

Common Terms and Definitions

(Source: PMA Design Guidelines)

Alloy: A mixture of two or more metals, or of a metal with a non-metallic material.

Annealed: The softest possible state of any material.

Annealing: The process whereby metal is heated beyond its critical range, held at that temperature to allow crystallization to occur, and then slowly cooled through the critical range. A metal is annealed to soften the metal, improve ductility, and to reduce or remove working strains.

Anodizing: It is the process of applying a controlled oxide layer to the surface of aluminum to improve surface hardness or impart color.

Barrel Tumbling: A typically low cost method of removing burrs from parts using a many-sided barrel and slowly rotating the parts by themselves or with an abrasive media.

Bed: The bottom “working” area of a metal forming machine. The bed is a key variable that limits the size and complexity of a part that can be processed.

Bend Radius: The inside radius of a formed feature.

Bend Relief: A notch that provides clearance at an end of a flange that prevents distortion or tearing during bending.

Blank: The piece resulting from cutting a shape from a larger piece of sheet metal to be used as a finished part or for subsequent operations.

Blanking: Cutting of the outside shape of a part.

Bleed Out: The process of trapped plating solutions leaching out of an assembled work piece. Typically, a stain or surface discoloration will occur and may lead to corrosion.

Breakout: The fracture on the cross section of a cut edge of steel.

Burnish: Also called shear or cut band, it is the smooth shiny area above the breakout on a sheared edge.

Burr: The raised sharp edge inherent in shearing, blanking, punching and drilling

Burr Direction: The side of the stock on which the burr(s) are present

Burr Height: The distance the burr extends beyond the material surface

CNC Turret Press: A programmable punch press that automatically indexes material and selects the required tool from a rotary tool holder (turret) to punch, pierce, blank and form work pieces

Camber: The deviation from straightness on the edge of coil and sheet stock resulting from the slitting or shearing operation

Case Hardening: A heat treating process in which the surface layer of the steel is made substantially harder than its core

Checks: Ripples and cracks on the surface induced by forming

Chromate: A clear, yellow or blue (hue) coating used primarily over zinc to seal the surface after coating for the prevention of oxidation and/or to improve the electrical properties of the coating

Clamp Marks: Grip marks (indentations) caused by pressure from the turret press stock holders

Coil Breaks (Cross Break): Ridges or marks across the width of sheet or coil stock caused by improper coiling or leveling

Coining: Compressing or squeezing of the metal resulting in a metal flowing action

Coil Set: The tendency of material to retain its “coiled” shape when it is uncoiled

Cold Rolled Steel: Hot Rolled Pickled and Oiled Steel that has been further processed to its final thickness in a cold state using a rolling mill. This process helps to minimize thickness variation and produces a smooth surface

Cold Weld: Weld defect due to inadequate heat or improper contact during welding

Cold Worked: Natural hardening of material due to forming (repeated forming) at ambient temperature

Commercial Grade (Quality): Standard materials readily available through service centers

Compound Die: A tool used to pierce, form and blank a part with a single press stroke

Concentricity: The dimensional relationship of multiple items sharing a common center line

Connecting Lines: Two lines on a part drawing tangent

Core: In case hardening applications, the center or internal section of the steel not changed

Corner Radius: Outside radius

Counter Boring: Machining or coining process that generates a cylindrical flat bottomed hole

Counter Sinking: Machining or coining process that generates a conical angle on a hole

Cross Sections: Sectional views

Cumulative Tolerance (Stacked): The accumulation of tolerances resulting from multiple operations or assembly of multiple parts

Datum: Theoretically exact planes, lines, or points from which other features are located on design drawings

Dedicated Tooling (Hard): Tooling made to produce a specific part

Die: Tool used to shear or form metal parts using a “punch” fitted to a cavity or void

Die Clearance: The amount of space, per side, between the punch and die opening

Die Cushion: A large pressurized cylinder used to apply upward pressure to the lower die

Die Marks (Tool Marks): Any type of scratches, indentations, galling, etc. of parts by tooling

Draw—A term used interchangeably with tempering in the heat treating process.

Drawing—(1) Engineering document depicting a part or assembly. (2) In metal forming, the stretching or compressing of a sheet metal part into a die by a punch to create a 3-dimensional part.

Draw Ring—Holding device in a die to control material flow and wrinkling during forming.

Ductility—Ability of a material to be bent or otherwise formed without fracture.

Edge—A transition between surfaces.

Edge Bulge—Condition resulting from any forming, piercing, hardware insertion or spot welding operation too close to an edge.

Edge-to-Feature—A dimension between the edge of the part and a feature.

Effective Case Depth— The perpendicular distance from the surface of a hardened case to the deepest point at which a specified level of hardness is attained.

Electrodes—(1) In welding, a tungsten rod, (TIG) or consumable metal wire (MIG) which is used as an electrical conductor and arc point between the welding torch and the workpiece.
(2) In spot welding, the upper and lower shaped, conductive elements between which, two or more sheet metal parts are squeezed and through which, current flows during resistance welding

Electrolytic ally Deposited—Depositing of one material on another (commonly known as plating).

Electroplating—Deposition of a thin layer of metal to a workpiece using an electrolytic process.

Electrostatic Spraying—Method of spray painting in which an electrostatic potential is created between the article and atomized paint particles. The charged particles of paint are attracted to and deposited on the articles being painted. The electrostatic potential is used in some processes to aid the atomization of the paint.

Enclosed Seam and Pocket— Formed , s p o t welded or welded area that can entrap plating solutions.

Etching—Chemical cleaning of parts.

Extruded Hole—Pierced and formed hole in sheet metal in which the metal has been stretched creating a tubular shape.

Feather Edge—Material thinning toward an edge, creating an irregular knife-e d g e, “tattered” appearance.

Feature - t o - Feature—Dimension between two features on a part.

Female Tool—A “mold” duplicating the exterior dimensions of the part.

Ferritic—Referring to iron content.

Ferrous—Metals containing iron as a major alloying constituent.

File Transfer Protocol (FTP)— The mutually agreed upon setting used by two computers in data transmission.

Fillet Weld—Joining method of filling an inside edge with welding metal.

First Article—A part produced using production tooling via the final production process. The part is inspected and documented as proof of conformance to print.

Fit-Up—Degree of physical match between two or more components.

Fixture— Tooling designed to locate and hold components in position.

Flame Hardening—A process consisting of heating a desired area, usually localized, with an oxyacetylene torch or other type of high temperature flame and then quenched to produce a desired hardness.

Flange— Formed projection or rim of a part generally used for stiffness or assembly.

Flat or Matte—Coating surface which displays no gloss when observed at any angle; a perfectly diffused reflecting surface.

Floating Fastener—Hardware which allows the threaded portion to move within its particular confines without rotating, to compensate for misalignment.

Form—A bend, or the process of bending a metal formed part.

Form-to-Form—Dimension between two forms on a part.

Formed Tab—Small flange bent at an angle from the body of a metal work piece.

Forming—Operation converting a flat sheet metal work piece into a three dimensional part.

Forming Slides—Cam operated units acting in a single plane used to drive tools on a slide forming machine.

Forming Tool—A slide mounted tool used for bending on a slide forming machine.

Fourslide Machine—A machine, either horizontal or vertical, used to fabricate formed metal stampings and wire forms, by the action of four or more forming slides acting upon a stationary mandrel or center tool.

Functionality— The degree to which the designed part will perform to meet its intended purpose.

Fuse Welded Joint— Welding method without addition of a filler metal, used to generate little, if any eruption above the original surface level.

Gage—See “Gauge” definition (1).

Galvanic Corrosion—Dissimilar metals in contact with each other in presence of moisture, acting as a battery and causing an electrolytic etching deteriorating effect.

Gas Metal Arc Welding (GMAW)—See “MIG Weld.”

Gas Tungsten Arc Welding (GTAW)— See “TIG Weld.”

Gas Welding—Melting and fusing metals together by use of an oxygen and flammable gas mixture.

Gauge— (1) Instrument for measuring, testing, or registering. (2) Numeric scale for metal thickness.

Gaylord—See “Master Carton.”

Go/No-Go Gauge—Measuring device with two registration elements which determine if a feature to be measured is between two established limits.

Gouge—Surface imperfection, deeper than a scratch, often with raised edges.

Grain Direction—(1) Crystalline orientation of material in the direction of mill rolling. (2) Orientation of a surface finish generated by abrasive method.

Grinding—Process of removing material by abrasion.

Grippers—Material clamping devices often serrated for additional holding force to restrain material during a die operation.

Grit—Mineral particles used for abrasive metal removal.

Hard Tooling— Tooling made for a specific part. Also called “dedicated tooling.”

Hardenability—The fundamental characteristic of a steel which determines the ease of preventing the transformation of austenite to anything else but martensite during the quench.

Hardware—Fasteners inserted into a sheet metal part.

Hardware List—Information that should be conveyed to the part supplier specifying part numbers, description and quality of fasteners.

Heat Sink—Good thermal conductor used to remove destructive heat from an area.

Hem -- Edge of material doubled over onto itself for the purpose of safe handling or to increase edge stiffness.

Hold-Down Marks—Slight indentations or scuff marks on one side of the stock which can result from the pressure of hold down devices during shearing operations.

Hole Rollover—Rounding of the top edge of a pierced feature caused by the ductility of the metal, which flows in the direction of the applied force.

Hole-to-Feature—Dimension between the center of a hole and another feature.

Hole-to-Form—Distance from the center of a hole to the edge of a formed feature.

Hole-to-Hole—Dimension between centers of holes.

Homogenizing—An annealing treatment at a fairly high temperature designed to eliminate or reduce chemical segregation.

Hot Dip—Application of a metal coating on a substrate by immersion in a molten metal bath.

Hot Rolled Steel—Steel which was roller formed from a hot plastic state into final shape; characterized by a rough, scaly surface.

Hydraulic Press—Machine which exerts working pressure by hydraulic means.

Hydrogen Embrittlement—Loss of ductility of a material due to absorption of hydrogen gas during an electrolytic process or during acid cleaning of heat-treated parts.

IGES—Acronym for “Initial Graphics Exchange Specification.”

Inclusions—Particles of impurities (usually oxides, sulphides, or silicates) which separate from the liquid steel and are mechanically held during solidification. In some grades of steel, inclusions are made intentionally high to aid machinability.

Indexable Tool Stations—Special tool positions in a turret press which are equipped with numerically controlled servo drives rotating the punch and die together to profile contours, nibble angles or for other special applications.

Inductance Instrument—Instrument which is used to measure thickness of applied coatings to metal substrates. Unlike magnetic thickness gauges, inductance gauges can measure either conductive or non-conductive coatings on magnetic or non-magnetic substrates.

Induction Hardening—A form of hardening in which the heating is done by induced electrical current.

Inserted Fastener— Variety of pins, nuts, studs, standoffs or special hardware which are installed in a work piece by inserting it into a specifically punched hole. See chapter on Inserted Fasteners.

Inside Radius— See “Bend Radius.”

Inspection Criteria—Characteristics by which the part will be evaluated both dimensionally and cosmetically.

Interrupted Quench—Stopping the cooling cycle at a predetermined temperature and holding at this temperature for a specific time before cooling to room temperature. Usually, done to minimize the likelihood of cracking, or to produce a particular structure in the part.

ISO Drafting Standard—Regulation for the creation of technical drawings published by the International Organization of Standards.

Isothermal Treatment—A type of treatment in which a part is quenched rapidly down to given temperature, then held at that temperature until all transformation is complete.

Jig—See Fixture.

Laser—Acronym for “Light Amplification by Stimulated Emission of Radiation.”

Lanced and Formed Tab—See “Formed Tab.”

Lanced Tab—See “Formed Tab.”

Lap-Welded Joint—Welded seam in which the two metal pieces to be joined overlap one another.

Laser Welding—Metal melting and fusing using the energy of a concentrated coherent light beam.

Layer—A CAD file is like a layered stack of clear transparency films with design information on the different layers. They are superimposed on each other. One can look down through all of the layers at once, or only selected layers.

Lead Screw—Part of a system which converts rotary to linear motion.

Lead Time—Time required to manufacture a product from order placement until availability. It includes planning, engineering, tool design and construction, acquisition of materials, scheduling, fabrication, finishing and packaging.

Leg Size—Width and height of the filler bead of welding material.

Linear Slide Machine—A vertical slide forming machine with the ability to place several opposing slides arranged in a linear fashion on both the front and back sides of the tooling area.

Lines—A straight line segment between two points.

Line Width—Thickness of a line in CAD drawings.

MIG Weld (Metal Inert Gas) or GMAW (Gas Metal Arc Weld)—Metal melting and fusing process using a continuous metal consumable electrode with an inert gas around the electrode to shield against oxidation.

Magnetic Thickness Gauge—Device, applicable only to ferrous substrates, which measures the thickness of non-conductive coatings.

Mandrel—Usually a fixed tool on a slide forming machine that metal is formed against by the action of a slide-mounted form tool.

Manganese (Mn.)—Lustrous reddish-white metal of hard, brittle and therefore non-malleable character. Element number 25 of the periodic system. Atomic weight 54.93.

Manufacturability—The degree to which a product can be efficiently and accurately produced using modern manufacturing methods.

Martempering or Marquenching—Martempering is a form of interrupted quenching in which the steel is quenched rapidly from its hardening temperature to about 450°F, held at 450°F until the temperature is uniform, then cooled in air to room temperature. Actual hardening does not occur until the air cooling starts and is accomplished with a minimum temperature differential. Martempering is indicated for low to medium alloy steels when distortion may be a problem.

Martensite—A ferritic material with distinctive needle like structure which is always present in heat treat of hardenable steel.

Martensitic Stainless Steel—Stainless – steel series which are magnetic and hardenable by heat treating.

Masking—Temporary shielding of a portion of a product to selectively prevent the application of a coating.

Master Carton—Large box, generally 42 in. wide, 48 in. long and 30 in. high, made from heavy test cardboard and designed to fit a standard pallet.

Master Die—Universal tool receptacle for holding changeable tool systems.

Master Document—An original file retained in case of subsequent errors to a copy.

Material Utilization—Extent to which optimal use of material is approached.

Mechanical Assemblies—Part combinations attached by mechanical means through the use of hardware.

Mechanical Fastener—Device clamping two or more components together by mechanical force, such as rivets, screws, etc.

Mesh—Number of holes per inch in sieves used to sort mineral abrasive particles into specific grit sizes.

Metal Thinning— Thickness reduction during any forming operation.

Micro Alloying—Specific alloy combination usually designed for special strength, ductility or flexibility.

Mill Edge—See “Edge Deckle.”

Model—(1) Pre-production sample, made with limited emphasis on tolerance, to test a design concept. See, also, “Prototype.” (2) A computer graphic depicting exact geometry of a part.

Mold Lines—Lines in a drawing connecting the inner radius and outer radius of a bend and showing the extent of bend.

NC—Numerically controlled.

N/C Press—Numerically controlled press. See “CNC Turret Press.”

Nesting—(1) Grouping of identical or different parts in multiples within a work piece to conserve material. (2) In packaging, stacking of parts whose shape permits one to fit inside another.

Nibble Marks—Slight irregularities at the edge of the stock surface after progressive punching (“nibbling”) operations in a turret press.

Nitriding— The process of adding nitrogen to the surface of a steel, usually from dissociated ammonia as the source. Nitriding develops a very hard case after a long time at comparatively low temperature, without quenching.

Nominal— The targeted value for a dimension that defines the size of an ideal part.

Non Ferrous Metal—Elements and their alloys without iron as a major constituent.

Non-uniform Coverage—Inconsistent paint thickness.

Normalizing—The process of heating steel to a temperature above its transformation range, followed by air cooling. The purpose of normalizing may be to refine grain structure prior to hardening the steel, to harden the steel slightly, or to reduce segregation.

Notching—Operation in which the punch removes material from the edge or corner of a strip or blank.

Nugget—Area melted together during resistance welding.

Obround—Contraction of the words oblong and round denoting a punched slot with semicircular ends and straight sides.

Oil Canning—Out of flatness condition in sheet material commonly known as “Oil Canning” in which, with the edges of the sheet restrained, the center of the sheet can be popped back and forth but cannot be flattened without specialized equipment. This condition is sometimes inherent in the material as received from the supplier and sometimes the result of multiple punching or forming operations.

Orange Peel—Irregular condition surface resembling an orange skin texture.

Orbital Sanding— Non-straight-line abrasive finish with irregular circular marks.

Organic Coating—Designation of any chemical finish containing carbon.

Outside Radius— Formed outside radius of a bend.

Overlapping Seam—See “Enclosed Seam and Pocket.”

Overspray—(1) Spray material which may be lost within the spray booth or to the atmosphere. (2) Spray material which subsequently falls on the product. (3) Areas adjacent to coating of surfaces requiring paint.

Oxidation—Chemical reaction between a material and oxygen.

Oxidation Scale—Stained, discolored and flaky surface condition.

Pallet—A platform designed to facilitate lift truck handling of parts or packages.

Parameterics—Defining a feature’s size by establishing a geometric relationship between it and other features, instead of defining it with a dimension.

Pattern Direction—Orientation of features or surface patterns on sheets and coils.

PEM® Fastener— Self-clinching inserted fastener (nut, stud, standoff, pin, blind stand off, etc.) made by Penn Engineering & Manufacturing Corp.

Pencil Hardness Test—Method to measure coating hardness based on the scratching of the film with pencil leads of known hardness. The result is reported as the hardest lead which will not scratch or cut through the film to the substrate.

Penetration—(1) Depth of a cutting operation before breakout occurs. (2) In welding, the depth of material through which fusion occurs.

Periphery—The extreme outer edge of part or drawing.

Perpendicularity—Dimensional relationship of a part or datum located at right angles (90°) to a given feature.

Phosphating— Treatment of steel or certain other metal surfaces by chemical solutions containing metal phosphates and phosphoric acid as the active ingredients, to form a thin, inert, adherent, corrosion-inhibiting chemical conversion coating which serves as a substrate for subsequent paint coats.

Phosphor Bronze—Copper base alloy with 3.5 - 10% of tin to which phosphorus has been added in a molten state in varying amounts of less than 1% for deoxidizing and strengthening purposes.

Pickled and Oiled—Hot rolled steel with the scale removed through immersion in acid and a follow up rinsing and oiling process for oxidation protection. Also referred to as “P&O” and “HRPO.”

Piercing—Punching of openings such as holes and slots in material.

Pigment— Finely ground, natural or synthetic, inorganic or organic, insoluble particles which, when dispersed in a liquid vehicle to make paint, may provide, in addition to color, many of the essential properties of a paint—opacity, hardness, durability, and corrosion resistance.

Pinch Trim — Trimming excess material from a drawn part at the bottom of the stroke. Leaves drawn shell without an inside burr, but with an outside burr and a thinned edge.

Pitting (Inter-Crystalline Corrosion)—Galvanic attack under moist and acidic conditions between molecular structures of differing alloy content.

Plasma Arc Welding (PAW) — Specialized process utilizing a non-consumable electrode ionizing an inert gas and increasing temperature to melt the material being welded.

Plastic Deformation—Permanent deformation occurring in forming of metal after elastic limits have been exceeded.

Plate—Sheet steel thicker than 7 gauge 0.179 in. (4.55 mm) or sheet aluminum thicker than 3/16 in (4.76 mm).

Point—A piece of geometry at an exact location.

Polishing—Abrasive process in which the surface created takes on a bright reflective finish, scratch-free to the unaided eye.

Powder Coating—100% solids coating applied as a dry powder and subsequently converted into a film with heat.

Precipitation Hardenable—Alloy in which a constituent precipitates from its supersaturated solution allowing the material to gain added strength.

Prefinished Material—Stock which has been painted or plated prior to fabrication or stamping.

Primer— First application of a substance capable of adhering to the substrate and providing good adhesion to a subsequent coating.

Programmable Back Gauges—Stops on metalforming machines which can be adjusted during and between cycles by computer numeric control.

Progressive Tool—Die using multiple stations or operations to produce a variety of options. Can incorporate piercing, forming, extruding and drawing, and is usually applied to high quantity production runs.

Projection Weld Nuts (or Studs)—See “Weld Nuts” and “Weld Studs.”

Projection Welding—Using protrusions on one of the two parts to be resistance welded, creating a positive conductance path.

Prototype—First part of a design which is made to test tolerance capability, tooling concepts and manufacturability. (See model)

Pull Down—Area of material next to the penetrating edge of a piercing punch, or die edge of the blanking station, where the material yields, i. e. flows in the direction of the applied force, creating a rounded edge. Also known as “roll-over.”

Pulse Mode—Intermittant surging of laser cutting power action.

Punch Direction— The direction from which a tool or punch enters the work piece.

Punch Press—Machine supplying compression force for reshaping materials.

Punch Side—Opposite side from burr side for pierced features; side on which the punch enters the material. The punch side is the burr side for blanked outside contours.

Quenching—Cooling from high temperature, usually at a fast rate.

Quick Change Inserts— Tool sections or parts which may be changed without removing the entire tool from the press.

Ram—Driven (movable) part of a metal forming machine.

Repositioning—Operation in turret press fabrication denoting the release of the work holders, movement of the X axis to a new position on the work piece, and the regripping of the work piece so that a sheet larger than the X axis table travel can be fabricated, all under computer numeric control.

Reproducibility—Extent to which parts from multiple lots are identical. Also known as repeatability.

Rerolling—Final cold rolling operation, usually done to achieve specific thickness control and improved finish.

Resins—Natural or synthetic basic material for coatings and plastics.

Resistance Projection Weld (RPW)— See “Projection Weld.”

Resistance Spot Welding (RSW)—Melting and joining action of two adjoining metal surfaces created by the thermal reaction of the metal to the flow of an electrical current forming a weld nugget.

Revision—A subsequent part drawing usually denoting corrected or improved version.

Revision Description—A written notice describing the nature of changes to a drawing.

Rivet Nut—Internally threaded fastener designed to be used as a rivet from one side of a workpiece or assembly and to provide threads for a screw or bolt to be used in assembly of a mating part.

Rockwell Hardness—An indentation hardness test based on the depth of penetration.

Roll Forming—A continuous bending operation in which sheet or strip metal is plastically deformed along a linear axis by being passed through a series of roller dies and progressively shaped to the desired contour.

Roll-Over—See “Pull Down.”

Rotary Slide Machine—A vertical forming machine with the ability to place several forming slides radially around the center tool and produce intricately formed stampings and wire forms.

Roundness—Extent to which a feature is circular.

Run Out Flange— Feature on a formed part which is designated by the designer to absorb the tolerance accumulations created by multiple forming operations.

Run—Sag or accumulation in a paint or finish film prior to curing.

Scale—(1) Thick oxide coating on material normally associated with hot working. (2) Deposit formed from solution directly in place upon a confining surface.

Scallop—Edge condition resulting from nibbling a feature in a turret press.

Scrap— Leftover, unused material relegated to recycling.

Self Extracting Archive File—A library file that can automatically create a group of (CAD) files without requiring the operator to have any special knowledge, or use special software.

Self Fixturing—Part designed to be self-locating into proper position to another part with the use of built-in locators.

Self Locking Fastener—Fastener which is machined with interference threads or which has a nylon insert or other locking mechanism to securely hold mating fasteners in high torque or vibration applications.

Semi-Gloss—A gloss range between high gloss and eggshell, approximately 35 to 90 on the 60 degree gloss scale.

Shake Aparts—Term designating a family of parts on a sheet which are held by “Micro Ties” so small that the parts can be removed from the sheet after CNC punching by simply shaking the sheet.

Shaker Parts—See shake “Aparts.”

Shear-to-Feature—Shearing of an edge of stock to an exact dimension from an already existing feature.

Shearing—Cutting force applied perpendicular to material causing the material to yield and break.

Shielding Gas—Inert gas used for oxidation protection during welding.

Shim Steel—Steel which has been rolled thin to a hard condition and very close tolerance.

Shrink Wrap—Thin poly film which is stretched or heat shrunk over parts for protection or display.

Shunting—Short circuiting of a (weld) current through a previously applied weld nearby.

Shut Height—Clearance in a press between ram and bed with ram down and adjustment up.

Silkscreening—Printing process using special inks being pressed through a fine meshed fabric which has been prepared by a photo process to let the ink pass through in predetermined patterns of lettering and graphics.

Single Action—Press utilizing one moving element.

Sinkhole—In welding, a dimple on the surface of stock caused by shrinking of the weld during cooling.

Skid Marks (Roll Slip)—Polished or burnished streaks across the stock surface resulting from improperly set roller driven material processing equipment. Skid marks are transverse to the direction of rolling.

Skin-pass—Single cold rolling process on material after a heat treating process.

Slide Forming—A high-volume stamping process in which a machine with multiple slides sequentially performs various operations (i.e. - blanking, piercing, forming, etc.).

Slot-to-Form—Distance from a slot edge to the inside edge of a formed feature.

Slug—Scrap from a piercing operation.

Slug Marks—Surface defects caused by scrap being indented into the metal surface.

Soft Tooling—A term generally applied to the fabrication of metal parts using computer controlled technology incorporating CNC turret presses, laser profilers and press brakes.

Solids—The ability of the CAD software to realize that a volume is filled with solid matter. These CAD systems can display a design so that it looks like a solid object. Includes recognition of surfaces and wire frames.

Solution Heat Treat—High temperature process in which an alloy is heated to the suitable temperature for the alloy constituents to be in a totally soluble condition for the purpose of creating a homogeneous alloy. Through rapid cooling the constituents stay in this solution state.

Metal so treated is left in a super saturated unstable state and may tend to age harden at ambient temperatures.

Solvent Based—Paint type in which a volatile liquid is used to dissolve or disperse the filmforming constituents.

Spatter—In welding, droplets of matter deposited as contaminants.

Spectral—Adjective referring to spectrum. See “Spectrum.”

Spectrophotometer—Device for the measurement of spectral transmittance, spectral reflectance, or relative spectral emittance.

Spectrum—Spatial arrangement of components of radiant energy in order of their wavelengths, wave number or frequency.

Spheroidizing—A heat treating process used to change all of the carbides in steel to rounded particles, or spheroids. A completely spheroidized structure is the softest and most workable structure for any composition.

Spot Face—Circular flat surface as a bearing area for hardware.

Spring Back—Partial rebounding of formed material caused by its elasticity.

Spring Loaded Panel Fastener—Inserted fastener which is equipped with a floating captive screw, spring and retainer such that the hardware will remain in the panel, ready for use, when the panel has been disassembled from its mating component.

Squareness—Measure of perpendicularity of adjacent edges or surfaces.

Stack-Ups—Tolerance accumulations.

Stainless Steel— Various ferritic alloys exhibiting high oxidation resistance through the alloying with chromium and nickel.

Stiffening Rib—Embossed feature in a sheet metal workpiece which is added to make the part more rigid.

Stains—Discolorations on the surface of sheet metal, caused during mill processing.

Staking—Method of fastening using displaced material for retention.

Stock Check—A device used to grip the material as the feed retracts, preventing movement of the material during the forming cycle.

Stock Reel—A powered or non-powered device used to support a coil of material as it is fed into the machine.

Stock Straightener—A machine mounted device consisting of a series of adjustable rolls used to straighten wire or strip stock as it comes off the coil.

Stretcher Leveled—A flattening process in which a material is stretched to achieve a desired flatness tolerance.

Strip Edge Forming—The use of a rolling technique to edge roll slit strip with shaped edge rolls to provide an edge finish equal to the material’s surface finish. Also called edge conditioning.

Stripper—Mechanical hold-down device applied to the workpiece during the punching process.

Stripper Marks—Imprints on one side of the stock around pierced holes, caused by punch strippers.

Stripping—Process of disengaging tooling from the workpiece.

Strips—Sheet material, sheared into narrow long pieces.

Stroke—RAM travel from top dead center (TDC) to bottom dead center (BDC).

Substrate—Original material surface to which a coating is applied.

Surface—The ability of the CAD software to recognize that a closed geometric shape represents a surface of a part. Includes recognition of wireframes.

Surface Inclusions—Debris rolled into the skin of material causing a depression or thinly coated pocket.

Surgical Stainless Steel Types—Any of the 300 series stainless steels with an 18% chromium and 8% nickel content. Also includes the PH type of stainless steels.

TIG Weld (Tungsten Inert Gas)—Process using a nonconsumable tungsten electrode and a shielding gas, with filler material optional.

T. I. R.—Total indicator reading. Absolute sum of all dimensional variance.

Tack Weld—Usually refers to a temporary weld used to hold parts in place while more extensive, final welds are made. In some sheet metal applications, tack welds may provide sufficient strength to eliminate the need for an “a II - around” fillet weld.

Tap Drill Size—See “Core Hole.”

Tape Adhesion Test—Adherence test for painted surfaces conducted by cross hatching the surface with a sharp knife in a 1/8 inch grid pattern, applying tape (usually 3M Scotch #600 or #250), allowing to sit for a specified period, and then removing with a quick pull perpendicular to the surface of the part. Adherence is measured by the percentage of paint remaining within the grid. See the Painted Parts Chapter.

Tapping—Operation to create internal threads by either cutting or forming.

Temper Designation—Identifying systems to denote the hardness of a particular material.

Tempering—Reheating quenched steel to a temperature below the critical range, followed by any desired rate of cooling. Tempering is done to relieve quenching stresses, or to develop desired strength characteristics.

Tensile Strength—The strength of a material when subjected to a stretching force.

Test File—A CAD system file used to test the compatibility of supplier and customer CAD systems.

Text Files—A file containing words, but no pictures.

Texture—Structure of a surface as it affects appearance or feel.

Thickness—Gauge or depth of material.

Thread Rolling Tap—Tool to generate internal threads by displacing and flowing metal into a thread shape.

Ties—See “Micro Ties.”

Tolerance—Permissible variation from a specification for any characteristic of the product.

Tooling Holes—Openings provided in parts for location purposes during production.

Tool (mandrel , chuck)— The “mold” from which the part is made.

Torque—Turning force.

Transfer—Exchanging electronic data from one medium to another.

Transfer Die— Variation of a progressive die where the part is transferred from station to station by a mechanical system. Mainly used where the part has to be free from the strip to allow operations to be performed in a free state.

Transfer Mechanism—Apparatus used to move a part between die stations.

Tungsten Electrode—Current carrier made from the metal tungsten for its high heat resistance.

Turret—Rotary tool holding device in CNC punch presses.

Turret Press— Automatic punch press, which indexes the material and selects the intended tool out of a rotary tool holding device (turret), for piercing, blanking and forming workpieces as programmed.

Twist— The rotation of two opposing edges of material in opposite directions.

Ultimate Strength—The breaking strength of a material when subjected to a stretching force.

Ultrasonic—Sound vibration above the audible range.

Undercut—Condition of the stock resulting from welding or grinding below a desired plane.

Unfolded—The act of developing a flat pattern.

V Die— Tool used in conjunction with a V punch.

V Punch— Vee shaped tool used for angle forming.

Vibratory Finishing—Burr removal process in which an appropriate number of parts, depending on part size and abrasive material, is accelerated and decelerated by mechanical means inside of a drum-like enclosure.

Viewing Angle—Inclination from which a surface is observed, i.e. looking straight at the object = 90°.

Viewing Time and Distance—Specified period to inspect a surface condition at a preset dimension from the eye.

Viscosity—Internal friction within a fluid which makes it resistant to flow.

Void—Area in a weld in which insufficient filler material is deposited.

Water-Borne—Generic designation for a variety of organic finishes which indicates that they are compounded with water as a dilutant rather than a volatile organic solvent.

Water-Soluble—Substance which dissolves in water.

Watts per square inch—Measure of speed based on power level of laser cutting machine.

Webs—(1) Material between two openings or edges. (2) See “Micro Ties.” (3) In some industries, thin material to be punched.

Weldability—Ability of a material to be fused successfully without special processing.

Weld Accessibility—Ease of reaching the weld area with the torch or electrode.

Weld Distortion—Depression or bulge on surface, caused by thermal expansion.

Weld Nut—Internally threaded hardware designed to be spot or projection welded onto sheet metal parts.

Weld Stud—Externally threaded hardware in various lengths in headed and head-less version, welded in place.

Weld-To-Edge Distance—Minimum distance from a spot weld to the material edge to create an acceptable spot weld.

Weld-to-Form Distance—Minimum distance from a formed area to electrodes to avoid shorting.

Weld-to-Weld Spacing—Minimum distance between spot welds to avoid shunting through the existing weld spot.

Wipe Die—Forming tool using two opposing edges, separated by one material thickness, moving past each other to form material.

Wire Form—A formed metal part made from wire that is usually fabricated on a slide forming machine.

Wire Frame—The capability of the CAD software to represent a design as a three dimensional arrangement of lines and arcs.

Wire Line—A standard dimension from the bed of the slide forming machine to the material, used in tool layout.

Work Hardening—Increase in tensile strength of material resulting from cold working process.

Work Holder—Mechanical device which holds a work piece.

Work Holder Mark—Marring of material through the use of clamping device.

Work Hole—See “Tooling Hole.”

Wrinkling—a: condition in a paint film appearing as ripples: (1) produced intentionally as a decorative effect or (2) defect caused by drying conditions or an excessively thick film (common in wet spraying). (C) condition of excess material created during the forming process.

Wrought—Describes material which has been plastically deformed into shape as by mill rolling.

Yield Strength—Maximum stress that can be applied without permanent deformation of material.

Zinc Plating— See “Electroplating.”