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# Standard Terminology Relating to Uninsulated Metallic Electrical Conductors<sup>1</sup>

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## INTRODUCTION

These terminologies relate only to interpretations as applied to uninsulated metallic electrical conductors in specifications under the jurisdiction of ASTM Committee B01 on Electrical Conductors, and do not necessarily correspond to the definitions used in other fields.

### 1. Scope

1.1 This terminology standard defines abbreviations and terms specific to uninsulated electrical conductors. For terms relating to superconductors, see Terminology B713.

1.2 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

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

B193 Test Method for Resistivity of Electrical Conductor Materials

B230 Specification for Aluminum 1350–H19 Wire for Electrical Purposes

B398/B398M Specification for Aluminum-Alloy 6201-T81 and 6201-T83 Wire for Electrical Purposes

B609/B609M Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes

B713 Terminology Relating to Superconductors (Withdrawn 2001)<sup>3</sup>

B941 Specification for Heat Resistant Aluminum-Zirconium Alloy Wire for Electrical Purposes

<sup>1</sup> This terminology is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.01 on Editorial and Records.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

B976 Specification for Fiber Reinforced Aluminum Matrix Composite (AMC) Core Wire for Aluminum Conductors Aluminum Matrix Composite Reinforced (ACAMCR) (formerly known as ACCR)

B978/B978M Specification for Concentric-Lay-Stranded Aluminum Conductors, Aluminum Matrix Composite Reinforced (ACAMCR), Formerly ACCR

B987/B987M Specification for Carbon Fiber Thermoset Polymer Matrix Composite Core (CFC) for use in Overhead Electrical Conductors

E8/E8M Test Methods for Tension Testing of Metallic Materials

### 3. Abbreviations

AAAC—all aluminum alloy conductor

AAC—aluminum conductor

AACSR—aluminum alloy conductor, steel reinforced

ACAR—aluminum conductor, aluminum alloy reinforced

ACSR—aluminum conductor, steel reinforced

ACSS—aluminum conductor steel supported

AMC—aluminum matrix composite

AW—old designation for what is now termed AW2

AW2—aluminum-clad steel core wire, normal strength

AW3—aluminum-clad steel core wire, high strength

AZ—old designation (aluminized)

CCA—copper-clad aluminum

CCS—copper-clad steel

COMP—compact construction

EHS—extra high strength

GA—old designation for what is now termed GA2

GA2—zinc coated (galvanized) steel wire, coating class A

GA3—zinc coated (galvanized) high strength steel wire, coating class A

GA4—zinc coated (galvanized) extra high strength steel wire, coating class A

GA5—zinc coated (galvanized) ultra high strength steel wire, coating class A

**GB**—obsolete designation, class B galvanizing is no longer offered

**GC**—old designation for what is now termed GC2

**GC2**—zinc coated (galvanized) steel wire, coating class C

**HS**—high strength

**IACS**—international annealed copper standard, which is 1/58 Ohm-mm<sup>2</sup>/m at 20 °C for 100 % conductivity

**LSE**—low stress elongation

**MA**—old designation for what is now termed MA2

**MA2**—zinc-5 % aluminum-mischmetal alloy coated steel wire, coating class A

**MA3**—zinc-5 % aluminum-mischmetal alloy coated high strength steel wire, coating class A

**MA4**—zinc-5 % aluminum-mischmetal alloy coated extra high steel wire, coating class A

**MA5**—zinc-5 % aluminum-mischmetal alloy coated ultra high steel wire, coating class A

**MB**—obsolete designation, class B galvanizing is no longer offered

**MC**—old designation for what is now termed MC2

**MC2**—zinc-5 % aluminum-mischmetal alloy coated steel wire, coating class C

**MS**—old designation for what is now termed MA3

**MM**—mischmetal

**NS**—non-specular

**SD**—self dampening construction

**SIW**—single input wire construction

**TP**—twisted pair

**TW**—trapezoidal shaped wire

**UHS**—ultra high strength

**UNS**—unified numbering system

**Zn-5Al-MM**—zinc-5 % aluminum-mischmetal alloy coating

#### 4. Acronyms

**ACAMCR**—a type of Aluminum Conductor Aluminum Matrix Composite Reinforced bare overhead electrical conductor. The composition of the ACAMCR conductor can be further identified using suffix modifiers where /XX is designation for the aluminum material and /YYYY is designation for the strength member material. Specification **B978/B978M** characterizes an ACAMCR / AT3 / AM1 type of conductor.

**ACAMCS**—a type of Aluminum Conductor Aluminum Matrix Composite Supported bare overhead electrical conductor. The composition of the ACAMCS conductor can be further identified using suffix modifiers where /XX is designation for the aluminum material and /YYYY is designation for the strength member material.

**ACCFCR**—a type of Aluminum Conductor Carbon Fiber Composite Reinforced bare overhead electrical conductor. The composition of the ACCFCR conductor can be further identified using suffix modifiers where /XX is designation for the aluminum material and /YYYY is designation for the strength member material.

**ACCFCS**—a type of Aluminum Conductor Carbon Fiber Composite Supported bare overhead electrical conductor. The composition of the ACCFCS conductor can be further identified

using suffix modifiers where /XX is designation for the aluminum material and /YYYY is designation for the strength member material.

4.1 The following suffix modifiers may be used for the above listed acronyms.

**/A0**—used as a suffix modifier for ACAMCS and ACCFCS type of conductors representing 1350 O Temper aluminum material in accordance with Specification **B609/B609M**.

**/A1**—used as a suffix modifier for ACAMCR and ACCFCR type of conductors representing 1350 H19 aluminum material in accordance with Specification **B230**.

**/A3**—used as a suffix modifier for ACAMCR and ACCFCR type of conductors representing 6201 T81 aluminum alloy material in accordance with Specification **B398/B398M**.

**/A4**—used as a suffix modifier for ACAMCR and ACCFCR type of conductors representing 6201 T83 aluminum alloy material in accordance with Specification **B398/B398M**.

**/AT3**—used as a suffix modifier for ACAMCR and ACCFCR type of conductors representing aluminum zirconium material in accordance with Specification **B941**.

**/M1**—used as a suffix modifier for ACAMCR and ACAMCS type of conductors representing an Aluminum Matrix Composite (AMC) core in accordance with Specification **B976**. Future suffix modifiers may be defined at a later date to identify additional types of metal matrix composite material.

**/CS1**—used as a suffix modifier for ACCFCR and ACCFCS type of conductors representing Regular Strength Carbon Fiber Thermoset Polymeric Matrix core in accordance with Specification **B987/B987M**.

**/CS2**—used as a suffix modifier for ACCFCR and ACCFCS type of conductors representing High Strength Carbon Fiber Thermoset Polymeric Matrix core in accordance with Specification **B987/B987M**.

**/CS3**—used as a suffix modifier for ACCFCR and ACCFCS type of conductors representing Extra High Strength Carbon Fiber Thermoset Polymeric Matrix core in accordance with Specification **B987/B987M**.

**/CP1**—used as a suffix modifier for ACCFCR and ACCFCS type of conductors representing Regular Strength Carbon Fiber Thermoplastic Polymeric Matrix.

**/CP2**—used as a suffix modifier for ACCFCR and ACCFCS type of conductors representing High Strength Carbon Fiber Thermoplastic Polymeric Matrix.

#### 5. Terminology

##### 5.1 Definitions:

**aeolian vibration**, *n*—resonant vibration of a conductor caused by the alternate shedding of wind-induced vortices from opposite sides of the conductor. (Frequency is usually less than 200 Hz and amplitude rarely exceeds one conductor diameter.)

**anneal (annealing)**, *n*—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.

*annealed wire*, *n*—see **soft wire**.

**area density**, *n*—mass per unit area.

**bare conductor**, *n*—a conductor having no nonmetallic covering.

**brazing**, *v*—the joining of ends of two wires, rods, or groups of wires with a nonferrous filler metal at temperatures above 800 °F (427 °C).

**breaking strength**, *n*—the maximum load that a conductor attains when tested in tension to rupture.

**bunch-stranded conductor**, *n*—a conductor composed of wires twisted together with a given length and direction of lay in such manner that the respective wires at successive cross sections along the length of the conductor do not necessarily form a symmetrical geometric pattern, nor necessarily occupy the same positions relative to each other.

**casting, continuous**, *n*—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.

**check**, *n*—a small surface blemish on the material that does not reduce its performance.

**circular mil (cmil)**, *n*—a unit of area equal to the area of a circle one mil (0.001 in., 0.0254 mm) in diameter. The area of a circle in circular mils is equal to the square of the diameter in mils (area(cmils) = diameter(mils)<sup>2</sup>), 1 cmil =  $7.854 \times 10^{-7}$  in.<sup>2</sup> ( $5.067 \times 10^{-10}$  m<sup>2</sup>).

**clad wire**, *n*—wire comprised of a given metal covered with a relatively thick application of a different metal. The bonding process is normally a combination of heat and pressure and results in a metallurgical bond.

**coated wire**, *n*—wire comprised of a given metal covered with a relatively thin application of a different metal. The coating process is normally electroplating or dip coating.

**coil**, *n*—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.

**cold-drawing**, *v*—reducing the cross section by pulling through a die or dies, at a temperature lower than the recrystallization temperature.

**cold work**, *n*—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.

**combination stranded conductor**, *n*—a conductor constructed with wires of different diameters with such differences occurring either within a single layer or from layer to layer.

**compact stranded conductor**, *n*—a unidirectional or unilay or conventional concentric conductor, constructed with a cen-

tral core surrounded by one or more layers of helically laid wires and formed into final shape by rolling, drawing, or other means; and manufactured to a specified nominal diameter, approximately 8 to 10 % below the nominal diameter of a conventional non-compact conductor of the same cross-sectional area.

**compressed stranded conductor**, *n*—a unidirectional or unilay or conventional concentric conductor manufactured to a specified nominal diameter 3 % less than the calculated diameter of non-compressed conductor of the same construction and cross-sectional area.

**composite conductor**, *n*—a conductor consisting of two or more types of wire, each type of wire being plain, clad, or coated; stranded together to operate mechanically and electrically as a single conductor.

**concentric-lay conductor**, *n*—conductor constructed with a central core surrounded by one or more layers of helically laid wires. Several types are as follows:

*compact round conductor*, *n*—see **compact stranded conductor**.

*conventional concentric conductor*, *n*—conductor constructed with a round central core surrounded by one or more layers of helically laid round wires. The direction of lay is reversed in successive layers, and generally with an increase in length of lay for successive layers.

*equilay conductor*, *n*—conductor constructed with a central core surrounded by more than one layer of helically laid wires, all layers having a common length of lay, direction of lay being reversed in successive layers.

*parallel core conductor*, *n*—conductor constructed with a central core of parallel-laid wires surrounded by one layer of helically laid wires.

*rope-lay conductor*, *n*—conductor constructed of a bunch-stranded or a concentric-stranded member or members, as a central core, around which are laid one or more helical layers of such members.

*unidirectional conductor*, *n*—conductor constructed with a central core surrounded by more than one layer of helically laid wires, all layers having a common direction of lay, with increase in length of lay for each successive layer.

*unilay conductor*, *n*—conductor constructed with a central core surrounded by more than one layer of helically laid wires. All layers having a common direction of lay and essentially similar length of lay, which is a multiple of the outer diameter of the finished conductor, for each successive layer. The lay length of the inner layers shall not vary by more than  $\pm 10$  % of the lay length of the outer layer.

**conductivity**, *n*—the measure of a material’s ability to conduct an electric current between two points. Conductivity is inversely related to resistivity and typically expressed as % IACS. Annealed copper is defined as 100 % IACS and other conductivity values are reported relative to annealed copper.

**conductor**, *n*—a wire or combination of wires not insulated from one another, suitable for carrying an electric current.

**conductor core**, *n*—the center strand or member about which one or more layers of wires or members are laid helically to form a concentric-lay.

**continuous cast drawing stock**, *n*—the as-rolled section, normally round, produced by a continuous casting and rolling process.

*core*, *n*—see **conductor core**.

**cored, annular, conductor**, *n*—a conductor in which one or more layers of wires are laid helically around a central core of metallic or nonmetallic material. The core is used as a mandrel for the application of subsequent layers of wire to maintain consistent spacing of these members around the conductor axis.

**direction of lay**, *n*—the lateral direction, designated as left-hand or right-hand, in which the wires of a member or units of a conductor run over the top of the member or conductor as they recede from an observer looking along the axis of the member or conductor.

**drawing stock**, *n*—the as-rolled or extruded section, normally round, made from any of a variety of manufacturing processes, intended as feed stock for subsequent drawing operations.

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

**electric-butt, cold-upset weld**, *n*—a weld between two prepared ends of adjacent lengths of work-hardenable material that is pressed together in a resistance welding apparatus which melts the abutting ends to unite them and form the weld. In turn, the resulting weld zone is forced out in the form of flash by a cold-upsetting operation which, through cold-working, restores the material substantially to its original tensile strength.

*equilay conductor*, *n*—see **concentric-lay conductor**.

**fill factor**—the ratio of the weight of a given length of a stranded conductor to the weight of the solid conductor of the same diameter, length, and material. It may also be expressed by the ratio of the nominal area of the conductor times (1 plus the stranding factor) and the area of the circle that encloses the strands of the conductor.

**flat wire**, *n*—a product up to and including 0.188 in. (4.78 mm) in thickness and up to and including 1¼ in. (31.8 mm) in width.

**galvanized steel wire**, *n*—steel wire coated with zinc.

**half-hard wire**, *n*—as applied to aluminum, wire that has been processed so as to produce a strength approximately midway between that of soft wire and that of hard-drawn wire.

**hard-drawn wire**, *n*—as applied to aluminum and copper, wire that has been cold drawn to final size so as to approach the maximum tensile strength obtainable.

**hot-rolled drawing stock**, *n*—the as-rolled section, normally round, produced by hot rolling in a rod mill from a billet or wire bar.

**intermediate temper**, *n*—as applied to aluminum, any temper between soft and hard drawn.

**joint**, *n*—that portion of the conductor where the ends of two wires, rods, or groups of wires are joined by brazing, soldering, welding, or by mechanical means.

**lay**<sup>4</sup>, *n*—one turn of the helix of a wire or member of a standard conductor. See also **direction of lay** and **length of lay**.

**lay**, *v*—to arrange the wires or members of a conductor either by twisting them or by forming them into one or more layers helically applied.

**lay factor**, *n*—the ratio of the length of lay to the external diameter of the corresponding layer of wires or members in the stranded conductor.

**length of lay**, *n*—the axial length of one turn of the helix of a wire or member.

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

**linear density**, *n*—mass per unit length.

**liquor-finished wire**, *n*—wire, usually of ferrous material, drawn through a wet solution of metallic salts, that is, tin or copper, to facilitate drawing and to enhance the appearance and surface characteristics of the finished wire, and not to provide the properties of a coated wire.

**magnet wire**, *n*—a nonferrous electrical core conductor containing an insulating film or dielectric that creates a magnetic field for converting electrical energy into useful mechanical work.

**medium-hard drawn wire**, *n*—as applied to copper wire, having tensile strength less than the minimum for hard-drawn wire, but greater than the maximum for soft wire.

**member**, *n*—a group of wires stranded together for combination with other stranded groups into a multiple-membered conductor.

**messenger wire**, *n*—a metallic supporting member either solid or stranded which may also perform the function of a conductor.

**mil**, *n*—a unit of length equal to 1/1000 of an inch [0.0254 mm].

**nominal**, *adj*—name or identifying value of a measurable property by which a conductor or component or property of a conductor is identified, and to which tolerances are applied.

**non-specular (NS)**, *n*—nonreflective matte grey surface finish for aluminum conductors.

**oxygen free copper**, *n*—a highly conductivity copper that has been produced in such manner as to contain no oxide or residual deoxidants. It has very high resistance to hydrogen embrittlement (Copper Nos. C10200, C10300).

*parallel-core conductor*, *n*—see **concentric-lay conductor**.

<sup>4</sup> From or adapted from American National Standard Definitions of Electrical Terms (ANSI C42.35—1957) published by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., P.O. Box 1331, Piscataway, NJ 08854-1331.