Abrasions: Light marks or scuffs on the metal surface generally caused by handling or packing materials.

Artificial Aging: An aging process that results in increased strength and hardness using a heating oven.

Age Softening: A sudden decrease of strength and hardness that takes place at room temperature in certain strain hardened alloys containing magnesium.

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)

Alloy: A substance with metallic properties composed of two or more chemical elements of which at least one is a metal. Aluminum plus one or more other elements, produced to have certain specific desirable characteristics.

Alumina: Aluminum oxide produced from bauxite by a complicated chemical process. It is a white powdery material that looks like granulated sugar. Alumina is an intermediate step in the production of aluminum from bauxite.

Aluminum: A silver-white soft metal, noted for its lightness, high reflectivity, high thermal conductivity, nontoxicity, and corrosion resistance. It is the most abundant metallic element, comprising about 1/12th of the earth’s crust. It is never found in nature as an elemental metal, but only in combination with oxygen and other elements. In ordinary commercial and industrial use, the word aluminum is often understood to mean aluminum alloy, rather than the pure metal.

Aluminum Oxide: A chemical compound of aluminum with oxygen, which forms immediately on an unprotected aluminum surface exposed to air. Aluminum Oxide does not flake off, but forms a protective layer that blocks further oxidation and so protects the integrity of the metal. It is transparent and does not alter the appearance of the aluminum surface.

Anodic Film: The aluminum oxide layer created after anodizing. Created by electrochemical treatment through anodic oxidation. This process may be used to increase the protective effect of aluminum’s transparent natural oxide surface. This film may also be different colors.

Bauxite: One of the ores from which alumina is extracted and from which aluminum is eventually smelted. Bauxite usually contains at least 45 percent aluminum oxide, and the best grades have a low silica content. About 4 pounds of bauxite is required to produce 1 pound of aluminum.

Billet: Commonly a cylindrical form of the aluminum alloy used in the extrusion press. Formed at casting houses, and shipped either in long logs or cut into specific lengths for extrusion press applications.

Blister: A raised area on the surface of an extruded product due to subsurface gas expansion during extrusion or thermal treatment.

Blistering: A defect in the paint film appearing as bubbles, usually caused by the expansion of air, solvent vapor, or moisture trapped beneath the film.
Bow: Longitudinal curvature of rod, bar, shapes, and tube. Bow is measured after allowing the weight of the extrusion to minimize the deviation. Bow can be caused by a non-uniform extrusion rate across the cross section resulting in one portion of the extrusion being longer than the other or non-uniform contraction during quenching.

Bright Dip: Chemical polishing of aluminum, often by treatment with a mixture of nitric acid and phosphoric acid, yielding a mirror like highly reflective surface. It is almost always followed by anodizing to protect the surface and provide some choice of colors.

Buffing: Mechanical finishing in which fine abrasives are applied to a metal surface by rotating fabric wheels for the purpose of applying a lustrous finish.

Burrs: A thin ridge of roughness left by a cutting operation such as trimming, shearing, sawing, and machining.

Caustic: The active ingredient in an alkaline bath, generally with a pH higher than 10, which removes aluminum from used extrusion dies by etching. The primary ingredient, caustic Soda, dissolves the aluminum alloy by chemical reactions with no affect on the steel die.

Cellular Manufacturing: Method of laying out a manufacturing facility or area that optimizes flow of the product that creates the least waste in processing time, scrap material, motion and/or storage space.

Chatter: A surface defect consisting of alternating ridges and valleys at right angles to the direction of extrusion.

Chemical Polishing: Improving the surface luster of the aluminum surface by chemical treatment.

Circumscribing Circle: The smallest circle that will completely enclose the cross section of an extruded shape.

Concentricity: Conformance to a common center.

Conductivity: The ability of a substance to transmit heat, light or electricity. Aluminum has a high electrical and thermal conductivity, making it useful in a wide range of electrical and heat-exchanging applications.

Conversion Coating: Chemical layer formed on the metal in the pre-treatment process which aids in paint adhesion and corrosion resistance.

Corrosion: The deterioration of metal by chemical or electrochemical reactions with substances in the environment.

Corrosion Galvanic: Two dissimilar conductors in an electrolyte or two similar conductors in dissimilar electrolytes. Aluminum will corrode if it is anodic to the dissimilar metal.

Corrosion Intergranular: Corrosion occurring at grain boundaries.

Corrosion Pitting: Localized corrosion resulting in small pits or craters in the aluminum surface.
Corrosion Stress Cracking: cracking resulting from selective directional attack caused by the simultaneous interaction of sustained tensile stress at an exposed surface with the chemical or electro-chemical effects of the surface environment.

Corrosion Water Stain: Superficial oxidation of the surface with a water film, in the absence of circulating air, held between closely adjacent metal surfaces.

Cryogenic: Very low temperatures. Aluminum gains strength as temperature is reduced, making it an appropriate material for cryogenic applications.

Deburring: Removing burrs, sharp edges, or fins from metal parts by filing, grinding, or tumbling in a media that removes the burrs from the aluminum.

Die: An extrusion tool with an opening through which heated aluminum is forced by pressure creating the shape of the opening in the die.

Die Assembly: An extrusion press will use associated tooling to hold the die in place in the press itself.

Die Holder: The press components that are located between the container and press platen to retain the extrusion die and its components. It may take many different forms and added functions depending upon its design.

Die Hollow: A steel extrusion tool which forms extruded closed profiles containing one or more voids such as rectangular tubing. The tool often consists of a die cap which generates the outer surface of the profile and the mandrel or core which generates the inside contour. Hollow or semi-hollow profiles are produced usually with either bridge, porthole or spider type dies. Extruded sections produced on such dies have seams or longitudinal weld lines due to the metal flow around the web supports that hold the mandrel. The latter determines the inside contour of the profile being extruded. After flowing around the supports, the metal is fused in a weld chamber before passing through the die.

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, and which usually is assigned for the same purpose to the product produced from that die.

Die Ring: A cylindrical sleeve that holds the die and backer in axial relationship to each other.

Die Semihollow: A circular steel extrusion tool which forms an open profile with a high tongue ratio. Generally this tongue ratio is greater than three to one. This type of die is similar to a hollow die. The tongue is protected by a web or bridge which reduces the billet pressure. When possible, for maximum support the tongue should be bolted to the web.

Die Slide: The extrusion press component located between the container and press platen. It supports, aligns to the press and retains the tooling (die, backer, bolster, sub-bolster, etc.) for the specified profile, as a unit. It may be designed to facilitate butt shearing and to provide die accessibility for replacement and repairing.
Die Solid: A steel disk, with one or more orifices of similar cross-section and contour as the desired product, through which metal is forced forming open profiles such as bar, channel and angle.

Die Stop: A defect resembling a weld around the entire extruded section, caused by stopping a press during extrusion and then restarting it.

Die Tool Assembly: The various components making up the assembly within the tool carrier or Die Slide. A typical example would be (from front to rear) a die and backer enclosed in a die ring, bolster and possibly a sub-bolster or spacer.

Die Weld: A region in extruded hollow profiles created by two streams of metal within the die joining them in the weld chamber around the mandrel of a hollow type die. Die welds are generally present in all extruded hollow profiles and in most cases are not visible.

Dove-tail: An interlocking connection frequently used for the assembly of interconnecting extrusions.

Double-cut: When a billet of aluminum is too long for intended product and extrusion must be cut by the puller system, while continuing to extrude more product. This can cause material to sometimes stretch more than desired and can result in the aluminum having a grainy appearance when anodized.

Ductility: The property that permits permanent deformation before fracture by stress in the tension.

Eccentricity: Deviation from a common center, for example, the inner and outer walls of a round tube. The difference between the mean wall thickness and minimum or maximum wall thickness at any one cross section. The permissible degree of eccentricity can be expressed by a plus and minus wall-thickness tolerance.

Electrical Conductivity: The capacity of a material to conduct electric current. For aluminum, this capacity is expressed as a percentage of the International Annealed Copper Standard (IACS), which has a resistivity of 1/58 ohm-mm2/meter at 68°F and an arbitrarily designated conductivity of unity.

Electrical Resistivity: The electrical resistance of a body of unit length and unit cross-sectional area or unit weight. The value of 1/58 ohm-mm2/meter at 68°F is the resistivity equivalent to the International Annealed Copper Standard for 100 percent conductivity.

Electrostatic Spraying: Application of a coating by applying a static electricity charge to the droplets of a spray and an opposite charge to the part being sprayed, which then attracts the droplets directly to its surface.

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 2 inches for flat specimens and round specimens whose diameter is 0.5 inch, or four times the diameter for specimens where that dimension is under 0.5 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.

Etching: Shaping or texturing a metal surface by controlled corrosive action.
Exposed Surface: Any face of an extruded profile which is exposed to view or other critical end-use aspects, such as an area with a high surface finish requirement.

Extrude: To force material through a die by pressure.

Extrusion Direct: Method of extruding where the die and ram are at opposite ends of the billet and the product and ram travel in the same direction.

Extrusion Indirect: Method of extruding where the die is at the ram end of the billet and the product travels through the hollow ram and in the opposite direction.

Fabrication: To work a material into a finished state by machining, forming or joining.

Feeder Plate: Plate employed in front of the extrusion die to alter the metal billet dimensions permitting extrusion of larger dimensioned product than normally possible or to assist in extrusion of difficult profiles.

Fillet: Concave junction where two surfaces meet.

Film Thickness: The depth of applied coating, expressed in mils, 1/1000 inch.

Fisheye: A defect in the paint film appearing as a circular depression resembling a crater but not revealing bare substrate.

Fit: The range of clearance or interference between mating parts. The American Standards Association recognizes 33 classes of fits ranging from loose sliding fit to tight force fit.

Flatness: For extrusions, flatness 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.

Flow: A term used when referring to the movement of aluminum through the die during the extrusion process.

Flow Line: Lines on the surface of painted sheet, brought about by incomplete leveling of the paint. The line pattern revealed by etching, which shows the direction of plastic flow on the surface or within a wrought structure.

Formability: The relative ease with which a material can be shaped through plastic deformation.

Forming: Changing the shape of metal except by shearing or blanking without intentionally altering its thickness.

Galvanic Corrosion: Deterioration of a metal caused by the electric current produced when two unlike metals are in contact under certain conditions.

Galvanizing: An undesirable grainy or spangled condition on the surface of etched or anodized extrusions. This condition is not obvious in mill finish aluminum extrusions but can be revealed by etching or anodizing.
Gloss: The degree to which a surface reflects light, generally, the smoother the surface, the higher the gloss.

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

Grain Size: A measure of crystal size, usually reported in terms of average diameter in millimeters, grains per square millimeter, or grains per cubic millimeter.

Hard Coat Anodizing: A combined electrical and chemical finishing process for aluminum that produces a hard, colored, protective film on the surface.

Hardening: Increasing the hardness of metal by suitable treatment, usually involving heating and cooling.

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.

Heat-Treatable Alloy: An aluminum alloy that can be hardened to produce desired properties by a controlled cycle of heating and cooling.

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.

Hinge Joint: A joint which, when assembled, allows its parts to rotate relative to each other without separating. Hinge joints are extruded as relatively loose slip-fit joints with an open-sided ball-in-socket design.

Hollow Billet: A billet prepared for extruding seamless tube or pipe. The outside diameter may be scalped and the inside diameter may be bored or cast hollow to assure sound metal.

Hollow Dies: Extrusion tools capable of forming profiles with voids where such dies are typically classified as either bridge, porthole, or spider types. Extruded sections produced on these dies have one or more seams or longitudinal weld lines, due to metal flow around the supports that hold the stub mandrel. The stub mandrel determines the inside contour of the section being extruded. After passing around the supports, the metal is fused in a weld chamber before passing through the die proper.

Hollow Profile: An extruded profile, where any part of the cross section completely encloses a void.

Homogenizing: Is 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.

Hot Tears: Transverse surface scars or separations along the length of the extruded profile caused by excess speed and/or temperature.
Hot Spot: Dark grey or black surface patches appearing after anodizing. These areas are usually associated with lower hardness and coarse magnesium silicide precipitate caused by non-uniform cooling after extrusion.

Inclusion: Foreign material in the metal or impressed into the surface.

Interference Fit: The class of fit in which a mating part is deliberately made slightly oversized for the part into which it will be inserted.

Interlocking Joint: A joint in which a curved projection on one part is inserted by a rotating motion into a similarly curved receiving groove on the other part. The parts cannot then be separated by straight-line motion.

Kerf: The notch or slit made by a saw or torch when cutting.

Key-locked Joint: A joint with two or more primary elements which are locked together only when an additional specialized part, the key is inserted to prevent them from separating.

Keyway: A slot in the shaft of a mechanical drive system that provides a means of locking a gear or other part onto the shaft.

Lap Joint: A joint formed with one member overlapping the other.

Lapping: A method of finishing metal to produce a very smooth, highly accurate surface.

Linearity: The extent to which a measuring instrument’s response is proportional to the measured quantity.

Line Flow: The line pattern which shows the direction of flow on the surface.

Mark: A large number of very fine scratches or abrasions. A rub mark can occur by metal-to-metal contact, movement in handling and movement in transit.

Metal Dimension: Any dimension, through a part of an extruded cross-sectional shape.

Mill Finish: Mill finish is the finish obtained by standard extrusion practices and produced without the aid of any subsequent operations. This finish generally varies from a structural finish with surface imperfections to an architectural finish with uniformly good appearance.

Milling: Removing metal with a machine tool something like a CNC machine or manual mill.

Modulus of Elasticity: The ratio of stress to corresponding strain throughout the range where they are proportional. As there are three kinds of stresses, so there are three kinds of moduli of elasticity for any material — modulus in tension, in compression, and in shear.

Nesting Joints: A general class of joints with mating elements that serve to align adjoining parts with little or no self-locking action.
Nitriding: The introduction of nitrogen into the surface of tool steel by holding at a suitable temperature in contact with a nitrogenous material, usually ammonia, to produce a hard wear resistant case.

Non-Heat Treatable Alloys: Aluminum alloys that are strengthened by cold working and not by heat treatment.

O.D.: The nominal overall measurement of tube or pipe outside diameter measured across its outer perimeter because of variations in actual wall thickness, it does not necessarily indicate true dimensions at all location.

Open Space Dimension: A dimension across part of an extruded cross-sectional shape that only partially encloses a space, whose length includes more than 25 percent space, versus metal.

Orange Peel: Surface roughening on formed products which occurs when large grains in the metal are present. An irregularity in the surface of a paint film resulting from the inability of the wet film to level out, or become smooth after being applied, thus resembling the surface of an orange. This finish may be considered desirable or a defect depending on the end use.

Ovality: Deviation from a circular periphery, usually expressed as the total difference found at any one cross section between the individual maximum and minimum diameters, which usually occur at or about 90 degrees to each other. Since ovality is the difference between extreme diameters, it is not expressed as plus or minus.

Oxide: A chemical compound of oxygen with another element. Hydrated (water-including) iron oxide is called rust; it does not cling tightly to the underlying metal, so the oxidation process is progressive and iron easily rusts away. Aluminum oxide is a hard, transparent compound which clings tightly to the underlying metal and protects it against further oxidation.

Pickup: Small particles of oxide adhering to the surface of a product at irregular intervals.

Pin Gauges: Precision machined pins used for measuring. Normally available as plus, minus and net size.

Pipe: Pipe that does not contain any line junctures (metallurgical welds) resulting from the method of manufacture. This product may be produced by extruding or by drawing, using either die-and-mandrel or hot-piercer processes. (Typically used for fluid-carrying applications under pressure.)

Polishing: Smoothing a metal surface, usually by rubbing with fine abrasives. A mechanical finishing operation for the purpose of producing a gloss or luster on the surface of a product.

Porthole: A die having a stationary core or mandrel that is held in place by integral core supports or webs. The porthole die is a modification of the spider die, except that the spider is replaced with a chambered disk that supports the mandrel (sometimes termed a stub mandrel); several portholes running through it annularly about the mandrel, distinguish the porthole types. The die contains a weld chamber so that when the billet is pushed the metal divides to flow around the core supports and welds together in the welding chamber before passing through the die. Porthole dies are used in producing extruded hollow profiles and tubing.

Powder Coating: Application of a coating in the form of a finely ground powder of coloring agents, resins, and additives; heating of the part, either before or after powder deposition, fuses the powder into a continuous coating.
Pre-treatment: The chemical alteration of a surface to make it suitable for application of paint or powder. The process usually includes cleaning and applying a conversion coating.

Profile: A product that is long in relation to its cross-sectional dimensions, having a cross-section other than those of wire, rod, bar, and tube, produced by extrusion, rolling, drawing, or cold finishing. Formerly termed a shape.

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

Reflectivity: Ability of a surface to reflect light and other electromagnetic radiation. Aluminum has high reflectivity: 80% or more for visible light, and 90% or more for infrared radiation.

Rib: An elongated projection on a shape, forging or casting to provide stiffening.

Runout Table: Table at the immediate exit of press leadout equipment, which helps to guide and support the extrusion.

Salt Spray: Corrosion test using salt, sprayed as a mist in a heated humidity chamber to simulate seashore conditions, or to accelerate corrosion at a controlled rate.

Seam: The junction line of metal that has passed through a hollow die, separated, and rejoined at the exit point. Seams are present in all extruded hollows produced from the extrusion process and in many cases are not visible.

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

Snap-fit: A self-locking joint whose mating parts exert a cam action, flexing until one part slips past a raised lip on the other part, preventing their separation.

Soft Alloy: A general term loosely describing most alloys of the 1xxx, 3xxx, or 6xxx series.

Solid Dies: A steel disk with one or more orifices or apertures of the same cross-sectional area and contour as the desired product, through which metal is forced. Such dies are generally employed where profiles other than hollow are required. If solid dies are used for hollow profiles then a mandrel actuated by the action of the ram must be employed. These may be fixed or floating mandrels which require hollow billets.

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.

Speed Tear: A series of surface cracks perpendicular to the extruding direction. Speed tearing normally occurs in corner radii or extremities of a section and is caused by localized high temperature.

Spider Die: An extrusion die for producing hollow shapes, whose mandrel is supported by multiple legs attached to the cap. Metal flows between the spider’s legs and reunites before emerging through the die aperture.
Squaren ess: The measure of a bearing being perpendicular to the die face, which can be accomplished with a toolmaker’s square or equivalent techniques. Characteristic of having adjacent sides or planes meeting at 90 degrees.

Sticking: Adherence of foil surfaces sufficient to interfere with the normal ease of unwinding.

Straightness: The absence of divergence from a right (straight) line in the direction of measurement.

Strength/Weight Ratio: The relationship between the structural strength of a material and its weight. The strength-to-weight ratio of structural aluminum alloys is about twice that of mild steel.

Stretch Straightening: The process of stretching extruded sections beyond the yield strength of the alloy to achieve longitudinal straightness.

Stretching: In extrusion, straightening an aluminum member by pulling. An average stretch increases the length by about one-half of one percent, and produces correspondingly a slight decrease in the cross-sectional dimensions, called stretch-down.

Surface Tear: Minute surface cracks on products which can be caused by insufficient ingot scalping.

Tear: A series of surface cracks perpendicular to the extruding direction. Speed tearing normally occurs in corner radii or extremities of a section and is caused by localized high temperature.

Tearing: Typically cracks or separations due to high extrusion speed or extrusion temperature.

Temper: The combination of hardness and strength imparted to a metal by mechanical or thermal treatments and characterized by certain metallurgical structures and mechanical properties determining temper designation.

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

Thermal Conductivity: The ability of a material to transmit heat through its bulk and, by direct contact, to other substances. Aluminum is a good heat conductor and is widely used in cookware and in radiators and other heat exchangers.

Tolerance: Aluminum extrusions are produced to standard dimensional tolerances, unless otherwise specified.

Tongue and Groove Joint: A joint in which one part has a groove which receives a projection (tongue) on the other part, shaped to fit snugly.

Transverse Weld: A condition existing within an extrusion which is created by the interface of two separate billets. In practice the interface is extruded at different rates through the die and is formed into a conical or pointed configuration within a portion of the extrusion.

Tube: A tube that does not contain any line junctures metallurgical welds resulting from the method of manufacture. 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 is generally not considered seamless. Seamless tube is typically used for fluid-carrying
Twist: A departure from straightness.

Undercure: The result of curing a paint at either too low of a temperature or too little time, resulting in inadequate hardness and solvent resistance.

Viscosity: That property of a liquid which enables it to resist flow. High viscosity means a fluid resists flowing; low viscosity means it flows readily.

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

Wrap: A characteristic of liquid or powder coatings in an electrostatic application to seek out and adhere to parts of the substrate not in direct line of sight of the delivery system end point.

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. For aluminum alloys, the yield strengths in tension and compression are approximately equal.