16 in. (76 to 406 mm) in diameter, normally ranging in weight from 100 to 4200 lb (45 to 1905 kg).

*bimetal tube*—see **tube, bimetal**.

**blank**—a piece of flat product intended for subsequent fabrication by forming, bending, cupping, drawing, hot pressing, and so forth.

*Bourdon gage tube*—see **tube, Bourdon gage**.

<sup>1</sup> This terminology is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.93 on Terminology.

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<sup>2</sup> 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.

*brazed tube*—see **tube, brazed**.

**brazing filler material**—wire, rod, strip, or powder that is manufactured to special chemical composition for use in joining metals by brazing.

*bright annealed finish*—see **finish, bright annealed**.

*bright dip*—see **dip, bright**.

*bright dipped finish*—see **finish, bright dipped**.

*bright rolled finish*—see **finish, dry rolled**.

*Brinell hardness test*—see **test, Brinell hardness**.

*brush brass finish*—see **finish, brush brass**.

**buckle (centre bulge or oil can)**—alternate bulges and hollows recurring along the length of a strip with the edges remaining relatively flat.

*buffed surface finish*—see **finish, buffed surface**.

*bull rod*—see **redraw rod**.

**bus bar**—includes material of solid rectangular or square cross section or a solid section with two plane parallel surfaces and round or other simple regular-shaped edges.

**bus conductor stock**—a bar, rod, or shape of high-conductivity copper used to make bus conductors.

*bus stock bar*—see **bar, bus stock**.

*butt seam tube*—see **tube, open seam**.

**cake**—refinery shape used for rolling into plate, sheet, strip, or shape. Rectangular in cross section and of various sizes, normally ranging in weight from 140 to 62 000 lb (63 to 28 123 kg).

**capable of**—the test need not be performed by the producer of the material. However, if subsequent testing by the purchaser establishes that the material does not meet the specified requirements, the material shall be subject to rejection.

*cast bar*—see **bar, cast**.

**casting**—a general term for a metal object produced at or near-finished shape by pouring or otherwise introducing molten metal into a mold and allowing it to solidify.

**casting, centrifugal**—a casting produced in a cylindrical mold rotating on its axis with the major axis of the product coinciding with the axis of rotation. The axis of rotation may be horizontal, vertical, or any angle in between.

**casting, centrifuged**—a casting produced in a mold, a number of which may be mounted around a central sprue. The molds are rotated, in a vertical position, about a central axis concentric with the central sprue.

**casting, continuous**—a casting produced by the continuous pouring and solidification of molten metal through a water-cooled mold which determines the cross-sectional shape. The length of the product is not restricted by mold dimensions.

**casting, permanent mold**—a product produced in a reusable mold constructed of a durable material, usually iron or steel, with the molten metal being introduced by gravity, low-pressure, or vacuum.

**casting, sand**—a casting produced in a sand mold.

**casting, semicentrifugal**—a casting produced in a manner similar to the centrifugal casting except that a central core is used to allow the formation of other than a cylindrical inside surface. The axis of rotation is always vertical.

**cathode**—unmelted, electrodeposited, and somewhat rough flat plate normally used for melting. The customary size is

about 3 ft (0.914 m) square, about ½ to ¾ in. (12.7 to 22.2 mm) thick, weighing up to about 300 lb (136 kg) and may have hanging loops attached. Cathodes may also be cut to smaller dimensions.

*cavitation corrosion*—see **corrosion, cavitation**.

**chemically refined copper**—copper recovered from an aqueous solution by other than electrolytic means. Usually when this term is used alone it refers to chemically refined tough pitch copper. This designation applies to the following: (a) copper cast in refinery shapes suitable for hot or cold working, or both, and by extension, to fabricators products made therefrom, (b) ingots or ingot bars suitable for remelting.

**cladding ratio**—ratio by percent thickness of the component layers, for example.

*clean annealed finish*—see **finish, clean annealed**.

**close nipple**—a nipple with no shoulder or unthreaded portion between two threads; the shortest possible pipe nipple with complete threads.

**coil**—a length of the product wound into a series of connected turns. The unqualified term “coil” as applied to tube usually refers to a bunched coil.

**coil, bunched**—a coil in which the turns are bunched and held together such that the cross section of the bunched turns is approximately circular.

**coil, double layer flat**—a coil in which the product is spirally wound into two connected disc-like layers such that one layer is on top of the other. (Sometimes called “double layer pancake coil” or “double layer spirally wound coil.”)

*coil, helical*—See **coil, level or traverse wound**.

**coil, level or traverse wound**—a coil in which the turns are wound into layers parallel to the axis of the coil such that successive turns in a given layer are next to one another. (Sometimes called a “helical coil.”)

**coil, level or traverse wound on a reel or spool**—a coil in which the turns are positioned into layers on a reel or spool parallel to the axis of the reel or spool such that successive turns in a given layer are next to one another.

**coil, single layer flat**—a coil in which the product is spirally wound into a single disc-like layer. (Sometimes called “pancake coil” or “single layer spirally wound coil.”)

**coil, stagger wound**—a coil in which the turns are positioned into layers approximately parallel to the axis of the coil, but not necessarily with the fixed regularity of a level or traverse wound coil.

*cold rolled finish*—see **finish, cold rolled**.

**cold-rolled rod**—a metal rod brought to final dimensions by cold rolling, regardless of prior operations.

**cold work**—controlled mechanical operations for changing the form or cross section of a product and for producing a strain-hardened product at temperatures below the recrystallization temperature.

*commutator segment stock bar*—see **bar, commutator segment stock**.

*copper drainage tube*—see **tube, copper drainage (DWV)**.

*copper service tube*—see **tube, copper service**.

**corner radius on square or rectangular wire**—any configuration on the corner between a chamfer and a full radius. The

measurement of a corner radius is the distance from the blend point on one surface to the extension of the other surface.

**corrosion, cavitation**—the damage caused to a material by a moving liquid and associated with the formation and collapse of cavities in the liquid at the solid-liquid interface.

**corrosion, impingement attack**—a type of localized corrosion caused by the striking of a liquid over a period of time containing entrained gases, on a metal surface.

**corrosion, stress**—spontaneous failure of metals by cracking under combined action of corrosion and residual or applied stress.

*creep test*—see **test, creep**.

*cup test*—see **test, cup**.

**dents**—depressions in the copper foil which do not significantly change the thickness of the copper foil.

**deoxidized copper, high-residual phosphorus**—copper deoxidized with phosphorus residual in amounts 0.015 to 0.040 %. The copper is not susceptible to hydrogen embrittlement, as determined in Specification **B 379**. The copper is of relatively low-electrical conductivity due to the amount of phosphorus present.

NOTE 1—International Standards Organization specifications permit up to 0.050 % phosphorus.

**deoxidized copper, low-residual phosphorus**—copper deoxidized with phosphorus residual in amounts 0.004 to 0.012 %. The copper is not readily susceptible to hydrogen embrittlement, as determined in Specification **B 379**. The copper in the annealed condition has a minimum conductivity of 90 % IACS.

**dewetting**—a condition that results when molten solder has coated a surface and then receded leaving irregular-shaped mounds of solder separated by areas covered with a thin film but base metal is not exposed.

**dip, bright**—a dip solution used to give a bright surface to copper alloys.

**dip, matte**—a dip solution used to obtain a matte or dull finish on copper alloys.

**dip solution**—any chemical solution used to produce a specific color or finish on copper or copper alloys.

**disc**—a round, commercially flat solid blank made from a flat rolled product.

*disc straightening*—see **straightening, ring or disc type**.

**dish (cross or transverse bow)**—the departure from flatness across the full width of the strip in the form of a single arc, excluding burrs.

**distribution tube (Type D)**—a seamless or welded copper tube known as copper distribution tube (Type D).

*drainage tube*—see **tube, copper drainage (DWV)**.

*drawn finish*—see **finish, drawn**.

*drawn flat product*—see **flat product, drawn**.

**drawn rod**—a metal rod brought to final dimensions by cold drawing through a die, regardless of temper or prior operations.

**drawn stress relieved (DSR)**—a thermal treatment of a cold-drawn tubular product to improve ductility without significantly affecting its tensile strength or microstructure.

*dry rolled finish*—see **finish, dry rolled**.

*duplex tube*—see **tube, bimetal**.

*DWV tube*—see **tube, copper drainage (DWV)**.

**electrolytic copper**—copper of any origin, refined by electrolytic deposition including electrowinning. Usually when this term is used alone it refers to electrolytic tough pitch copper. This designation applies to the following: (a) cathodes that are the direct product of the refining operation, (b) electrodeposited copper cast in refinery shapes suitable for hot or cold working or both, and by extension, to fabricators' products made therefrom, (c) electrodeposited copper cast into ingots or ingot bars suitable for remelting.

*embossed tube*—see **tube, embossed**.

**embrittlement**—the reduction of the normal ductility in a metal due to a physical or chemical change. As it relates to these test methods, embrittlement is the loss of ductility caused by the reaction of cuprous oxide in the copper product when exposed at elevated temperatures to a reducing atmosphere.

*endurance test*—see **test, endurance**.

*expansion test*—see **test, expansion (pin)**.

*extruded finish*—see **finish, extruded**.

**extruded rod**—a metal rod brought to final dimensions by extrusion. Also see **as-extruded**.

**extrusion**—a uniform metal shape, long in relation to its cross-sectional dimensions, produced by forcing a suitably preheated billet or preform through an orifice (die) of the desired cross section. Extrusions generally are furnished in straight lengths.

**finish, acid dipped-dry rolled**—the surface obtained by cold dry rolling on polished rolls of material previously dipped, giving a burnished appearance and retaining the color obtained by dipping.

**finish, bright annealed**—the surface obtained by annealing under conditions of controlled atmosphere to prevent oxidation and to retain the original luster of the product.

**finish, bright-dipped**—a bright surface having the true color of the metal obtained by immersion in a bright dipping solution.

*finish, bright-rolled*—see **finish, dry rolled**.

**finish, brush brass**—a frosted surface obtained on brass by brushing with a wheel that may or may not be treated with brush rouge and rotating at high speeds.

**finish, buffed surface**—the surface obtained by buffing with rouge or similar fine abrasive, resulting in a high gloss or polish. This may be applied in one operation or two, commonly known as cutting and coloring operations.

**finish, clean annealed**—a surface characterized by a light iridescent film generally obtained on copper alloys which have been annealed in a controlled atmosphere.

**finish, cold rolled**—the surface obtained by cold rolling of strip with a lubricant, giving a relatively smooth appearance. In the case of sheet or strip, cold rolling may be done without any lubricant, the finish then being similar to that described under dry rolled finish.

**finish, drawn**—the surface obtained on tube, wire, and drawn rod, bar, and strip by drawing through a die resulting in a relatively smooth and bright appearance with some residual lubricant on the surface.



**finish, dry rolled**—(a) the surface obtained by cold rolling on polished rolls without the use of any coolant or metal lubricant; (b) the surface obtained by the rolling or tumbling of brass articles in a barrel with either dry sawdust, leather, or scrap cork.

**finish, extruded**—the surface obtained on tube, wire, and rod, bar, and strip by hot extrusion through a die, resulting in an oxidized and dull appearance.

**finish, hot rolled**—the surface obtained by rolling metal while hot resulting in a dark, oxidized, and relatively rough surface.

**finish, kerosine rolled**—the surface obtained by cold rolling with kerosine as a lubricant, giving a semi-burnished appearance. A similar finish can be obtained by cold rolling with soap or soluble oil.

**finish, plain pickled**—the surface obtained by immersion in a sulfuric acid solution. This effectively removes most heavy scale and oxides on yellow brasses, but less effectively on other alloys and will not remove any thin surface films of deposited copper. The color, is, therefore, usually duller than that of bright dipped.

**finish, planish**—a bright smooth surface usually obtained by rubbing metals together.

**finish, scratch brushed**—the surface obtained by mechanically brushing the surface with wire bristle brushes or by buffing with greaseless compound.

*finned tube*—see **tube, finned**.

**fire-refined copper**—copper of any origin or type finished by furnace refining without having been processed at any stage by electrolytic or chemical refining. Usually when the term fire-refined copper is used alone it refers to fire-refined tough pitch copper. This designation applies to the following: (a) copper cast in refinery shapes suitable for hot or cold working or both, and by extension, to fabricators' products made therefrom, (b) ingots or ingot bars suitable for remelting.

**flash**—as in welding, the metal that protrudes at the weld of the tube, internally, externally, or both, as a result of the pressure applied when a forge-type seam is produced; the two types of flash are internal flash and external flash.

**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."

**flat product, drawn**—a flat product brought to final dimensions by drawing through a die, and furnished in flat straight lengths, on spools, or in rolls. The corners or edges may be square or of other contours.

**flat product, rolled**—a flat product brought to final thickness by rolling, and furnished in flat straight lengths, on spools, or in rolls. Longitudinal edges may be those resulting from final rolling to thickness or the product may be brought to final width by shearing, slitting, sawing, machining or rolling. The corners or edges may be square or of other contours.

*flat straight lengths*—see **straightening and flattening (patent levelling) applicable to flat straight lengths**.

*flattening test*—see **test, flattening**.

**flat wire**—a product up to and including 0.188 in. (4.78 mm) in thickness and up to and including 1/4 in. (31.8 mm) in width.

*fluted outside and plain inside tube*—see **tube, fluted outside and plain inside**.

*fluted tube*—see **tube, fluted**.

**foil**—a term often applied to thin sheet or strip usually 0.005 in. (0.13 mm) or less in thickness.

**free-cutting**—the property of a material that enables it to be cut with high-speed machining equipment yielding a short, brittle chip.

**free-cutting brass**—a wrought copper alloy composed of copper, zinc, and lead having chemical composition within the defined limits of Copper Alloy UNS No. C36000.

**free-cutting copper**—a wrought copper enriched with tellurium and phosphorus, sulfur and phosphorus, or lead, having chemical composition within the defined limits of either Copper UNS Nos. C14500, C14510, C14520, C14700, or C18700.

**free-cutting muntz metal**—a wrought copper alloy composed of copper, zinc, and lead having chemical composition within the defined limits of Copper Alloy UNS No. C37000.

*free-machining*—see **free-cutting**.

*free-turning*—see **free-cutting**.

*hand straightening*—see **straightening, hand**.

**herringbone**—a series of long continuous waves running at various angles to the rolling direction.

**high-conductivity copper**—copper that in the annealed condition has a minimum electrical conductivity of 100 % IACS.

*hot rolled finish*—see **finish, hot rolled**.

**hot-rolled rod**—a metal rod brought to final dimensions by hot rolling.

**hot working**—controlled mechanical operations for shaping a product at temperatures above the recrystallization temperature.

*hydrostatic test*—see **test, hydrostatic**.

*impact test*—see **test, impact**.

*impingement attack corrosion*—see **corrosion, impingement attack**.

*inclined roll straightening*—see **straightening, inclined roll**.

**inclusions**—foreign particles which may or may not be enclosed in the copper foil.

**ingot and ingot bar**—refinery shapes used for remelting (not fabrication). Ingots normally range in weight from 20 to 35 lb (9 to 16 kg) and ingot bars from 50 to 70 lb (23 to 32 kg). Both are usually notched to facilitate breaking into smaller pieces.

*kerosine rolled finish*—see **finish, kerosine rolled**.

**lengths**—straight pieces of the product.

**lengths, ends**—straight pieces, shorter than the nominal length, left over after cutting the product into mill lengths, stock lengths, or specific lengths. They are subject to minimum length and maximum weight requirements.

**lengths, multiple**—straight lengths of integral multiples of a base length, with suitable allowance for cutting, if and when specified.