

Glossary

A

- abrasive wheels:** Wheels of a hard abrasive, such as Carborundum used for grinding.
- abrasive, natural:** (sandstone, emery, corundum, diamonds) or artificial (silicon carbide, aluminum oxide) material used for making grinding wheels, sandpaper, abrasive cloth and lapping compounds.
- acetone:** A colorless, flammable, volatile liquid used as a paint remover and as a solvent for oils and other organic compounds.
- Acme thread:** A screw thread having a 29 degree included angle. Used largely for feed and adjusting screws on machine tools.
- acute angle:** An angle that is less than 90 degrees.
- adapter:** A tool holding device for fitting together various types or sizes of cutting tools to make them interchangeable on different machines.
- align:** To adjust or set to a line or center.
- alloy steel:** A plain carbon steel to which another element, other than iron and carbon, has been added in a percentage large enough to alter its characteristics.
- alloy:** A substance with metallic properties, composed of two or more chemical elements of which at least one is a metal.
- allthread:** Steel or stainless steel rod threaded from end to end. It is available in a wide range of diameters and thread specifications.
- aluminum:** One of the chemical elements, a silvery, lightweight, easily worked metal that resists corrosion.
- angle plate:** A precision holding fixture made of cast iron, steel or granite. The two principal faces are at right angles and may be slotted for holding the work or clamping to a table.
- annealing:** The controlled heating and cooling of a metal to remove stresses and to make it softer and easier to work with.
- anvil:** A heavy iron or steel block upon which metal is forged or hammered; also the fixed jaw on a micrometer against which parts are measured.
- apron:** That portion of a lathe carriage that contains the clutches, gears and levers for moving the carriage. It also protects the mechanism.
- arbor press:** A hand-operated machine tool designed for applying high pressure for the purpose of pressing together or removing parts.
- arbor:** A shaft or spindle for holding cutting tools; most usually on a milling machine.
- assembly:** A unit of fitted parts that make up a mechanism or machine, such as the headstock assemble of a lathe.

ASTM: The American Society for Testing and Materials.

austenite: One of the basic steel microstructures wherein carbon is dissolved in iron. Austenite forms at elevated temperatures.

automatic stop: A device which may be attached to any of several parts of a machine tool to stop the operation of the machine at any predetermined point.

AWS: The American Welding Society.

axis: The line, real or imaginary, passing through the center of an object about which it could rotate; a point of reference.

B

babbitt: An antifriction metal alloy used for bearing inserts; made of tin, antimony, lead and copper.

back gears: Gears fitted to a machine to increase the number of spindle speeds obtainable with a cone or step pulley belt drive.

back rake: The angular surface ground back from the cutting edge of cutting tools. On lathe cutting tools the rake is positive if the face slopes down from the cutting edge toward the shank and negative if the face slopes upward toward the shank.

backlash: The lost motion or looseness (play) between the faces of meshing gears or threads.

bandsaw: A power saw the blade of which is a continuous, narrow, steel band having teeth on one edge and passing over two large pulley wheels.

bar stock: Metal bars of various lengths, made in flat, hexagon, octagon, round and square shapes from which parts are machined.

bastard: Threads, parts, tools and sizes that are not standard, such as bastard nuts, bastard plugs, bastard fittings, and so forth. The term also refers to a standard coarse-cut file.

bearing: Rollers and balls placed between moving parts to reduce friction and wear.

bed: One of the principal parts of a machine tool, having accurately machined ways or bearing surfaces for supporting and aligning other parts of the machine.

bell mouth: The flaring or tapering of a machined hole, usually made at the entrance end because of misalignment or spring of the cutting tool.

bench grinder: A small grinding machine for shaping and sharpening the cutting edges of tools.

bevel: Any surface that is not at right angles to another surface. Also, the name given a tool used for measuring, laying out, or checking the accuracy of work machined at an angle or bevel.

bit, tool (cutter): A hardened steel bar or plate that is shaped according to the operation to be performed and the material to be machined.

blind hole: A hole made in a workpiece that does not pass through it.

body-centered cubic (BCC): One of the common types of unit cells described as a cube with an atom at each of the eight corners and a single atom at the center of the cell. This

arrangement is typical of the ferritic form of iron. Among the common BCC metals are iron, carbon steel, chromium, molybdenum and tungsten.

bore: To enlarge and finish the surface of a cylindrical hole by the action of a rotating boring bar (cutting tool) or by the action of a stationary tool pressed (fed) against the surface as the part is rotated.

boring bar: A combination tool holder and shank.

boring tool: A cutting tool in which the tool bit the boring bar and, in some cases, the tool holder are incorporated in one solid piece.

boss: A projection or an enlarged section of a casting through which a hole may be machined.

brass: A nonferrous alloy consisting essentially of copper and zinc.

brazing: A group of welding processes that produces coalescence of materials by heating them to the brazing temperature in the presence of a filler metal having a liquidus above 850°F (450°C) and below the solidus of the base metal. The filler metal is distributed between the closely fitted faying surfaces of the joint by capillary action.

brine: A saltwater solution for quenching or cooling when heat treating steel.

Brinell hardness test: A common testing method using a ball penetrator. The diameter of the indentation is converted to units of Brinell hardness number (BHN).

Brinell hardness: A method of testing the hardness of a metal by controlled pressure of a hardened steel ball of a given size.

broach: A long, tapered cutting tool with serration's which, when forced through a hole or across a surface, cuts a desired shape or size.

bronze: A nonferrous alloy consisting essentially of copper and tin.

buff: To polish to a smooth finish of high luster with a cloth or fabric wheel to which a compound has been added.

burnishing: The process of finishing a metal surface by contact with another harder metal to improve it. To make smooth or glossy by or as if by rubbing; polish.

burr: The sharp edge left on metal after cutting or punching; also, a rotary cutting tool designed to be attached to a drill.

bushing: A sleeve or a lining for a bearing or a drill jig to guard against wear.

C

caliper: A device used to measure inside or outside dimensions.

cam: A device for converting regular rotary motion to irregular rotary or reciprocating motion. Sometimes the effect of off-center lathe operations.

capillary action: The force by which liquid in contact with a solid is distributed between closely fitted faying surfaces of the joint to be brazed or soldered.

carbide tool bits: Lathe cutting tools to which carbide tip inserts have been brazed, to provide cutting action on harder materials than the high speed cutters are capable of.

carbon steel: A broad term applied to tool steel other than high-speed or alloy steel.

- carbon:** A nonmetallic chemical element that occurs in many inorganic and all organic compounds. Carbon is found in diamond and graphite and is a constituent of coal, petroleum, asphalt, limestone and other carbonates. In combination, it occurs as carbon dioxide and as a constituent of all living things. Adjustment of the amount of carbon in iron produces steel.
- carriage:** A principal part of a lathe that carries the cutting tool and consists of the saddle, compound rest and apron.
- case hardening:** A heat treating process, basically carbonizing that makes the surface layer or case of steel substantially harder than the interior or core.
- cast iron:** A family of alloys, containing more than 2% carbon and between 1 and 3% silicon. Cast irons are not malleable when solid and most have low ductility and poor resistance to impact loading. There are four basic types of cast iron gray, white, ductile and malleable.
- casting:** A part made by pouring molten metal into a mold.
- castle nut:** A nut with grooves cut entirely across the top face for the purpose of resisting loosening with vibration.
- center drill:** A combined countersink and drill used to prepare work for mounting centers.
- center gage:** A small, flat gage having 60° angles that is used for grinding and setting the thread cutting tools in a lathe. It may also be used to check the pitch of threads and the points of center.
- center head:** A part of a combination square set that is used to find the center of or to bisect a round or square workpiece.
- center punch:** A pointed hand tool made of hardened steel and shaped somewhat like a pencil.
- center, dead:** A center that does not rotate; commonly found on the tailstock of a lathe. Also, an expression for the exact center of an object.
- center, half:** A dead center that has a portion of the 60 degree cone cut away.
- center, live:** A center that revolves with the work. Generally this is the headstock center; however, the ball bearing type tailstock center is also called a live center.
- center:** A point or axis around which anything revolves or rotates. In the lathe one of the parts upon which the work to be turned is placed. The center in the headstock is referred to as the "live" center and the one mounted in the tailstock as the "dead" center.
- chamfer:** The bevel or angular surface cut on the edge or a corner of a machined part.
- chasing threads:** Cutting threads in a lathe or screw machine.
- chatter:** The vibrations caused between the work and the cutting tool which leave distinctive tool marks on the finished surface that are objectionable.
- chip breaker:** A small groove ground back of the cutting edge on the top of a cutting tool to keep the chips short.
- chipping:** The process of cutting metal with a cold chisel and hammer.

- chisel:** Any one of a variety of small hand cutting tools, generally wedge-shaped.
- chromium:** A lustrous, hard, brittle, steel-gray metallic element used to harden steel alloys, in production of stainless steel and as a corrosion resistant plating.
- chuck, independent jaw:** A chuck, each of whose jaws (usually four) is adjusted with a screw action independently of the other jaws.
- chuck, universal (self-centering chuck, concentric chuck):** A chuck whose jaws are so arranged that they are all moved together at the same rate by a special wrench sometimes called a "key."
- chuck:** A device on a machine tool to hold the workpiece or a cutting tool.
- clearance angle:** The angle between the rear surface of a cutting tool and the surface of the work at the point of contact.
- clearance:** The distance or angle by which one object surface clears another.
- climb milling:** A method of milling in which the work table moves in the same direction as the direction of rotation of the milling center. Sometimes called down cutting or down milling.
- coefficient of thermal expansion:** The increase in length per unit length for each degree a metal is heated.
- cohesion:** Cohesion is the result of a perfect fusion and penetration when the molecules of the parent material and the added filler materials thoroughly integrate as in a weld.
- cold work:** Cold working refers to forming, bending, or hammering a metal well below the melting point. Cold working of metals causes hardening, making them stronger but less ductile.
- cold-rolled steel:** Steel that has been rolled to accurate size and smooth finish when made. In contrast, hot-rolled steel may have a rough, pitted surface and slag inclusion.
- collet:** A precision work-holding chuck which centers finished round stock automatically when tightened. Specialized collets are also available in shapes for other than round stock.
- combination square:** A drafting and layout tool combining a square, a level, a protractor and a center head.
- compound (rest):** The part of a lathe set on the carriage that carries the tool post and holder. It is designed to swing in any direction and to provide feed for turning short angles or tapers.
- concave:** A curved depression in the surface of an object.
- concentric:** Accurately centered or having a common center.
- contour:** The outline of an object.
- convex:** The curved surface of a cylinder, as a sphere when viewed from without.
- coolant:** A common term given to the numerous cutting fluids or compounds used with cutting tools to increase the tool life and to improve surface finish on the material.
- corrosion:** Oxidation (rusting) or similar chemical change in metals.

- counterbore:** To enlarge the top part of a hole to a specific size, as for the head of a socket-head or cap-screw. Also, the tool that is used.
- countersink:** To enlarge the top part of a hole at an angle for a flat-head screw. Also, the tool that is used.
- cross feed:** The feed that operates across the axis of the workpiece or at right angles to the main or principal feed on a machine.
- cross section:** A view showing an internal structure as it would be revealed by cutting through the piece in any plane.
- crucible steel:** A high-grade tool steel made by melting selected materials in a crucible.
- CS:** Cutting speed.
- cutting fluid:** A liquid used to cool and lubricate the cutting to improve the work surface finish.
- cutting speed:** The surface speed of the workpiece in a lathe or a rotating cutter, commonly expressed in feet per minute (FPM) and converted to revolutions per minute (RPM) for proper setting on the machine.
- cutting tool:** A hardened piece of metal (tool steel) that is machined and ground so that it has the shape and cutting edges appropriate for the operation for which it is to be used.

D

- dead center:** See center, dead.
- dead smooth:** The term applied to the finest cut of a file.
- deburr:** To remove sharp edges.
- die stock:** The frame and two handles (bars) which hold the dies (chasers) used for cutting (chasing) external screw threads.
- die:** A tool used to form or stamp out metal parts', also, a tool used to cut external threads.
- dividers, spring:** Dividers whose legs are held together at the hinged end by the pressure of a C-shaped spring.
- dividing head (index bead):** A machine tool holding fixture which positions the work for accurately spacing holes slots flutes and gear teeth and for making geometric shapes. When geared to the table leadscrew, it can be used for helical milling operations.
- dog:** A clamping device (lathe dog) used to drive work being machined between centers. Also, a part projecting on the side of a machine worktable to trip the automatic feed mechanism off or to reverse the travel.
- dovetail:** A two-part slide bearing assembly used in machine tool construction for the precise alignment and smooth operation of the movable components of the machine.
- dowel:** A pin fitted or keyed in two adjacent parts to accurately align the parts when assembling them.

- down feed (climb cutting, climb milling):** A seldom used method of feeding work into milling cutters. The work is fed in the same direction as the portion of the cutter which comes in contact with it.
- draw:** See tempering.
- dressng:** The act of removing the glaze and dulled abrasives from the face of a grinding wheel to make it clean and sharp. See truing.
- drift:** A tapered, flat steel used to remove drills and other tapered shank tools from spindles, sockets, or sleeves. Also a round, tapered punch used to align or enlarge holes.
- drill bushing:** A hardened steel guide inserted in jigs, fixtures or templates for the purpose of providing a guide for the drill in drilling holes in their proper or exact location.
- drill chuck:** A device used to grip drills and attach them to a rotating spindle.
- drill jig:** A jig which holds parts or units of a structure and by means of bushings, guides the drill so that the holes are properly located.
- drill press:** A drilling machine with a counterbalanced spindle which makes it possible for the operator to control accurately the rate at which the drill is fed into the work. The sensitive drill press usually contains drills that are less than ½ inch in diameter and which rotate at high speeds.
- drill rod:** A term given to an annealed and polished high carbon tool steel rod usually round and centerless ground. The sizes range in round stock from .013 to 1½ inches diameter. Commercial qualities embrace water and oil hardening grades. A less popular but nevertheless standard grade is a non-deforming quality. Drill rod is used principally by machinists and tool and die makers for punches, drills, taps, dowel pins, screw machine parts and small tools.
- drill sleeve:** An adapter with an internal and external taper which fits tapered shank tools such as drills or reamers to adapt them to a larger size machine spindle.
- drill socket:** An adapter similar to a sleeve except that it is made to adapt a larger tapered-shank tool to a smaller size spindle.
- drill, center:** A combination drill and countersink.
- drill, twist:** A commonly used metal-cutting drill, usually made with two flutes running around the body.
- drive fit:** One of several classes of fits in which parts are assembled by pressing or forcing one part into another.
- ductility:** The property of a metal that permits it to be drawn, rolled, or hammered without fracturing or breaking.

E

- eccentric:** A circle not having a geometric center. Also, a device such as a crankshaft or a cam for converting rotary motion to reciprocating motion.

elastic limit: The greatest stress the material can withstand without permanent elongation when all load has been removed from the specimen. Any strains developed up to the elastic limit are both small and reversible.

element: Matter which cannot be broken up into simpler substances by chemical action, that is, whose molecules are all composed of only one kind of atom.

emery: A natural abrasive used for grinding or polishing. It is being largely replaced by artificial abrasives.

emulsion: A coolant formed by mixing soluble oils or compounds with water.

F

face milling: Milling a large flat surface with a milling cutter that operates in a plane that is at right angles to its axis.

face: To machine a flat surface, as in the end of a shaft in the lathe. The operation is known as facing.

face-centered cubic (FCC): One of the common types of unit cells in which atoms are located on each corner and the center of each face of a cube. Among the common FCC metals are aluminum, copper, nickel and austenitic stainless steel. This arrangement is typical of the austenitic form of iron.

faceplate: A large circular plate with slots and holes for mounting the workpiece to be machined. It is attached to the headstock of a lathe.

facing: The process of making a flat or smooth surface (usually the end) on a piece of stock or material.

fatigue failure: The sudden and complete breakage of a part as a result of the repeated application of a load. Fatigue failure is progressive and may not occur until after millions of load cycles.

fatigue strength: Ability of a material to withstand repeated loading.

fatigue: The effect on certain materials, especially metals, undergoing repeated stresses.

feed mechanism: The mechanism, often automatic, which controls the advancing movement (feed) of the cutting tools used in machines.

feed: The rate of travel of a cutting tool across or into the work, expressed in inches per minute, in inches per revolution, mm per minute or mm per revolution.

female part: A concave piece of equipment which receives a mating male (convex) part.

ferrous: A metal alloy in which iron is the major ingredient.

filler material: The material, metal, or alloy to be added in making a welded, brazed, or soldered joint.

fishtail: A common name for the center gage. It is used to set thread cutting tools and has scales on it for determining the number of threads per inch.

fit: The relation between mating or matching parts, that is, the amount of, or lack of play between them.

- fixture:** A production work-holding device used for machining duplicate workpieces.
Although the term is used interchangeably with a jig, a fixture is not designed to guide the cutting tools as the jig does. Also, a device designed to hold and maintain parts in proper relation to each other.
- flange:** A relatively thin rim around a part.
- flute:** The groove in a cutting tool which provides a cutting edge and a space for the chips to escape and permits the cutting fluids to reach the cutting edges.
- flycutter:** A single-point cutter mounted on a bar in a flycutter holder or a flycutter arbor-used for special applications for which a milling cutter is not available.
- follower rest:** A support for long, slender work turned in the lathe. It is mounted on the carriage, travels close to and with the cutting tool and keeps the work from springing away.
- footstock:** Part of an indexing, attachment which has a center and serves the same purpose as the tail stock of a lathe.
- force fit:** A fitting which one part is forced or pressed into another to form a single unit.
There are different classes of force fits depending on standard limits between mating parts.
- forge:** To form or shape heated metal by hammering. Also, the name of the unit used for heating metal, as the blacksmith's forge.
- formed cutters:** Milling cutters, which will produce shaped surfaces with a single cut are so designed that they may be sharpened without changing their outline or shape.
- forming tool:** Tool ground to a desired shape to reproduce this shape on the workpiece.
- FPM:** Feet per minute of workpiece.
- free cutting steel:** Bar stock containing a high percentage of sulfur making it very easy to machine.
- free fit:** A class of fit intended for use where accuracy is not essential or where large temperature variations are likely to be encountered, or both conditions.
- fuel gas:** A gas such as acetylene, natural gas, hydrogen, propane, stabilized methylacetylene propadiene and other fuels normally used with oxygen in one of the oxyfuel processes and for heating.
- fulcrum:** The point or support on which a lever turns.
- fusion:** The joining of base material, with or without filler material, by melting them together.

G

- gage, feeler (thickness gage):** A gage consisting of a group of very thin blades, each of which is accurately ground to a specific thickness.
- gage, indicating (dial indicator):** A gage consisting of a dial, commonly graduated (marked) in thousandths of an inch, to which is fastened an adjustable arm.
- gage, radius (fillet gage):** Any one of a number of small, flat, standard-shaped metal leaves or blades used for checking the accuracy of regular concave and convex surfaces.

gage, screw pitch: A gage consisting of a group of thin blades used for checking the number of screw threads per unit of distance, usually per inch, on a screw, bolt, nut, pipe, or fitting.

gage, telescoping: A T-shaped gage used to measure the diameter or width of holes.

gage: Any one of a large variety of devices for measuring or checking the dimensions of objects.

gang milling: A milling setup where a number of cutters are arranged on an arbor so that several surfaces can be machined at one time. It is commonly used for production purposes.

gib: A tapered strip of metal placed between the bearing surface of two machine parts to ensure a precision fit and provide an adjustment for wear.

GTAW: The Gas Tungsten Arc Welding process; non-standard terms are Heliarc™ and TIG (tungsten inert gas).

H

hacksaw: A metal blade of hardened steel having small, close teeth on one edge. It is held under tension in a U-shaped frame.

Half-nut: A lever-operated mechanism that resembles a split nut that can be closed on the leadscrew of a lathe when threads are being cut.

handwheel: Any adjusting or feeding mechanism shaped like a wheel and operated by hand.

hardening: A heat-treating process for steel which increases its hardness and tensile strength and reduces its ductility.

hardness tests: Tests to measure the hardness of metals.

headstock: The fixed or stationary end of a lathe or similar machine tool.

heat treatment: The process of heating and cooling a solid metal or alloy to obtain certain desired properties or characteristics.

helical gear: A gear with teeth cut at some angle other than at a right angle across the face of the gear, thus permitting more than one tooth to be engaged at all times and providing a smoother and quieter operation than the spur gear.

helix angle: The angle between the direction of the threads around a screw and a line running at a right angle to the shank.

helix: A path formed as a point advances uniformly around a cylinder, as the thread on a screw or the flutes on a drill.

hex: A term used for anything shaped like a hexagon.

hexagonal close packed (HCP): A unit cell in which two hexagons (six-sided shapes) form the top and bottom of the prism. An atom is located at the center and at each point of the hexagon. Three atoms, one at each point of a triangle, are located between the top and bottom hexagons. Among the common HCP metals are zinc, cadmium and magnesium.

high-carbon steel: See carbon steel.

high-speed steel (HSS): An alloy steel commonly used for cutting tools because of its ability to remove metal at a much faster rate than carbon steel tools.

hob: A cylindrical cutting tool shaped like a worm thread and used in industry to cut gears.

hobbing: The operation of cutting gears with a hob.

hog: To remove in excess of what is considered normal, sometimes causing accidents or tool breakage; also, to rough out haphazardly.

hole saw: A cutting tool used to cut a circular groove into solid material.

honoring: The process of finishing ground surfaces to a high degree of accuracy and smoothness with abrasive blocks applied to the surface under a light controlled pressure and with a combination of rotary and reciprocating motions.

hot-rolled steel: Steel which is rolled to finished size while hot. Identified by a dark oxide scale left on the surface.

hydrogen: The lightest chemical element, colorless, odorless and tasteless. It is found in combination with other elements in most organic compounds and many inorganic compounds. Hydrogen combines readily with oxygen in the presence of heat and forms water.

I

ID: Inside diameter.

idler: A gear or gears placed between two other gears to transfer motion from one gear to the other gear without changing their speed or ratio.

impact strength: The ability of a material to resist shock, dependent on both strength and ductility of the material.

independent chuck: A chuck in which each jaw may be moved independently of the others.

index plate: A metal disk or plate punched with many holes arranged in a series of rings, one outside the other each ring containing a different number of holes.

indexing fixture: A complete indexing unit composed of a dividing head and rootstock. (See dividing head.)

indexing: The process of positioning a workpiece for machining it into equal spaces, dimensions or angles using an index or dividing head.

indicator: A precision instrument which shows variations of thousandths of an inch or less when testing the trueness or alignment of a workpiece, fixture, or machine.

inserted-tooth cutter: A milling cutter designed with replaceable cutting tooth inserts to save the expense of a new cutter whenever the teeth become damaged or worn. Generally, they are made 6 inches or more in diameter.

intermediate gear: See idler.

IPM: Feed rate in inches per minute.

iron carbide: A binary compound of carbon and iron; it becomes the strengthening constituent in steel.

iron-carbon phase diagram: A graphical means of identifying different structures of steel and percentages of carbon occurring in steel at various temperatures.

J

jack, leveling: Small jacks (usually screw jacks) for leveling and holding work on planner beds and similar places.

Jarno: A standard taper having 0.600-inch taper per foot used on some machine tools.

jig: A device that holds the workpiece in place and guides the cutting tool during the cutting operation.

Johansson blocks (Jo blocks): Common term for the precision gage blocks used and accepted as dimensional standards by machinists, toolmakers and inspectors.

joint clearance: The distance between the faying surfaces of a joint in brazing or soldering.

K

kerf: The width of a cut produced during a cutting process.

keyseat: A recessed groove (slot) machined into a shaft or a part going on the shaft (usually a wheel or gear).

key: One of the several types of small metal objects designed to fit mating slots in a shaft and the hub of a gear or pulley to provide a positive drive between them. Also the name of the T-handle wrench used on chucks.

knee: That part of a column of a knee-type milling machine which carries the saddle and the table and provides the machine with vertical feed adjustments. Also, the name of a precision angle plate called a "toolmaker's knee".

knurl: A decorative gripping surface of straight-line or diagonal design made by uniformly serrated rolls called knurls.

knurling: The process of finishing a part by scoring (pressing) patterns on the surface of the work.

L

land: That surface on the periphery of a rotary cutting tool, such as a milling cutter, drill tap, or reamer, which joins the face of the flute or tooth to make up the basic cutting edge.

lap: A tool made of soft metal and charged with fine abrasives for precision finishing of metal surfaces. Also, to perform the operation using a lap.

lard oil: A cutting oil made from animal fats usually mixed with mineral oils to reduce its cost and improve its qualities.

layout: To locate and scribe on blank stock the shape and size dimensions required to machine or form the part.

lead hole: See pilot hole.

leadscrew: The long, precision screw located in front of the lathe bed geared to the spindle and used for cutting threads. Also, the table screw on the universal milling machine when geared to the indexing head for helical milling.

lead: The distance a thread will advance along its axis in one complete revolution. Also, a heavy, soft, malleable metal having a low melting point. It has a bright, silvery color when freshly cut or poured and turns to a dull gray with aging.

LH: Left hand.

limits: The smallest and largest dimension which are tolerable (allowed).

lip of a drill: The sharp cutting edge on the end of a twist drill.

liquidus: The lowest temperature at which a metal or an alloy is completely liquid.

live center: See center, live.

loading: A condition caused by grinding the wrong material with a grinding wheel or using too heavy a grinding action.

M

machinability: The degree of difficulty with which a metal may be machined; may be found in appropriate handbooks.

machine tool: A power-driven machine designed to bore, cut, drill, or grind metal or other materials.

machining, finish: Machining a surface to give it the desired finish.

machining, rough (rough finishing): Removing excess stock (material) with a machine tool thus shaping it in preparation for finish machining.

machinist: A person who is skilled in the operation of machine tools. He must be able to plan his own procedures and have a knowledge of heat-treating principles.

magnesium: A lightweight, ductile metal similar to but lighter than aluminum.

magnetic chuck: A flat smooth-surfaced work holding device which operates by magnetism to hold ferrous metal workpieces for grinding.

malleable: Capable of being extended or shaped by hammering or rolling.

mandrel: A precision-made tapered shaft to support work for machining between centers.

manganese: A gray-white nonmagnetic metallic element resembling iron, except it is harder and more brittle. Manganese can be alloyed with iron, copper and nickel, for commercial alloys. In steel it increases hardness, strength, wear resistance and other properties. Manganese is also added to magnesium-aluminum alloys to improve corrosion resistance.

MAPP[®] gas: A trade name for a fuel gas methacetylene-propadiene.

martensite: A very hard, brittle microstructure of steel produced when steel is rapidly quenched after being transformed into austenite.

medium steel: Refer to carbon steel.

mesh: To engage, as the teeth between two gears.

metal: A class of chemical elements that are good conductors of heat and electricity, usually malleable, ductile, lustrous and more dense than other elemental substances.

- metallic bond:** The principal atomic bond that holds metals together.
- metallurgy:** The science explaining the properties, behavior and internal structure of metals.
- methylacetylene propadiene:** A family of alternative fuel gases that are mixtures of two or more gases (propane, butane, butadiene, methylacetylene and propadiene).
Methylacetylene propadiene is used for oxyfuel cutting, heating, brazing and soldering.
- mike:** A term used for micrometer, or to measure with a micrometer.
- micrometer, depth:** A micrometer in which the spindle projects through a flat, accurately machined bar used to measure the depth of holes or recesses.
- micrometer, thread:** A micrometer in which the spindle is ground to a point having a conical angle of 60 degrees. The anvil, instead of being flat has a 60-degree V-Shaped groove, which fits the thread.
- microstructure:** A term use to describe the structure of metals. Visual examination of etched metal surfaces and fractures reveal some configurations in etched patterns that relate to structure, but magnification of minute details yields considerably more information. Microstructures are examined with low-power magnifying glass, optical microscope, or electron microscope.
- mild steel:** Refer to carbon steel.
- mill:** A milling machine; also, the act of performing an operation on the milling machine.
- milling cutter:** A cutting tool, generally cylindrical in shape used on a milling machine and operated essentially like a circular saw.
- milling, climb:** See climb milling; see face milling.
- minor diameter:** The smallest diameter of a screw thread. Also known as the root diameter.
- modulus of elasticity:** The ratio of stress to strain in material; also referred to as Young's modulus.
- molybdenum:** A hard, silver-white metal, a significant alloying element in producing engineering steels, corrosion resistant steels, tool steels and cast irons. Small amounts alloyed in steel promote uniform hardness and strength.
- monel:** A high tensile strength Ni-Cu alloy that exhibits high fatigue resistance in salt water, corrosive atmospheres and various acid and alkaline solutions. It is non-magnetic and spark-resistant.
- Morse taper:** A self-holding standard taper largely used on small cutting tools such as drills, end mills and reamers and, on some machines, spindles in which these tools are used.
- MSDS:** Material Safety Data Sheet.
- multiple-thread screw:** A screw made of two or more threads to provide an increased lead with a specified pitch.
- music wire:** A high-quality steel wire used for making springs. Also called piano wire.

N

NC: National Coarse.

necking: Machining a groove or undercut in a shaft to permit mating parts to be screwed tightly against a shoulder or to provide clearance for the edge of a grinding wheel.

NF: National Fine.

nickel: An alloying element which increases the strength, toughness and wear and corrosion resistance of steels.

nitrogen: A gaseous element that occurs freely in nature and constitutes about 78% of earth's atmosphere. Colorless, odorless and relatively inert, although it combines directly with magnesium, lithium and calcium when heated with them. Produced either by liquefaction and fractional distillation of air, or by heating a water solution of ammonium nitrate.

nominal pipe size (NPS): The size of pipe is identified by its *nominal pipe size*. For pipes between 1/8- and 12-inches nominal size, the outside diameter (OD) was originally selected so that the inside diameter was equal to the nominal size for pipes of standard wall thickness of the times. This is no longer true with the changes in metals and manufacturing processes, but the nominal size and standard OD continue in use as a trade.

noncorrosive flux: A soldering flux that in either its original or residual form does not chemically attack the base metal. It usually is composed of rosin-based materials.

nonferrous: Metal containing no iron, such as brass and aluminum.

normalizing: The process of heating a metal above a critical temperature and allowing it to cool slowly under room temperature conditions to obtain a softer and less distorted material.

O

OD: Outside diameter.

off center: Not centered; offset, eccentric, or inaccurate.

oil hardening: The process of quenching in oil when heat treating alloy steel to bring out certain qualities.

oilstones: Molded abrasives in various shapes used to hand-sharpen cutting tools.

oxidizing flame: An oxyfuel flame in which there is an excess of oxygen, resulting in an oxygen-rich zone extending around and beyond the cone.

oxygen: A colorless, odorless, tasteless, gaseous chemical element, the most abundant of all elements. Oxygen occurs free in the atmosphere, forming 1/5 of its volume and in combination in water, sandstone, limestone, etc.; it is very active being able to combine with nearly all other elements and is essential to life.

P

pack hardening: A heat-treating process in which the workpiece is packed into a metal box together with charcoal, charred leather or other carbonaceous material to case-harden the part.

parallels: Hardened steel bars accurately ground to size and ordinarily made in pairs in many different sizes to support work in precision setups.

parting: The operation of cutting off a piece from a part held in the chuck of a lathe.

pattern: Wood, metal, paper, or plastic sheet material that replicates the shape of a part. Patterns are used to transfer this shape to the work and may contain other information such as hole location, alignment marks and bend lines.

pd: pitch diameter.

peen: To draw, bend or flatten, also, the formed side of a hammer opposite the face.

phase transitions: When metals or metal alloys go from solid to liquid or the reverse, this is a phase transition. Iron phase transitions are: at room temperature to 1,670°F (910°C) iron is body-center cubic, 1670°F (910°C) to 2535°F (1388°C) iron is face-center cubic and 2535°F (1390°C) the melting point of iron to 2800°F (1538°C) iron is again body-center cubic. These changes are also called allotropic transformations.

phosphoric acid: The acid, H₃PO₄, widely used in industrial metal cleaning.

phosphorous: A highly reactive, toxic, nonmetallic element used in steel, glass and pyrotechnics. It is almost always found in combination with other elements such as minerals or metal ores. Found in steel and cast iron as an impurity. In steel it is reduced to 0.05% or less otherwise phosphorous causes embrittlement and loss of toughness, however small amounts in low-carbon steel produce a slight increase in strength and corrosion resistance.

pilot hole: A starting hole for large drills to serve as a guide, reduce the resistance and aid in maintaining the accuracy of the larger hole. Also called a lead hole.

pilot: A guide at the end of a counterbore which keeps it aligned with the hole.

pin fixture: A tool for bending wire, bar, or rod into a curve or series of curves.

pinning: A term used to describe the condition of a file clogged with metal filings causing it to scratch the work.

pitch diameter: The diameter of a thread at an imaginary point where the width of the groove and the width of the thread are equal.

pitch line: An imaginary line which passes through threads at such points that the length of the part of the line between adjacent threads is equal to the length of the line within a thread.

pitch: The distance from any point on a thread to the corresponding point on the adjacent thread, measured parallel to the axis.

plain cutter: A milling cutter with cutting teeth on the periphery (circumference) only.

play: The looseness of fit (slack) between two pieces.

plug weld: A weld made in a circular hole in one member of a joint fusing that member to another member.

powder coating: A durable, weather-proof, polymer coating for metals applied in a spray and then cured in an oven.

proportional limit: The greatest stress a material can withstand without deviation from the straight-line proportionality between stress and strain.

protective atmosphere: A gas or vacuum envelope surrounding the workpieces, used to prevent or reduce the formation of oxides and other detrimental surface substances and to facilitate their removal.

PTFE seal: A polytetrafluoroethylene polymer seal; TEFLON® is the DuPont trademark for PTFE.

punch, center: A solid punch with a point used to get a drill started in the proper location and often used after the location is initially marked with a prick punch. A center punch has a more blunt point than a prick punch and is usually used after a prick punch.

punch, prick: A solid punch with a sharp point, used to mark centers or other locations on metal.

pyrometer: A device for measuring the high temperatures in a heat-treating furnace.

Q

quenching: The sudden cooling of heated metal by immersion in water, oil, or other liquid. The purpose of quenching is to produce desired strength properties in hardenable steel.

quick return: A mechanism on some machine tools that provides rapid movement of the ram or table on the return or anointing stroke of the machine.

R

rack: An array of gears spaced on a straight bar.

radial: In a direction directly outward from the center of a circle or sphere or from the axis of a cylinder. The spokes of a wheel, for example, are radial.

radius: The distance from the center of a circle to its circumference (outside).

rake: That surface of a cutting tool against which the chips bear while being severed. If this surface is less than 90° from the surface being cut, the rake is positive, if more, the rake is negative.

ram: That part of a shaper which moves back and forth and carries the tool head assembly.

rapid traverse: A lever-controlled, power-operated feature of some machines that permits the rapid movement of the worktable from one position to another.

reaming, line: The process of reaming two or more holes to bring them into very accurate alignment.

recess: An internal groove. See undercut.

relief: A term for clearance or clearance angle.

residual stress: Stress present in a joint member or material that is free of external forces or thermal gradients.

RH: Right hand.

Rockwell hardness test: The most common hardness testing method. This procedure uses a minor load to prevent surface irregularities from affecting results. There are nine different Rockwell hardness tests corresponding to combinations of three penetrators and three loads.

root diameter: See minor diameter.

roughing: The fast removal of stock to reduce a workpiece to approximate dimensions, leaving only enough material to finish the part to specifications.

running fit: A class of fit intended for use on machinery with moderate speeds, where accurate location and minimum play are desired.

S

SAE: The Society of Automotive Engineers.

scale: The rough surface on hot finished steel and castings. Also, a shop term for steel rules.

scraper: A hardened steel hand tool used to scrape surfaces very smooth by removing minute amounts of metal.

scribe (scribe; scratch awl): A steel rod 8 to 12-inches long and about 3/16 inches in diameter. It has a long, slender, hardened steel point on one or both ends.

sector: A device that has two radial, beveled arms which can be set to include any number of holes on the indexing plate of a dividing head to eliminate recounting the holes for each setting.

set screw: A plain screw used principally for locking adjustable parts in position.

set: The bend or offset of a saw tooth to provide a clearance for the blade while cutting. Also, the permanent change in the form of metal as the result of repeated or excessive strain.

setup: The preparation of a machine tool to complete a specific operation. It includes mounting the workpiece and necessary tools and fixtures and selecting the proper speeds, feeds, depth of cut and coolants.

SF: Standard form.

shank: That part of a tool or similar object which connects the principal operating part to the handle, socket, or chuck by which it is held or moved.

shear strength: The characteristic of a material to resist shear forces.

shims: Very thin sheets of metal made in precise thickness and used between parts to obtain desired spacing. Sometimes they are laminated, to be pulled off to the desired depth.

shoulder: A term for the step made between two machined surfaces.

shrink fit: A class of fit made when the outer member is expanded by heating to fit over a shaft and then contracts or shrinks tightly to the shaft when cooled.

side cutter: A milling cutter that has cutting teeth on the side as well as on the periphery or circumference.

side rake: That surface which slopes to the side of the cutting edge. It may be positive or negative and is combined with the back rake. See rake.

sine bar: A precision instrument for laying out, setting, testing and otherwise dealing with angular work.

slabbing cutter: A wide, plain milling cutter having helical teeth. Used for producing large, flat surfaces.

- slitting saw:** A narrow milling cutter designed for cutoff operations or for cutting narrow slots.
- slotter:** An attachment which operates with a reciprocating motion. Used for machining internal slots and surfaces.
- soft hammer:** A hammer made of brass, copper, lead or plastic to a non-marring finished surfaces on machines or workpieces.
- soft jaws:** Plastic, leather, lead, or aluminum covers on the jaws of a vise or pliers used to prevent marking and damage to the work.
- solder:** The metal or alloy used as a filler metal in soldering, which has a liquidus not exceeding 840°F (450°C) and below the solidus of the base metal.
- spheroidizing:** A stress relieving method of long-term heating of high-carbon steel at or near the lower transformation temperature, followed by slow cooling to room temperature.
- spindle speed:** The RPM at which a machine is set.
- spindle:** A rotating device widely used in machine tools such as lathes, milling machines, drill presses and so forth, to hold the cutting tools or the work and to give them their rotation.
- spot facing:** Finishing a bearing surface around the top of a hole.
- spur gear:** A gear with teeth parallel to the axis of the shaft on which it is mounted.
- square surface:** A surface at a right angle with another surface.
- square threads:** A thread having a depth, width and space between threads that are equal. It is used on heavy jack screws, vise screws and other similar items.
- square, solid (toolmakers' try square):** A very accurate try square in which a steel blade is set firmly into a solid, rectangular-shaped handle so that each edge of the blade makes an angle of exactly 90° with the inner face (side) of the handle.
- steady rest:** A support that is clamped to the bed of a lathe used when machining a long workpiece. Sometimes called a center rest.
- steel:** A material composed primarily of iron, less than 2% carbon and (in an alloy steel) small percentages of other alloying elements.
- step block:** A fixture designed like a series step to provide support at various heights required for setups.
- stock:** A term for the materials used to make parts in a machine tool. Also, the die stock used for threading dies.
- stop:** A device attached to a machine tool to limit the travel of the worktable and sometimes the work head.
- straddle milling:** A milling setup where two side milling cutters are spaced on an arbor to machine two parallel surfaces with a single cut.
- surface grinding:** The process of grinding flat surfaces on a surface grinding machine. With special setups, angular and form surfaces may also be ground.

surface plate: An accurately machined and scraped flat metal piece (usually of cast iron) used to check the flatness of surfaces.

swing: The dimension of a lathe determined by the maximum diameter of the work that can be rotated over the ways of the bed.

T

tailstock: That part of a machine tool, such as a lathe or cylindrical grinder which supports the end of a workpiece with a center. It may be positioned at any point along the way of the bed and may be offset from center to machine tapers.

tang: The flat on the shank of a cutting tool, such as a drill, reamer or end mill, that fits a slot in the spindle of a machine to keep the tool from slipping. Also, the part of a file that fits into a handle.

tap: A tool used to cut threads on the inside of a round hole.

taper: A uniform increase or decrease in the size or diameter of a workpiece.

tapping: The process of cutting screw threads in a round hole with a tap.

T-bolt: Term for the bolts inserted in the T-slots of a worktable to fasten the workpiece or work-holding device to the table.

tempering: A heat-treating process to relieve the stresses produced when hardening and to impart certain qualities, such as toughness; sometimes called "drawing."

template: A pattern or guide for laying out or machining to a specific shape or form.

tensile strength: The resistance to breaking exhibited by a material when subjected to a pulling stress. Measured in lb/in² or kPa.

thermal expansion: The expansion of materials caused by heat input.

thermal stress relieving: A process of relieving stresses by uniform heating of a structure or a portion of a structure, followed by uniform cooling.

thread axis: A line running lengthwise through the center of the screw.

thread crest: The top surface joining the two sides of a thread.

thread depth: The distance between the crest and the root of a thread.

thread pitch diameter: The diameter of a screw thread measured from the thread pitch line on one side to the thread pitch line on the opposite side.

thread pitch: The distance from a point on one screw thread to a corresponding point on the next thread.

thread root: The bottom surface joining the sides of two adjacent threads.

thread: A helical projection of uniform section on the internal or external surface of cylinder or cone. Also, the operation of cutting a screw thread.

tool steel: A general classification for high-carbon steel that can be heat treated to a hardness required for metal cutting tools such as punches, dies, drills, taps, reamers and so forth.

torsion: The stress produced in a body, such as a rod or wire, by turning or twisting one end while the other is held firm or twisting in the opposite direction.

tpf: Taper per foot.

tpi: Taper per inch.

traverse: One movement across the surface of the work being machined.

truing: The act of centering or aligning a workpiece or cutting tool so that an operation may be performed accurately. Also, correcting the eccentricity or out of round condition when dressing a grinding wheel.

T-slot: The slots made in the tables of machine tools for the square-head bolts used to clamp the workpiece, attachments, or work-holding fixtures in position for performing the machining operations.

tumbler gears: A pair of small lever-mounted gears on a lathe used to engage or to change the direction of the leadscrew.

two-lip end mill: An end-milling cutter designed with teeth that cut to the center so that it may be used to feed into the work like a drill.

U

ultimate tensile strength (UTS): The maximum tensile stress a material placed in tension can bear without breaking.

UNC: Unified National Coarse.

UNF: Unified National Fine.

universal milling machine: A milling machine with a worktable that can be swiveled for milling helical work. It is always supplied with attachments, including an indexing fixture.

universal vise: A vise designed for holding work at a double or compound angle. Also called a toolmakers' vise.

V

volt: A unit of electrical force or potential.

W

ways: The flat or V-shaped bearing surfaces on a machining tool that guide and align the parts which they support.

wheel dresser: A tool or device for dressing or truing a grinding wheel.

work hardening: Also called cold working; the process of forming, bending, or hammering a metal well below the melting point to improve strength and hardness.

Y

yield strength: The stress at the uppermost point on the straight-line portion of the stress-strain curve. Stress imposed on the sample below this level produces no permanent lengthening and stress can vary from zero up to the yield strength. Stress above yield strength causes permanent lengthening.