

TOOLING TIPS

NATIONAL MACHINERY COMPANY - GUIDELINES

Glossary of Cold Forming Terms

AB MODE – An abbreviation for “Alternate Blow Mode”. A machine feature that allows for the feeding of the wire on every other machine stroke. This allows for the forming of some higher load parts on a given machine size.

ADVANCING KICKOUT – A machine mechanism (normally found on Single Die Double Stroke Rivet Headers) where the die kickout pin moves forward between the cone and finish blows to expose material to be upset into the head.

ALIGNMENT PLUG – A tooling component used to represent a formed part during the setup of the transfer fingers in the external setup fixture. These plugs change to suit the part diameter being gripped.

ALLOY STEEL – Steel which contains in addition to the normal elements of iron, carbon, and manganese, one or more elements in sufficient quantity to impart improved mechanical properties. The small amounts of elements and impurities such as sulfur, silicon, phosphorus, and aluminum which are usually present in any steel are not considered alloys. If manganese is added to steel in sufficient quantity, it may be considered as an alloy in alloy steel.

ANNEAL – Subjecting to high heat, with subsequent slow cooling to remove effects of cold working, to soften material hardened in heat treatment, to increase ductility and relieve stress; heating metal to a temperature above the critical range, holding it at that temperature a sufficient length of time for it to be heated through its full volume, and slowly cooling it through the critical range: cooling may be performed by cooling the metal slowly in the furnace, or by allowing it to cool to room temperature in still air.

BACKWARD EXTRUSION – When metal is contained in a die or punch insert and forced to flow around a penetrating punch or pin. Typically applies to the forming of a hole in a workpiece.

BDC or B.D.C. – An abbreviation for “Back Dead Center”. This is when the heading slide is at the opposite end of the forming stroke, furthest from the face of the dies.

BELL MOUTH – A slightly conical shape at the front of a tooling impression.

BLANK – 1). A specific length of stock after being sheared from the coil of wire.

2). A part while in the process of being formed.

3). A formed but not yet completed part. (Example “Screw Blank”)

BLANK SUPPORT – See **TRANSFER ASSIST.**

BLIND INSERT – A straight, cylindrical insert pressed into a case with a mating counterbore. The insert does not go all the way through the case.

BLOW – A particular forming operation or a given die or tool station.

BOLSTER PLATE – See **TOOL HOLDER.**

BOLT STOP – A spring loaded stop used in the trim station of Boltmakers that discharge trimmed bolts up through the heading slide to the pointer. The stop keeps the trimmed bolts from falling back through the trim discharge tube and trim die.

BOLTMAKER TRANSFER – See **STRAIGHT ACROSS TRANSFER.**

BOSS – A raised portion of material.

BOTTLING – The forward extrusion of a hollow part without a mandrel supporting the inside of the hole during extrusion.

BOTTOM DISCHARGE TRIM – A term used to describe the trim in the last station of a FORMAX, FORMAX PLUS, or Large FORMAX PLUS machine. See **TRIM.**

BOW – The longitudinal curvature of the part or cutoff.

BROACH – Similar to trimming but removes a very small amount of metal for a more accurately finished part.

BUCKLING – Uncontrolled bending of stock during upsetting. Also encountered on tooling components without proper guide or exceeding the unsupported length.

BULLNOSE – To make a portion of a tool or die case that is not contained by the tool holder or die block larger in diameter. This gives improved support to the inserted assembly.

BURNISH – A forming operation that produces a smooth, polished surface by rubbing. Usually forcing a slightly larger diameter punch or pin through a hole in the part or forcing a part through a slightly smaller die orifice. The punch or die has a smooth surface to produce a polished finish.

BUTTON UPSET – Typically refers to the head preform of a bolt blank prior to the trimming operation.

CARBON STEEL – Steel which owes its properties chiefly to various percentages of carbon and is without substantial amounts of other alloying elements.

CASE – 1). The surface layer of an iron based alloy which has been made substantially harder than the interior by some form of hardening.

2). The container or holder of the inserts on either the punch or die side of the tooling.

CASSETTE – The individual punch holder or die holder on the large FORMAX Plus machines. A part of the tool changing system.

CENTERING DISC – Used behind the punch holders on machines with punch rockers. It acts as a hardplate for the tooling and the centering block for the punch holders. Allows the punch holder to be removed from the punch rocker and re-installed back on center.

CHAMFER – The bevel on a corner that is at an angle to either side.

CHEVRON – An internal burst defect on a forward extruded part. Usually occurs in multiples along the length of the forward extrusion, and is caused by multiple extrusion passes over the same section of the part.

CHISEL POINT – Typically a horizontal knife edge added to the end of a kickout pin. The purpose is to keep the part from rotating during the kickout or insertion of a part into or from a die. Required when the formed part must be oriented between forming operations. The kickout pin is also keyed to the tooling to keep it from rotating.

CHOKER SLEEVE – A special kickout sleeve or punch sleeve with a restricted orifice to contain the slug after piercing.

CENTRAL BURSTING – See **CHEVRON**. Also refers to the single internal burst that can occur at the junction of a head upset and the start of the shank.

CNF TRANSFER – An abbreviation for “Cold Nut Former” transfer. The transfer allows for the 180 degree rotation of parts between forming stations. With the addition of special units, the parts can be transferred straight across between stations as well. The fingers do not have cam controlled opening and closing so blanks are typically gripped on the maximum outside dimension and the forming punches passed through the fingers. Typically used for short nut type products.

COAP – An abbreviation for “Change Over Assistance Package”. This is a special die block and tool package for quick changeover. Removal of mechanical fasteners allow removal of the entire die block as a unit and the entire tool package as a unit.

COIN – To form to more exacting dimensions and shape by re-striking. The amount of forming is usually relatively small.

COLD SHUT – A fissure or lap on a formed surface which has been closed without fusion during the forming process; the surface folds over on itself.

COLD WORKING – See **WORK HARDENING**.

COMBINATION PUNCH HOLDER – A special tool holder on a machine with a punch rocker. It allows for either a stationary or sliding tool. Can be used in either the cone or finish blow.

CONE – 1). Typically the first preform upsetting operation with the top remaining the wire diameter but the base increasing in diameter creating a conical shaped section. 2). The term used to indicate the gathering of metal before forming.

CONE PUNCH HOLDER – The tool holder for the first blow on a machine with a punch rocker.

CONTROLLED CLOSING FINGERS – Special transfer fingers with a stop to limit how far closed the fingers can go without a blank in the fingers. Used when there are short cutoff blanks, short stepped parts, or where the fingers could be hit by the punch when the machine is cycled empty.

CONTROL LENGTH – The linear amount of guide of a part in either a die or punch. It is used during the transfer finger analysis.

CROSS SLOT – General term used to describe the head impression for driving a screw. Varieties include flat blade, Phillips, etc.

CUTOFF – See **BLANK**.

CUTTER – The moving tooling component of the cutoff mechanism. It most often contains a hardened insert to extend the life of the cutting edge.

CVD – An abbreviation for “Chemical Vapor Deposition”. This process is used to add a wear resistant coating to some tooling components. Commonly referred to as the “Hot” process.

DEFORMä – A finite element analysis program for the cold forming process. This is the registered trademark of Scientific Forming Technologies Corporation.

DELAYED TKO – See **MODIFIED TKO**.

DIE – An individual tooling component with a forging cavity or the assembly of a case, inserts, fillers, etc. on the stationary side of the tooling.

DIE BLOCK – The holder for the stationary side tooling. Can hold from one to six dies depending on the machine type.

DIE LUBRICATION – The recirculating liquid lubrication applied to the tooling or workpiece during the forming operations. It reduces friction, minimizes tooling wear, lubricates the tooling, and helps to carry away the heat generated by the cold forming process.

DIEPAK – The die side assembly of the Formapak on FORMAX & FORMAX Plus machines. It includes the die block and faceplate.

DIE POINT – A forward extrusion that is stopped on the end of a shank forming a chamfer. See **POINTING**.

DIE RATIO – The ratio between the outside diameter of the case and the inside diameter of the insert.

DIE RETAINER – This device is used to hold the die case assembly in the die block on FORMAX or FORMAX PLUS machines.

DIE SLIDE – The linear distance a sliding die must move to allow for the backward extrusion of a hole, piercing, or the upsetting of a preform.

DIE SPACE – A drawing or series of drawings showing the dimensions in the tooling area that must be used during the tooling design.

DIMPLE – A conical or domed impression on the end of a formed part often used as a preform for a subsequent forming or extruding operation.

DISPLACE – The movement of metal from one place to another, a combination of extruding and upsetting.

DOUBLE HEADER – A situation where two parts have been accidentally formed in a die.

DOUBLE PUNCH OUT – Refers to a hollow part that has been pierced, then upset forming a second slug, and pierced a second time.

DOUBLE TRIM – 1). A forming sequence where the formed part is trimmed twice. Such as in the forming of a hex flange bolt. The hex is sheared out of a preform shape and the flange is formed in one operation and then the flange diameter is sheared to size in the next forming operation.

2). A trimming technique using two opposing trim dies to reduce the amount of burr below a trimmed surface.

DOUBLE UPSET – The forming of a second upset on a part on the opposite end from the first upset. Requires the use of special opening segment tooling.

DRAWING – 1). A metal forming operation done on a cup type part. The part is pushed through series of progressively smaller diameter dies with an mandrel. The thickness of the wall is reduced resulting in a longer part. 2). The process used to reduce the diameter of the incoming wire by passing it through an insert before entering the machine. Also see **DRAWDIE**.

DRAW BOLT – A special contoured bolt and sleeve combination used to clamp a punch in a tool holder. Also used to hold in either the cutter or quill on FORMAX, FORMAX Plus, and Large FORMAX Plus machines.

DRAW DIE – A tooling component located in a wire drawer. It slightly reduces the diameter of the incoming wire and helps to press lubricant onto the surface of the wire. Also see **DRAWING & WIRE DRAWER**.

DROP OUT / REFEED – A cold forming technique used with difficult to form materials. The part is formed in several stations and then dropped from the machine. The partially formed part can then be annealed and coated or heated and then re-fed into the machine for finish forming operations. Requires many machine specials and secondary equipment.

DUAL TRANSFER – A special design transfer for large Cold Formers. With one transfer slide installed, it moves like a normal straight across transfer. With the combination slide installed, it moves similar to a FORMAX PLUS PMP transfer. The fingers lift from the face of the dies, the slide moves to the delivery station, and the transfer delivers the part into the next die. This combination transfer slide also has the ability to rotate parts 180 degrees between forming stations, but with very limited finger opening.

EFFECTIVE TRANSFER LENGTH – This is the length of the part being transferred combined with the location of the punch at front dead center at the delivery station. This length is used as a check to make sure a part may be transferred from one station to another without interference by the tooling.

EMBOSS – To raise the metal (as to emboss a trade mark or code on screw heads).

ENCLOSED UPSET – The upset material is totally contained within the tooling cavity at the end of the forming stroke. Also see **UPSET**.

ENERGY – Work as a function of the forming load throughout the forming stroke. This is supplied by the motor and is used to form the parts in each station. If more energy is consumed by all forming operations than the motor can re-supply for the next forming stroke, then the machine will slow down and possibly stop. It is expressed in either Foot-Pounds or Joules.

EP ADDITIVE – An “Extreme Pressure” additive for the liquid die lubricant. Helps to perform the various forming operations and prevents galling of the part or tooling.

EXTRUSION LAND – The smallest diameter of a forward extrusion die that forms an orifice for the metal to flow through or the diameter on a backward extrusion punch or pin that determines the diameter of the formed hole.

EXTRUSION PIN / PUNCH – A tooling component that forms the hole in a backward extruded part.

EXTRUSION PUNCH HOLDER – This is a special first station punch holder used on Three Blow-Two Die Headers. It carries the punch used for the trapped extrusion in the first die on those machines.

FACE ANGLE – This is the angle on the nose of a punch or pin measured from a line perpendicular to the axis of the punch or pin.

FDC or F.D.C. – An abbreviation for “Front Dead Center”. This is when the heading slide is at the end of the forming stroke and the forming operations are complete.

FEED – The movement of a controlled length of wire into the machine for cutoff.

FEED GRIP – A tooling component in the wire line of a machine equipped with a linear feed mechanism. They are typically adjustable to cover a range of wire diameters.

FEED ROLLS – A tooling component in the wire line of a machine equipped with a rotating wheel feed mechanism. They are grooved for a specific wire diameter and must be changed when the incoming wire diameter changes.

FEED TUBE – A tooling component in the wire line of a machine between the feed rolls or grips and the quill. It guides the wire through the machine and into the quill.

FILL – A term used to indicate the extent that the metal fills the die impression or to express the success in accomplishing a desired shape by under or over filling an impression. (Example, “pressures required to fill the head are ...”)

FILLER – A tooling component that fills up the space behind pins and inserts.

FILLET – A radius between two meeting surfaces.

FIN – See **FLASH**

FINGER – A replaceable tooling component usually attached to the transfer arms and used to grip the formed part. Typically made from low carbon steel with a wear resistant layer on the gripping surfaces.

FINGER PATH – The graphical representation of the opening movement of the transfer fingers in relationship to the heading slide motion or the closing movement of the transfer fingers in relationship to the die kickout motion.

FINGER SPREADING UNIT – A special transfer unit for the CNF transfer with limited finger opening capability. Fingers were opened with a probe mounted on the tool holder.

FINISH PUNCH HOLDER – The tool holder for the second blow on a machine with a punch rocker.

FLANGE – Projecting rim.

FLASH – The excess metal forced out between the edges of the forming dies.

FLOATING PUNCH – A tooling design where the punch is supported in the case by “O”-rings. This design allows the punch to move slightly to accommodate any mis-alignment between the punch and die.

FLOW STRESS – A fundamental property that describes a material’s resistance to being deformed or having its shape changed. A material with a higher flow stress will be more difficult to form and require more load to deform it.

FLOWER POT – A slightly tapered condition formed at the intersection of two outside diameters on a hollow part. It is caused by the metal flow as the backward extrusion punch or pin passes the intersection of the outside diameters.

FLUTES – See **SERRATIONS**

FOD or F.O.D. – An abbreviation for “Face of Dies”. This is the front face of the dies.

FOLD – A flaw on a part where a gap has been closed without fusion.

FORMAPAK – The quick change die set assembly for FORMAX & FORMAX Plus machines allowing for rapid changeover from one job to the next.

FORWARD EXTRUSION – When metal is forced through a smaller diameter orifice thereby reducing its diameter and increasing its length. The starting material may be partially or totally contained in the tooling before the start of extrusion.

FRICTION DRAG – A device built into the tooling to apply resistance to the kickout pins within the tool set. The resistance applied holds the kickout pins at their end of kick positions and aids in the transferring of the part into the tooling.

FULL TUBULAR RIVET – A rivet with a cavity extending more than half of the length of the shank.

GALLING – Welding that occurs between the workpiece and tooling surface due to inadequate coating or lubrication.

GATHERING STOCK – An operation by which a portion of the forming stock is increased above its original diameter.

GRIND RELIEF – A small undercut added to the inside or outside diameters of tooling components to make the finish grinding of the component easier.

GRIP – See **FINGER & FEED GRIP**.

GUIDE TUBE – A tooling component in the wire line of a machine between the wire payoff reel and the feed rolls or grips. It controls the wire as it moves through the sound enclosure and/or between the straightener rolls and the feed rolls or grips.

HANDLING HOLE – A tapped hole added to tooling components such as cases, hardplates, and fillers to make them easier to lift or insert/remove from the machine or die set.

HARD WELD – A special weldable material that leaves a very hard wear surface. Typically added to transfer fingers.

HARDPLATE – A tooling component located behind a punch or die assembly. It helps to distribute the forming load into the wedge on the heading slide or the faceplate behind the die block.

HEAD – 1). A general term derived from forming heads on bolt blanks. The common usage applies to that portion of a part that has been upset and made larger than the starting stock.

2). A tooling component/feature that is put on a punch or pin in the tooling assembly.

HEADING SLIDE – This is the moving part of the machine that the tooling is mounted on.

HEADING PUNCH HOLDER – A special 1st station tool holder on a Three Blow-Two Die Header that allowed the use of upset tooling at the 1st die.

HOOKER EXTRUSION – The forward extrusion of a hollow part with a mandrel used to maintain the inside diameter of the extruded part.

HOLLOW RIVET – A rivet with a cavity completely through the shank and the head. Sometimes called “Thru” hole rivet.

HONE – See **LAP**.

HOOP STRESS – The tangential stress at each radial element of an insert, case, or sleeve created by the assembly of the insert or sleeve in the case and the radial load applied to the inside of the insert during the forming process.

IFO – An abbreviation for “Individual Finger Opening”. These are the adjustable cams used to open and close the transfer fingers at each transfer station.

IMPRESSION – To make a mark into the metal.

INDENT – To form a slight recess. Usually an operation in preparation for further forming or to assist in transferring the part.

INTERFERENCE FIT – The difference in diameters between a case and an insert that is assembled into the case. The outside diameter of the insert is larger than the inside diameter of the case. This gives support to the inside diameter of the insert during the forming process.

INTERNAL AIR / OIL – Special machining to allow for the introduction of either compressed air or liquid die lubricant directly into the tool or die.

INSERT – A tooling component made from a hard, wear resistant material and pressed into a case for support. This component is in direct contact with the formed piece.

IRONING – See **DRAWING**.

KICKOUT – The ejection of the formed part from either the tool or the die. This is done using either pins or sleeves inside of the tooling.

KNURL – Checkered or straight notches on the outside diameter of a part.

LAND – 1) The short straight section of a forward extrusion die that forms the extruded diameter. 2) The short straight section of a backward extrusion punch that forms the extruded hole diameter. 3) The short straight section of a piercing punch that forms the pierced hole diameter.

LAP – 1). A fold of material on the outside surface of a part that has been closed without fusion.

2). A process used during the tooling manufacture to polish the inside surfaces of the inserts and to refine the internal dimension of the assembled insert.

LIFT – The distance away from the face of the dies that the transfer fingers move on a PMP transfer.

LOAD – 1). The force required to do the forming operations. It is typically measured at its maximum point which is at front dead center. It is expressed in either Tons, Metric Tons, or kN. 2). A term used to describe the procedure for the assembly of inserts into a case

LOAD VECTOR ANGLE – An analysis tool used during the tooling design process to check for the proper thickness of supporting fillers and hardplates.

MANDREL – A tooling component that is used to maintain the inside diameter of an extruded hole in subsequent forming operations.

MARK FOR PIERCING – A forming operation that forms a sharp corner by shearing to establish satisfactory conditions for the piercing of a slug from a formed part.

MODIFIED TKO – A special TKO stroke where the tool side kickout stroke starts some distance after front dead center.

MPM – An abbreviation for “Micro Position Monitor”. This a non-contact gross load monitor.

NIB – A small perishable punch or die.

NONFERROUS – Metals or alloys that contain no appreciable quantity of iron. Applied to such metals as copper, aluminum, and brass.

OFFSET FINGERS – A special design of transfer finger where the gripping portion of the finger has been moved away from or closer to the face of the dies. This is done to aid in the transferring of the part between forming stations.

OPEN EXTRUSION – This refers to a forward extrusion where a portion of the incoming blank is not contained within the tooling before the extrusion takes place.

OPEN UPSET – The outside surface of the upset material is not contained by any tooling cavities at the end of the forming stroke. Also see **UPSET**.

OVERFILL – A portion of the formed part which has too much metal to give it the full shape of the tooling impression or cavity. Usually creates a fin or burr.

PANCAKE – A term used to describe an enclosed upset operation where the incoming blank diameter is increased as a preform for a subsequent forming operation.

PHILLIPS PUNCH HOLDER – The special sliding tool holder for the first blow on a machine with a punch rocker.

PIERCE – An operation to remove a slug from a formed part to create a thru hole in the part.

PICK-UP – See **GALLING**.

PIN – A tooling component used to form and/or eject a part from a cavity.

PMP TRANSFER – An abbreviation for the FORMAX PLUS “Pick Move Place Transfer”. This transfer moves the blank straight across between forming stations with a movement away from the face of the dies before the transfer leaves the pickup station. The transfer moves back to the face of the dies after arrival at the delivery station. It returns to the pickup station without lifting.

POINTER – A mechanism typically mounted on either Boltmakers or Threaders that is used to cut a point on the end of a cold formed bolt blank before thread rolling.

POINTING – Chamfering the end of a blank before thread rolling. The point may be formed in the die or cut in the external pointer.

PREFORM – To establish a preliminary shape suitable for forming into the final part dimensions.

PRESS-FIT – See **INTERFERENCE FIT**

PULLOUT – 1). The distance the TKO lever moves away from the face of the dies during the untimed portion of the TKO stroke. 2). The distance the part is permitted to pull out of the die during the first portion of the T.K.O. stroke.

PUMPING OUT – A condition where blanks or die inserts are forced out of place prematurely due to hydraulic action.

PUNCH – A tooling component typically mounted on the moving side of the tooling.

PUNCH HOLDER – See **TOOL HOLDER**.

PUNCH-OUT – See **PIERCE**

PUNCH ROCKER – An oscillating mechanism mounted on the front of the heading slide of single die-two blow or two die-three blow forming machines. The tooling is mounted onto the punch rocker. Between forming blows, the mechanism moves the next forming punch on center with the die.

PUSH THRU TRIM – See **TRIM**.

PUSHER – A pin or rod that pushes the cutoff blank out of the cutter insert and into the transfer fingers.

PVD – An abbreviation for “Physical Vapor Deposition”. This process is used to add a wear resistant coating to some tooling components. Commonly referred to as the “Cold” process.

QUIKCALC / QUIKCALC PLUS – A software package developed by National Machinery to aid with die design calculations.

QUILL – The stationary tooling component of the cutoff mechanism. It can be a one piece or inserted assembly.

RADIUS – Round off.

RAM – See **HEADING SLIDE**.

READINESS – Having all of the tooling required to form a part complete, checked, and assembled ready to put into the machine.

RECESS – Indent or form an impression in the end of a part.

REDUCTION IN AREA – Usually expressed as a percentage for forward and backward extrusions. It is the percentage difference between the starting area and the extruded area.

RELIEF ANGLE – The transition angle between the extrusion land and the relief diameter.

RELIEF DIAMETER – A slightly larger diameter after the extrusion land in a forward extrusion insert. A slightly smaller diameter after the extrusion land on a backward extrusion punch or pin. The purpose is to minimize the friction between the formed part and the tooling.

RELIEVING KICKOUT – A machine mechanism normally found on Single Die Double Stroke Headers and Three Blow Two Die Headers where the die kickout pin retracts slightly between the cone and finish blows to allow for better fill on the finished part or to help get a better trim.

RETAINER – A part of the die block or tool holder used to keep the die or tool assembly in place.

REVERSE FORMING – A technique used when the formed part is inverted by exchanging the normal punch and die tooling so as to improve the blank control during the transfer motion or converting a rotating transfer process into a straight across transfer process.

SCRAP – 1). Rejected parts.

2). Pierced out slug or trim ring.

SEAM – A linear flaw on the outside surface of wire. It can lead to cracking of the material when upset.

SEGMENTED INSERTS – 1). An insert made from more than one piece. An example would be a hex insert made from six pieces and assembled into a sleeve. This is done to improve the life of the insert.

2). A special insert design used for double upsetting. The insert is split into three or four pieces so that it can open and close to allow for the kickout of the finished part.

SEMI-TUBULAR RIVET – A rivet with a cavity extending less than half the length of the shank.

SEMI-UNIVERSAL UNIT – A transfer unit for the Universal Transfer or UT II transfer that allowed the use of CNF spring style, non-opening transfer fingers.

SERRATIONS – Notches or grooves in the metal. Can be straight or spiral.

SETDOWN – A dimension used to check for the proper amount of interference fit on a tapered insert assembly. Also the distance that a tapered insert is pressed into a case for assembly.

SHANK – 1). Bolt or screw – the section under the head.

2). Other parts – usually a long cylindrical portion of the part.

SHAVE – A metal removal process by cutting, usually small amounts.

SHEAR DOWN – A small area usually under a head or shoulder where some material has been displaced into the tail or shank.

SHOULDER – The portion of a part or tooling component between two different diameters.

SHRINK-FIT – A method of assembling an insert into a case with an interference fit. The case is heated to expand the inside diameter for assembly. Upon cooling the case will support the insert.

SHUT HEIGHT – The distance from the face of the dies to the face of the wedge at front dead center.

SINGLE POINT TKO – A tool side kickout design that uses a single intermediate rod between the TKO lever or rod in the heading slide and the tooling. Can be used to push a single pin on the centerline of the tool or to push a filler and spider pins for a kickout sleeve.

SIZE – To form to final dimensions.

SKINNING – A surface condition where a small portion of the part material has been sheared and pushed into another location.

SKIRT – A thin rim that is parallel to the axis of a part. Examples would be the thin radial projection on top of the hex on spark plug shells or Nylock nuts.

SLEEVE KICKOUT – A design using a thin walled sleeve to strip a hollow part off of a pin and to eject the part out of the tool/die cavity. The sleeve is usually kicked with 3 or 4 spider pins.

SLIDING DIE / TOOL – A tool design allowing the tool or die case assembly to move axially. Used for the backward extrusion of a hole into a part, piercing, or the upsetting of a preform shape.

SLUG – 1). The small amount of material pierced from a hole.

2). A blank as prepared for forming.

SLUG DISCHARGE – Machine and tooling designs to allow for the removal of the pierced slug from either the tool or die and into the scrap discharge chutes of the machine.

SNAP DOWN – A term used to describe the movement of transfer fingers closing on a larger diameter and then moving to a smaller diameter during the part kickout motion.

SPARK PLUG BOLSTER – A special tool holder located on the heading slide and used for the forming of the thin skirt above the hex on a spark plug shell. It contains two pairs of springs, each pair connected with an oval tangent pin. The two tangent pins then transfer the combined spring load to the sliding tool.

SPC – An abbreviation for “Statistical Process Control”. Used to judge the repeatability and consistency of a process.

SPIDER PINS – Either three or four pins working as a group between the kickout rod or filler and a kickout sleeve to remove the formed part from the tool or die.

SQUARE – 1). Square up: A forming operation to make the ends of the cutoff blank more perpendicular to the sides.

2). Square the shoulder: To reduce the radius and further sharpen the corner.

STAMP – To make a mark into the metal (as to stamp a trade mark or code on screw heads).

STEM – See **SHANK**

STOCK GAGE TIP – An adjustable stop at the cutoff station that controls the length of the sheared blank. Used on machines with rotating feed rolls that feed in the wire.

STRAIGHT ACROSS TRANSFER – A transfer with cam controlled opening and closing fingers that moves the parts in a straight line between forming stations. Typically used for long shank type products.

STRAIGHT INSERT – An insert design where the outside diameter of the insert is parallel to the axis of the insert. In some cases there can be a very slight taper towards the rear of the insert to aid in the assembly of the insert into the case.

STRAIGHTENER ROLLS – A tooling component in the wire line of a machine equipped with a wire straightener. They are either grooved for a specific wire diameter and must be changed when the incoming wire diameter changes or they can have a “V” groove to cover a range of incoming wire diameters.

STRIPPER AT FACE OF DIE – A machine mechanism used to remove thin walled backward extruded parts from the extrusion pin when a kickout sleeve is not practical. The “U” shaped stripper tip moves between the part at the end of the die kickout stroke and the face of the die. A large spring on the die kickout pin then pulls the extrusion pin out of the part before the transfer starts to move.

STRIPPER BAR – A tooling component that ties the two intermediate kickout pins together for a two-point TKO tool design. The TKO rod pushes against the bar to move the intermediate pins.

STRIPPER INSERT – A tooling component pressed into the stripper plate for a two-point TKO tool design. This insert varies to suit removing hollow parts from the forming punch.

STRIPPER PLATE – A tooling component for a two-point TKO design. It is on the front of the tool and fastened to two spring loaded pins. The springs pull the stripper plate back to its starting position after the TKO stroke is finished.

SUCK IN – A depression in the end of a solid part or around the hole of a hollow part resulting from the material flow and friction during the extrusion process.

SUPPORTED KICKOUT – This is a special kickout pin design that gives additional support to the kickout pin during the kickout stroke. The design is used whenever the unsupported length of the kickout pin exceeds 10 to 12 diameters.

TANGENT PIN – A pin intersecting the periphery of the tool or die bore normal to the axis of the bore and used to hold in a sliding tool or die or to maintain radial orientation of the tool or die.

TAPERED INSERT – An insert design where the outside diameter of the insert is not parallel to the axis of the insert but is tapered towards the front of the insert.

THREADS – 1). Pitch Diameter – Generally used as the thread rolling diameter for machine screw threads.

2). Major Diameter – The outside diameter of the threads.

3). Minor Diameter – The smallest diameter or “root” diameter of the thread.

THREAD ROLLING – A method of forming external threads on a blank by squeezing the part between two forming dies. In flat die forming, one of the dies is stationary and fastened to the bed of the machine. The other die is mounted to a reciprocating slide.

THREADED FILLER – A special filler screwed into the back of a tapered insert design case. This filler is used to keep the tapered inserts in position with axial pressure.

TIMED AIR – Special machining to allow for the introduction of timed compressed air directly into the tool or die. Used to blow a pierced slug off of a piercing punch.

TIMED HOLD – The first portion of the TKO motion in the heading slide. During this part of the stroke, the dimension from the face of the die to the face of the TKO lever or rod stays the same. The majority of the formed part should be removed from the tool during this part of the stroke.

TIR or T.I.R. – An abbreviation for “Total Indicator Reading”. This is used to indicate the amount of runout between formed surfaces.

TKO or T.K.O. – An abbreviation for “Timed Kickout”. This is the part ejection mechanism on the machine heading slide. It is used to remove parts from the tools after forming.

TOOL – A general term used to describe a heading tool or punch carried on the heading slide as compared to a stationary die. Often “Tooling” refers to a complete die set.

TOOL CAP – This is a removable portion of the tool holder on the FORMAX and FORMAX PLUS machines. It allows for the quick changing from one style of tool holder to another and still maintaining the centering of that tool holder.

TOOL HOLDER – This is the machine part fastened to the face of the heading slide that holds the moving tooling components.

TOOLPAK – The punch side assembly of the Formapak on FORMAX & FORMAX Plus machines. It includes the tool holders and wedges.

TOOL SLIDE – The linear distance a sliding tool must move to allow for the backward extrusion of a hole, piercing, or the upsetting of a preform.

TOTAL HOLD – This is the addition of the timed hold and untimed hold movements during the TKO stroke. The tooling needs to be designed to accommodate the total hold value selected.

TRANSFER ASSIST – A machine mechanism that is mounted below the die block. It raises and lowers a support tip that keeps the formed part from falling during the kickout stroke until the transfer fingers can grip the part. Primarily used with straight across transfers and formed parts that had multiple steps or tapers on the outside diameter.

TRANSFER CORRIDOR – The theoretical space that the transfer fingers move through from station to station. It is important that any tooling items do not infringe on the corridor during the transfer movement.

TRAP – A condition where an incoming blank or tooling item forms an enclosed cavity that does not allow the escape of oil or air from that cavity.

TRAPPED EXTRUSION – This refers to a forward extrusion where the incoming blank is totally enclosed inside the tooling before the extrusion takes place.

TRIM – A metal removal process where the excess metal is sheared from the outside surface of the part. (Example: to trim the hex shape on a bolt blank).

1). **BOLTMAKER (pinch) TRIM** – The metal is sheared from the outside of a button upset and formed into a trim chip between the trim punch and die. A machine mechanism provides a bump kick through the die kickout pin to shear off the trim chip.

2). **HEX FLANGE BOLT (crush) TRIM** – The metal is sheared from the outside of a preform upset and formed into the flange. The outside of the flange is trimmed in a subsequent BOLTMAKER TRIM operation.

3). **PUSH THRU TRIM** – The formed blank is pushed through a die insert and the outside surface is trimmed from the part. No trim kick mechanism is required.

TRIM CHIP – See **SCRAP**.

TRIM DIE – The tooling component that shears the metal during the trim operation.

TRIM KICK – A positive mechanical die kick motion at or slightly after front dead center to and used to shear off the trim kick.

TRIM PAK – A special Toolpak for FORMAX & FORMAX Plus machines with a special trim discharge wedge in the last station that discharges the trimmed parts under the heading slide.

TRIM PUNCH – The stationary component of the trim tooling typically mounted in the die block.

TRIM TUBE – The tube in the heading slide on traditional machines that guides the trimmed parts from the heading slide to the pointer.

TWO POINT TKO – A tool side kickout design that uses two intermediate rods connected by a bar. These are located between the TKO lever or rod in the heading slide and two spring loaded pins in the tooling. The pins are mounted on the vertical centerline of the tool bore and are attached to a plate. This design allows for the plate to be pulled back after the TKO stroke to get more die lubricant on the punch. This design also allows for shorter forming punches.

TUBE UPSET – The forming of a hollow upset from a hollow preform.

UNDERFILL – A portion of the formed part which has insufficient metal to give it the full shape of the tooling impression or cavity.

UNDERSLUNG FINGERS – Special transfer fingers that are used when the fingers must snap down from

a larger diameter to a smaller diameter during the die kickout motion. They give added control to the part during the snap down process.

UNIT PRESSURE – Load divided by area.

UNIVERSAL TRANSFER – A transfer design that combined features from the straight across transfer and the CNF transfer. The fingers units could be setup to take parts straight across between stations or to rotate the part 180 degrees between stations with fingers that did not open. The units could also be changed to have cam opened and closed fingers that could also transfer parts straight across or rotate them between forming stations.

UNSUPPORTED STOCK – The length of material during an upsetting operation not controlled by the tooling. Usually expressed by “number of diameters” (length , diameter).

UNTIMED HOLD – The second portion of the TKO motion in the heading slide. During this part of the stroke, the dimension from the face of the die to the face of the TKO lever or rod starts to increase meaning that the lever or rod is starting to move away from the face of the die. However, that movement is less than the movement of the heading slide during the same time. Consequentially, the kickout parts inside the tooling see more kickout stroke.

UPSET – When metal is reduced in height and the starting diameter is increased. A process typically used to form a head on a part. The upset material may be in the open between the tooling components or it may be totally enclosed within the tooling at the end of the forming stroke.

UPSET RATIO – The ratio of the finished height of the upset versus the finished outside diameter of the upset. It is used to help determine the load required to do the upset.

VAPOR BLAST – A manufacturing technique that will apply a fine texture to a hardened piece of steel.

VENT – A small hole or groove(s) in the tooling providing for the escape of air and oil from a tooling cavity.

WARM FORMING – A special metal forming process where the incoming wire or re-fed blank is heated to an elevated temperature to reduce the forming load and increase ductility.

WASTE – The metal used in excess of that required for the finish part.

WATERFALL PUNCH – A special design backward extrusion punch with a partial spherical nose shape and no extrusion land.

WEDGE – An adjustable machine part mounted on the heading slide behind the tooling. Wedge adjustment moves the tooling closer or farther away from the face of die at front dead center. Used to control the length dimensions of the formed parts.

WHISTLE NOTCH – An angle machined cut in the side of a tool or die case that accepts the hold down screw from the tool holder or die block.

WIRE:

ALUMINUM KILLED – The most uniform commercial quality wire having a consistent structure throughout the entire cross-section.

ANNEALED – Produces improved ductility to a lesser degree than spheroidizing.

BRIGHT STEEL – A wire with a very thin lime coating only. Suitable for heading and threading but not extruding.

COLD EXTRUSION COATING – A coating that must be suitable for at least two extrusion operations.

COLD EXTRUSION QUALITY – Exceptionally ductile wire with surface defects kept to a minimum.

COLD HEADING QUALITY – Wire satisfactory for the forming of trimmed hex head or square head bolts.

DOUBLE EXTRUSION COATING – See **COLD EXTRUSION COATING**.

DOUBLE X COATING – See **COLD EXTRUSION COATING**.

FINE GRAIN – The result of Aluminum Killing.

LIME COATED – This is a “dipped” coating not normally suitable for extruding without applying a lubricant by wire drawing. Lime is the lubricant carrier but can be used in some applications (nuts) where extrusion is not required.

PHOSPHATE COATED – A surface coating to lubricate the wire surface. It has high pressure resistance.

RECESSED HEAD QUALITY – Wire to be used for the forming of high strength socket head screws, recessed head screws, and similar parts.

RIMMED – A wire with an outer rim that is low in carbon and manganese with a core of higher carbon and manganese content. This produces a very ductile rim. Widely used in heading of low carbon fasteners.

SPHEROIDIZE-ANNEAL-IN-PROCESS – A heat treating operation between two drawing operations to produce a high quality wire with maximum ductility.

ZINC PHOSPHATE COATED – See **PHOSPHATE COATED**.

WIRE DRAWER – A device in the wire line of the machine before the feed rolls/grips. It reduces the diameter of the incoming wire. It can be either an in-line wire drawer powered by the cold forming machine or a stand alone capstan type with its own drive mechanism. This allows the use of larger tolerated hot rolled rod which can be draw to specific diameters.

WIRE STRAIGHTENER – A device with multiple staggered opposing rolls used to remove the bends and kinks from the incoming wire.

WORK HARDENING – Strength increase resulting from the permanent plastic deformation of a metal at a temperature below its recrystallization point, low enough to produce strain hardening.

WORK STROKE – The distance that the heading slide moves to perform a specific forming operation.

ZERO CLEARANCE – A machine feature on FORMAX and FORMAX PLUS machines that removes the heading slide running clearances as the parts are formed.

ABBREVIATIONS / ACRONYMS

3B-2D – Three Blow Two Die Header	IFO – Individual Finger Opening
AB – Alternate Blow	HP – Horsepower
AFDC – After Front Dead Center	HS CBH – High Speed Cold Ball Header
AIP – Anneal in Process	HS DSRH – High Speed Double Stroke Roller Header
BDC – Back Dead Center	HS DSSD – High Speed Double Stroke Solid Die Header
BFDC – Before Front Dead Center	HS TRH – High Speed Tubular Rivet Header
BH – Ball Header	J – Joule
BM – Boltmaker	KO – Kickout
CBH – Cold Ball Header	Ksi – 1000 pounds per square inch
CC – Controlled Closing	KW – Kilowatt
CF – Cold Fomer	L/D – Length divided by diameter ratio
CH – Cold Header	LS TRH – Long Stroke Tubular Rivet Header
CNF – Cold Nut Former	MF – Microformer
CO – Cutoff	MPM – Micro Position Monitor
COAP – Changer Over Assistance Package	MT – Metric Ton
CVD – Chemical Vapor Deposition	N – Newton
DSOD – Double Stroke Open Die Header	NF – Nut Former
DSSD – Double Stroke Solid Die Header	OD – Outside Diameter
DSRH – Double Stroke Roller Header	PD – Pitch Diameter
EDM – Electrode Discharge Machining	PH – Progressive Header
EOK – End of Kick	PKO – Punch Kickout
EP – Extreme Pressure	PMP – Pick-Move-Place
FC – Forming Center	PPM – Parts per minute
FDC – Front Dead Center	PSI – Pounds per Square Inch
FEA – Finite Element Analysis	PVD – Physical Vapor Deposition
FEM – Finite Element Method	QCPP – Quick Change Piercing Punch
FOD – Face of Dies	QCT – Quick Change Tooling
Ft-Lbs – Foot Pounds	R – Radius
FX – FORMAX	RA – Reduction in Area
FXH – FORMAX Header	RA_B – Reduction in Area – Backward Extrusion
FXP – FORMAX Plus	RA_F – Reduction in Area – Forward Extrusion
FXPT – FORMAX Plus Threader	RA_H – Reduction in Area – Hooker Extrusion
FXR – FORMAX Rivet Header	RATEX – Robot Assisted Tooling Exchange
FXT – FORMAX Threader	Rb – Rockwell “B” Hardness
G – Grind (Finish)	Rc – Rockwell “C” Hardness
GD&T – Geometric Dimensioning & Tolerancing	RH – Roller Header
HSS – High Speed Steel	RKO – Relieving Kickout
HT – Heat Treat	
ID – Inside Diameter	

RPM – Revolutions Per Minute
SAFS – Spheroidize Anneal at Final Size
SAIP – Spheroidize Anneal in Process
SF – Shell Former
SHCS – Socket Head Capscrew
SPC – Statistical Process Control
SPM – Strokes per Minute
T – Tons (US)
Tm – Metric Ton
t/D – Thickness divided by Diameter
TC – Tungsten Carbide
THD – Thread
TiC – Titanium Carbide
TiCN – Titanium Carbon Nitride
TiN – Titanium Nitride
TIR – Total Indicator Reading
TKO – Timed Kickout
TRH – Tubular Rivet Header
TSC – Theoretical Sharp Corner
TYP – Typical
UT – Universal Transfer
UT II – Universal Transfer 2
WD – Wire Drawer
WF – Warm Former