

# TERMINOLOGY

**SCOPE:** The following list of terms is associated primarily with wrought aluminum products (and their production) which form the basis of most of the information found in Aluminum Standards and Data. The list is not intended to include every term likely to be used within the aluminum industry.

## A

**Aging** - Precipitation from solid solution resulting in a change in properties of an alloy, usually occurring slowly at room temperature (natural aging) and more rapidly at elevated temperatures (artificial aging).

**Alclad** - An aluminum or aluminum-alloy coating that is metallurgically bonded to either one or both surfaces of an aluminum alloy product, and that is anodic to the alloy to which it is bonded, thus electrolytically protecting the core alloy against corrosion. For Alclad products, see specific product such as "Plate," "Sheet," "Tube" or "Wire."

**Alloy** - A substance having metallic properties and composed of two or more elements of which at least one is an elemental metal.

**Annealing** - A thermal treatment to soften metal by removal of stress resulting from cold working or by coalescing precipitates from solid solution.

**Anodizing** - Forming a coating on a metal surface produced by electrochemical treatment through anodic oxidation.

## B

**Bar** - A solid wrought product that is long in relation to its cross-section which is square or rectangular (excluding plate and flattened wire) with sharp or rounded corners or edges, or is a regular hexagon or octagon, and in which at least one perpendicular distance between parallel faces is 0.375 inch or greater.

**Bar/Rod INTERNATIONAL DEFINITION** - Includes all solid wrought products in straight lengths which are not profiles, which have uniform cross-section along their length and whose width to thickness ratio is less than 10.

**Bar, Cold-Finished** - Bar brought to final dimensions by cold work to obtain improved surface finish and dimensional tolerances.

**Bar, Cold-Finished Extruded** - Cold-finished bar produced from extruded bar.

**Bar, Cold-Finished Rolled** - Cold-finished bar produced from rolled bar.

**Bar, Extruded** - Bar brought to final dimensions by hot extruding.

**Bar, Rolled** - Bar brought to final dimensions by hot rolling.

**Bar, Saw-Plate** - Bar brought to final thickness by hot or cold rolling and to final width by sawing.

**Billet** - A hot worked semi-finished product suitable for subsequent working by such methods as rolling, forging, extruding, etc.

**Blank** - A piece of metal cut or formed to regular or irregular shape for subsequent processing such as by forming, bending or drawing. The piece of sheet stock cut out by blanking die. It will subsequently be drawn into a cup or end shell.

**Brazing** - Joining metals by fusion of nonferrous alloys that have melting points above 425°C (800°F) but lower than those of the metals being joined. This may be accomplished by means of a torch (torch brazing), in a furnace (furnace brazing), or by dipping in a molten flux bath (dip or flux brazing).

**Buffing** - A mechanical finishing operation in which fine abrasives are applied to a metal surface by rotating fabric wheels for the purpose of developing a lustrous finish.

**Burr** - A thin ridge of roughness left by a cutting operation such as slitting, trimming, shearing, blanking or sawing.

**Bursting Strength** - The pressure required to rupture a foil specimen when it is tested in a Mullen instrument under specified conditions. See also "Mullen Test."

## C

**Center** - The difference in thickness between the middle and edges (average) of a sheet.

**Chop** - Metal sheared from a vertical surface of a die forging, which is spread by the die over an adjoining horizontal surface.

**Coating** - Continuous film on the surface of a product.

**Coating, High or Low** - Failure of the coating to meet the agreed upon thickness limits measured in weight per unit area.

**Coil Orientation** - Clockwise Coil: With the coil core vertical ("eye to the sky") and viewed from above, a trace of the metal edge from the ID to the OD involves clockwise movement. Counter-Clockwise (Anti-Clockwise) Coil: With the coil core vertical ("eye to the sky") and viewed from above, a trace of the metal edge from the ID to the OD involves counter-clockwise (anti-clockwise) movement.

**Cold Working** - Plastic (i.e., permanent) deformation of metal at such temperature and rate that strain-hardening occurs.

**Coloring** - A finishing process, or combination of processes, which alters the appearance of an aluminum surface via coating, chemical and/or mechanical operations.

**Concentricity** - Conformance to a common center as, for example, the inner and outer walls of a round tube.

**Corner Turn-up** - A distortion, buckle or twist condition that causes the corner(s) of the sheet to deviate from a perfectly flat plane on which it rests.

**Corrosion** - The deterioration of a metal by chemical or electrochemical reaction with its environment.

**Coupon** - A piece of metal from which a test specimen may be prepared.

**Crazing** - A macroscopic effect of numerous surface tears, transverse to the rolling direction, which can occur when the entry angle into the cold mill work rolls is large.

### D

**Deep Drawing** - Forming a deeply recessed part by forcing sheet metal to undergo plastic flow between dies, usually without substantial thinning of the sheet.

**Die Line** - A longitudinal depression or protrusion formed on the surface of drawn or extruded material. Die lines are present to some degree in all extrusions and are caused by a roughening of the die bearing.

**Die Number** - The number assigned to a die for identification and cataloging purposes, which usually is assigned for the same purpose to the product produced from that die.

**Drawing** - (1) In forging, an operation of working metal between flat dies to reduce the cross-section and increase length. (2) The process of pulling material through a die to reduce the size, change the cross-section or shape, or harden the material.

**Drawing Stock** - A hot worked intermediate solid product of uniform cross-section along its whole length, supplied in coils and of a quality suitable for drawing into wire.

**Drawn Product** - A product formed by pulling material through a die.

**Ductility** - The property that permits permanent deformation before fracture by stress in tension.

### E

**Ears** - Wavy symmetrical projections formed in the course of deep drawing or spinning as a result of directional properties or anisotropy in sheet. Ears occur in groups of 4 or 8 with the peaks of the projections located at 45 degrees and/or at 0 and 90 degrees to the rolling direction. Degree of earing is the difference between average height at the peaks and average height at the valleys, divided by average height at the valleys, multiplied by 100 and expressed in percent.

**Elongation** - The percentage increase in distance between two gauge marks that results from stressing the specimen in tension to fracture. The original gauge length is usually two inches for flat specimens and round specimens whose diameter is 1/2 inch, or four times the diameter for specimens where that dimension is under 1/2 inch. Elongation values depend to some extent upon size and form of the test specimen. For example, the values obtained from sheet specimens will be lower for thin sheet than for thicker sheet.

**Extrusion** - A product formed by pushing material through a die.

**Extrusion Billet** - The starting stock for the extrusion operation. Extrusion billet is a solid or hollow form, commonly cylindrical and is the length charged into the extrusion press cylinder. It is usually a cast product but may be a wrought product or powder compact.

**Extrusion Ingot** - A cast form that is solid or hollow, usually cylindrical, suitable for extruding. See also "Fabricating Ingot."

**Extrusion Log** - The starting stock for extrusion billet. Extrusion log is usually produced in lengths from which shorter extrusion billets are cut.

**Extrusion Seam** - A region in extruded hollow profiles observed after creating two streams of metal and rejoining them around the mandrel of a porthole or bridge die.

**Eyehole** - See "Holiday."

### F

**Fabricating Ingot** - A cast form suitable for subsequent working by such methods as rolling, forging, extruding, etc. ("Rolling Ingot," "Forging Ingot," & "Extrusion Ingot.")

**Fatigue** - The tendency for a metal to break under conditions of repeated cyclic stressing considerably below the ultimate tensile strength.

**Flash** - A thin protrusion at the parting line of a forging which forms when metal, in excess of that required to fill the impressions, is forced between the die interfaces.

**Flatness** - (1) For rolled products, a distortion of the surface of sheet such as a bulge or a wave, usually transverse to the direction of rolling. Often described by location across width, i.e., edge buckle, quarter buckle, center buckle, etc. (2) For extrusions, flatness (off contour) pertains to the deviation of a cross-section surface intended to be flat. Flatness can be affected by conditions such as die performance, thermal effects and stretching.

**Foil** - A rolled product rectangular in cross-section of thickness less than 0.006 inch. In Europe, foil is equal to and less than 0.20 mm.

**Forging** - A metal part worked to a predetermined shape by one or more processes such as hammering, upsetting, pressing, rolling, etc.

**Forging Billet** - The term “Forging Stock” is preferred.

**Forging Ingot** - A cast form intended and suitable for subsequent working by the forging process.

**Forging Stock** - A wrought or cast rod, bar or other section suitable for forging.

**Forging, Blocker-Type** - A forging made in a single set of impressions to the general contour of a finished part.

**Forging, Cold-Coined** - A forging that has been restruck cold in order to obtain closer dimensions, to sharpen corners or outlines and in non-heat-treatable alloys, to increase hardness.

**Forging, Die** - A forging formed to the required shape and size by working in impression dies.

**Forging, Precision** - A forging produced to tolerances closer than standard.

**Formability** - The relative ease with which a metal can be shaped through plastic deformation.

**Fracture Toughness** - A generic term for measure of resistance to extension of a crack. The term is sometimes restricted to results of a fracture mechanics test, which is directly applicable in fracture control.

## G

**Gauge** - A term previously used in referring to the thickness of a wrought product. Thickness is preferred in dimension description.

**Grain Flow** - The directional characteristics of the metal structure after working, revealed by etching a polished section.

## H

**Hardness** - Resistance to plastic deformation, usually by indentation. The term may also refer to stiffness or temper, or to resistance to scratching, abrasion or cutting. Brinell Hardness: Brinell hardness of aluminum alloys is obtained by measuring the permanent impression in the material made by a ball indenter 10 millimeters in diameter after loading with a 500 kilogram-force for 15 seconds and dividing the applied load by the area of the impression. Rockwell Hardness: An indentation hardness test based on the depth of penetration of a specified penetrator into the specimen under certain arbitrarily fixed conditions.

**Heat Treating** - Heating and cooling a solid metal or alloy in such a way as to obtain desired conditions or properties. Commonly used as a shop term to denote a thermal treatment to increase strength. Heating for the sole purpose of hot working is excluded from the meaning of this definition—see “Solution Heat Treating,” “Aging.”

**Heat-Treatable Alloy** - An alloy which may be strengthened by a suitable thermal treatment.

**Homogenizing** - A process whereby ingots are raised to temperatures near the solidus temperature and held at that temperature for varying lengths of time. The purposes of this process are to (1) reduce microsegregation by promoting diffusion of solute atoms within the grains of aluminum and (2) improve workability.

## I

**Impact** - A part formed in a confining die from a metal slug, usually cold, by rapid single stroke application of force through a punch, causing the metal to flow around the punch and/or through an opening in the punch or die.

**Inclusion** - Foreign material in the metal or impressed into the surface.

**Ingot** - A cast form suitable for remelting or fabricating. See “Remelt Ingot,” “Fabricating Ingot,” “Extrusion Ingot,” “Forging Ingot,” “Rolling Ingot.”

## L

**Leveling, Tension** - Leveling continuously carried out by uniaxial stretching usually with the assistance of bending.

**Leveling, Thermal** - Leveling carried out at an elevated temperature under an applied load normal to the surface to be flattened.

**Lot, Heat-Treat** - Material of the same mill form, alloy, temper, section and size traceable to one heat-treat furnace load (or extrusion charge or billet in the case of press heat-treated extrusions) or, if heat treated in a continuous furnace, charged consecutively during an 8-hour period.

## M

**Mark** - Damage in the surface of the product whose name is often described by source.

**Mechanical Properties** - Those properties of a material that are associated with elastic and inelastic reaction when force is applied, or that involve the relationship between stress and strain; for example, modulus of elasticity, tensile strength, endurance limit. These properties are often incorrectly referred to as physical properties.

**Minimum Residual Stress (MRS)** - The term applied to products, usually flat rolled, which have been processed to minimize internal stress of the kind that causes distortion when material is disproportionately removed from one of the two surfaces through mechanical or chemical means.

**Mullen Test** - Measurement of bursting strength of foil in pounds per square inch. Testing machine applies increasing pressure to one square inch of the sample until it ruptures.

## N

**Non-Heat-Treatable Alloy** - An alloy which can be strengthened only by cold work.

## P

**Pit** - A depression in the rolled surface which is usually not visible from the opposite side.

**Plate** - A rolled product that is rectangular in cross section and with thickness not less than 0.250 inch with sheared or sawed edges.

**Preheating** - A high temperature soaking treatment to provide a desired metallurgical structure. Homogenizing is a form of preheating.

**Profile** - A wrought product that is long in relation to its cross-sectional dimensions which is of a form other than that of sheet, plate, rod, bar, tube, wire or foil.

## Q

**Quenching** - Controlled rapid cooling of a metal from an elevated temperature by contact with a liquid, a gas or a solid.

## R

**Redraw Rod** - This term is not recommended. The term "Drawing Stock" is preferred.

**Rod/Bar INTERNATIONAL DEFINITION** - Includes all solid wrought products in straight lengths which are not profiles, which have uniform cross-section along their length and whose width to thickness ratio is less than 10.

**Rod, Cold-Finished** - Rod brought to final dimensions by cold working to obtain improved surface finish and dimensional tolerances.

**Rod, Extruded** - Rod produced by hot extruding.

**Rolling Ingot** - A cast form suitable for rolling. See "Fabricating Ingot."

**Rolling Slab** - A rectangular semifinished product, produced by hot rolling fabricating ingot and suitable for further rolling.

## S

**Sample** - A part, portion or piece taken for purposes of inspection or test as representative of the whole.

**Scalping** - Mechanical removal of the surface layer from a fabricating ingot or semi-finished wrought product so that surface imperfections will not be worked into the finished product.

**Seam, Extrusion** - The junction line of metal that has passed through a bridge or porthole hollow die, separated and rejoined at the weld point. Seams are present in all such extruded hollows and in many cases are not readily visible. See "Seamless" and "Weld, Incomplete."

**Seamless** - A hollow product which does not contain any line junctures resulting from method of manufacture.

**Sheet** - A rolled product that is rectangular in cross-section with thickness less than 0.250 inch but not less than 0.006 inch and with slit, sheared or sawed edges.

**Sheet, Coiled** - Sheet in coils with slit edges.

**Sheet, Coiled Cut to Length** - Sheet cut to specified length from coils and which has a lesser degree of flatness than flat sheet.

**Sheet, Flat** - Sheet with sheared, slit or sawed edges, which has been flattened or leveled.

**Sheet, Mill Finish (MF)** - Sheet having a non-uniform finish that may vary from sheet to sheet and within a sheet, and may not be entirely free from stains or oil.

**Sheet, One Side Bright Mill Finish (1SBMF) -**

Sheet having a moderate degree of brightness on one side and a mill finish on the other.

**Sheet, Standard One Side Bright Finish (S1SBF) -**

Sheet having a uniform bright finish on one side and a mill finish on the other.

**Sheet, Standard Two Sides Bright Finish (S2SBF) -**

Sheet having a uniform bright finish on both sides.

**Solution Heat Treating** - Heating an alloy at a suitable temperature for sufficient time to allow soluble constituents to enter into solid solution where they are retained in a supersaturated state after quenching.

**Stabilizing** - A low temperature thermal treatment designed to prevent age-softening in certain strain-hardened alloys containing magnesium.

**Streak (Stripe)** - A superficial band or elongated mark which produces a non-uniform surface appearance. A streak is often described by source.

## T

**Temper** - The condition produced by either mechanical or thermal treatment, or both, and characterized by a certain structure and mechanical properties.

**Tensile Strength** - In tensile testing, the ratio of maximum load to original cross-sectional area. Also called "Ultimate Strength."

**Tool** - A term usually referring to the dies, mandrels, etc., used in the production of extruded or drawn profiles or tube.

**Tube** - A hollow wrought product that is long in relation to its cross section, which is symmetrical and round, a regular hexagon or octagon, elliptical, or square or rectangular with sharp or rounded corners, and that has uniform wall thickness except as affected by corner radii.

**Tube, Drawn** - A tube brought to final dimensions by cold drawing through a die. (Note: This product may be produced from either seamless or non-seamless extruded stock or from welded stock.)

**Tube, Extruded** - A tube formed by hot extruding. (Note: This product may be either seamless or non-seamless.)

**Tube, Seamless** - A tube that does not contain any line junctures (metallurgical welds) resulting from the method of manufacture. (Note: This product may be produced by die and mandrel or by hot piercer processes. Tube produced by porthole die extrusion, bridge die extrusion or welding processes are generally considered "Non-Seamless.")

**Twist** - (1) For rolled products, a winding departure from flatness. (2) For extrusions, a winding departure from straightness.

## W

**Wire** - A solid wrought product that is long in relation to its cross section, which is square or rectangular with sharp or rounded corners or edges, or is round, hexagonal, or octagonal, and whose diameter or greatest perpendicular distance between parallel faces is less than 0.375 inch.

**Wire, Drawn** - Wire brought to final dimensions by drawing through a die.

**Wire, Extruded** - Wire produced by hot extruding.

**Workability** - The relative ease with which various alloys may be formed by rolling, extruding, forging, etc.

**Wrought Product** - A product that has been subjected to mechanical working by such processes as rolling, extruding, forging, etc.

## Y

**Yield Strength** - The stress at which a material exhibits a specified permanent set. The offset used for aluminum and its alloys is 0.2 percent of gauge length.