

	Breakage Problem	<i>Have manufacturer do quality check</i>
TOOL LIFE	Poor Tool Selection	<i>Match tool with material being machined</i>
	Speeds & Feeds	<i>Make proper changes to improve chipload & heat removal</i>
	Poor Dust Collection	<i>Improve dust collection capability to remove chips & heat</i>
	Part Movement	<i>Check vacuum hold down & clamping devices</i>
	Machine Problems	<i>Check condition of collets, collet nuts, spindles, slides, bearings and head mountings</i>
	Material Being Machined	<i>Select right tool for the job</i>
PART FINISH	Dull Tools	<i>Check for edge deterioration & replace with new or resharpened tools</i>
	Tool Selection	<i>Double edge or multi-edge tools provide better finish</i> <i>Use shortest CEL available to make necessary depth of cut</i> <i>Use keener edged HSS tools on natural wood & some plastics to improve finish</i> <i>Use up/down compression spirals to improve top & bottom finishes on veneered or laminated materials</i>
	Feed Direction	<i>Should be conventional for most applications</i>

GLOSSARY

ABRASIVE WEAR – THE WEAR THAT OCCURS WITH FRICTION AND HEAT OF THE CUTTING ACTION THAT DULLS THE TOOL.

ANGLE – THE AMOUNT OF DIVERGENCE BETWEEN TWO STRAIGHT LINES THAT MEET AT A VERTEX. MEASURED IN DEGREES AND MINUTES.

ARBOR – A MACHINE TOOL SPINDLE SHAFT EXTENSION USED TO HOLD GRINDING WHEELS OR MILLING CUTTERS.

AXIAL LOAD – THE VERTICAL DEPTH OF CUT PERPENDICULAR TO THE CENTER LINE OF THE CUTTING TOOL, NORMALLY EXPRESSED IN A PERCENTAGE OF THE DIAMETER OF THE TOOL.

AXIS – THE CENTER LINE (REAL OR IMAGINARY) PASSING THROUGH AN OBJECT ABOUT WHICH IT COULD ROTATE. A REFERENCE POINT OR LINE FOR A SYSTEM OF CNC MACHINE TOOL COORDINATES (I.E. X, Y, Z).

BACK-OFF – A SHOP TERM MEANING TO PUT RELIEF OR CLEARANCE LAND BACK OF THE CUTTING EDGE OR BEHIND THE PRIMARY CLEARANCE.

BACKLASH – LOST MOTION (PLAY) IN MOVING PARTS, SUCH AS THREAD IN A NUT OR THE TEETH OR MESHING GEARS CAN REEK HAVOC WITH SIZE CONTROL.

BALLNOSE – A 180 ARC GROUND ON THE PLUNGE POINT OF THE TOOL

BALL RADIUS – USED IN THE DESCRIPTION OF “O” AND SPIRAL

FLUTES. THE MAXIMUM FLUTE DEPTH FROM FLUTE CENTER TO A LINE PERPENDICULAR TO THE CUTTING EDGE. IF THE ARC IS CONTINUED AROUND TO COMPLETE AN IMAGINARY CIRCLE OR BALL IT BECOMES THE BALL DIAMETER AND IS SOMETIMES DESCRIBED AS SUCH.

BINDER – THE METALLIC CONSTITUENT IN CARBIDE WHICH HOLDS THE GRAINS TOGETHER.

BODY – THE ACTIVE PORTION OF A ROUTER BIT WHICH INCLUDES THE CUTTING EDGE AND ALL CLEARANCES NECESSARY TO ACHIEVE A SPECIFIED CUTTING DIAMETER.

BRAZING – THE JOINING OF METALS BY HEATING A NON-FERROUS METALLIC ALLOY, COMBINED WITH A SUITABLE FLUX, TO ITS LOWER MELTING POINT TO BECOME THE BINDING MEDIUM. ADVANTAGE, NEITHER METAL JOINED IS DEFORMED. ONSRUD TECHNIQUES INVOLVE A COPPER-SILVER ALLOW COMBINED WITH A BORAX FLUX.

BURNING – OVERHEATING OF THE TOOL AND RESULTANT SURFACE DISCOLORATION CAUSED BY EXCESSIVE SPEEDS AND FEEDS.

CARBIDE TIPPED TOOLS (CT) – CUTTING TOOLS WITH TUNGSTEN, TANTALUM, OR OTHER CEMENTED CARBIDE INSERTS BRAZED TO A SOFTER STEEL FLUTE FACE.

CENTERLESS GRINDING – A SPECIFIC GRINDING PROCESS WHERE THE WORKPIECE IS SUPPORTED BY A BLADE REST AND NOT HELD BETWEEN CENTERS. WORKPIECE FEED RATE IS CONTROLLED BY A REGULATING WHEEL.

CERAMIC – A NEW MAN MADE COMPOSITE CUTTING MATERIAL CONTAINING TWO OR MORE ORGANIC, INORGANIC, OR METALLIC MATERIALS. A POPULAR CERAMIC RECIPE IS A MIXTURE OF ALUMINUM OXIDE WITH SILICON CARBIDE FIBERS FOR STRUCTURAL ENHANCEMENT.

CHAMFER – THE BEVELED SURFACE USED TO ELIMINATE AN OTHERWISE SHARP CORNER (I.E. SHANKS). EXPRESSED IN LENGTH AND ANGLE.

CHATTER – PERIODIC DEFLECTION OF A WORKPIECE DURING A MACHINE TOOL OPERATION WHICH CAN LEAVE UNDESIRABLE SURFACE CONFIGURATIONS.

CHIPBREAKERS – NOTCHES, GROOVES, AND SIMILAR FEATURES DESIGNED TO BREAK UP CHIPS FOR FAST, CLEAN, AND EFFICIENT REMOVAL. REDUCES OVERALL CHIP LOAD.

CHIPBREAKER TOOLS - HOGGERS

CHIP DRAG – THE CLOGGING, LOADING, AND PACKING DUE TO IMPROPER CHIP EXTRACTION.

CHIP LOAD – THE AMOUNT OF MATERIAL REMOVED BY ONE TOOTH PER CUTTING REVOLUTION.

CHIP LOAD = FEED RATE / (RPM X NUMBER OF CUTTING FLUTES).

CHIPS – THE PIECE OF WASTE LEFT AFTER CUTTING.

CLEARANCE – AT ONSRUD, THE TERM CLEARANCE IS OFTEN USED TO DESCRIBE RELIEF. THEREFORE, IN AN EFFORT TO CONFORM TO ASME STANDARDS, THE PREFERRED TERM FOR PRIMARY CLEARANCE IS "RELIEF" AND FOR SECONDARY CLEARANCE IS "CLEARANCE".

CLEARANCE ANGLE – THE ANGLE FORMED BETWEEN THE CLEARANCE SURFACE AND A PLANE TANGENT TO THE CUTTING EDGE.

CLEARANCE, OVERALL – THE TOTAL CLEARANCE DISPLACED FROM THE CUTTING EDGE TO THE HEEL. IT IS EXPRESSED IN ANGLE AND AMOUNT OF INDICATOR DROP.

CLEARANCE, SECONDARY – (SEE PREFERRED TERM CLEARANCE) THAT CLEARANCE CONTAINED DIRECTLY BEHIND RELIEF (PRIMARY CLEARANCE). IT IS USUALLY EXPRESSED IN ANGULAR TERMS AND CAN BE AXIAL OR RADIAL IN DIRECTION OF MEASURE.

CLEARANCE (OR RELIEF) SURFACES – ANGULAR OR CURVED SURFACES BEHIND THE RELIEF LAND. **CONCAVE** – THAT CLEARANCE SURFACE THAT COMPRISES A CURVED DEPRESSION. **ECCENTRIC** – THAT CLEARANCE SURFACE THAT IS CONVEX OR ROUNDED AND NOT ABOUT A COMMON CENTER TO THE CUTTING EDGE. **FLAT** – THAT CLEARANCE SURFACE THAT IS ESSENTIALLY STRAIGHT OR FLAT.

CLIMB CUT – IN CNC ROUTING WITH RIGHT HAND ROTATIONAL TOOLING, ROUTING THE PERIMETER OF THE WORKPIECE IN A CLOCKWISE DIRECTION IS CLIMB CUTTING. ON INTERNAL CUTS CLIMB CUTTING IS COUNTER CLOCKWISE.

CNC – COMPUTER NUMERIC CONTROL. CUTTING ACTION AND WORKPIECE MOVEMENT CONTROLLED BY A COMPUTER PROGRAM. IT CAN BE PREPARED IN ADVANCE OR INPUT BY THE OPERATOR.

COLLET – A STANDARD TRISECTED HOLLOW CLAMPING OR CHUCKING DEVICE DESIGNED TO CLOSE TIGHTLY UPON A WORKPIECE WHEN DRAWN BACK AGAINST A TAPERED SLEEVE BY A DRAW BAR OR TUBE.

COMPARATOR – AN OPTICAL IMAGE MEASURING TOOL CAPABLE OF PRECISE CLEARANCE MEASUREMENTS AND GEOMETRY COMPARISONS THROUGH VISUAL MAGNIFICATION.

CONCENTRICITY – HOLDING A CONSISTENT RADIUS ABOUT A COMMON CENTER OR TOOL AXIS WITHIN A SPECIFIC TOTAL INDICATOR RUNOUT (TIR).

CONVENTIONAL CUT – IN CNC ROUTING WITH RIGHT HAND ROTATIONAL TOOLING, ROUTING THE PERIMETER OF THE WORKPIECE IN A COUNTER CLOCKWISE DIRECTION IS CONVENTIONAL CUTTING. ON INTERNAL CUTS CONVENTIONAL CUTTING IS CLOCKWISE.

CORE (WEB) DIAMETER – THE DIAMETER OF A CIRCLE WHICH IS TANGENT TO THE BOTTOM OF THE FLUTES.

CORNER RADIUS – A RADIUS GROUND ON THE CORNER OF THE PLUNGE OF THE ROUTER BIT.

CUTTING EDGE – THE SHARPENED, WORKING PORTION, OR LEADING EDGE OF A CUTTER TOOTH.

CUTTING EDGE DIAMETER – THE DISTANCE FROM A CUTTING EDGE TO A POINT IT WOULD OCCUPY UPON 180 ROTATION. THE MAXIMUM WIDTH OF CUT POSSIBLE. THE DIAMETER OF A CUTTING TOOL'S PERIPHERY.

CUTTING EDGE LENGTH (CEL) – AS APPLIED TO END MILLS, THE EFFECTIVE AXIAL CUTTING EDGE NOT INCLUDING THE CUTTER SWEEP WHICH PERFORMS SIDE CUTTING ON THE WORKPIECE.

CUTTING FEED – RATE AT WHICH THE TOOL PASSES THROUGH THE WORK. CAN BE EXPRESSED IN TERMS OF TABLE TRAVEL, NORMALLY EXPRESSED IN INCHES PER MINUTE.

CUTTING SPEED – NORMALLY EXPRESSED IN REVOLUTIONS PER MINUTE. FOLLOW MACHINE MANUFACTURER RECOMMENDATIONS.

CUTTING SWEEP – EXIT POINT OF GRINDING WHEEL WHEN TOOLS ARE INITIALLY FLUTED.

DE COMPRESSION – UP DOWNS, OR 2+2 UP DOWNS

DEFLECTION – OVERALL LOSS, OR UNEVEN WORKPIECE CONTACT WITH THE GRINDING WHEEL OR MILLING CUTTER DURING A MACHINE TOOL OPERATION. USUALLY A RESULT OF TOO HIGH A FEEDRATE, TOO MUCH STOCK REMOVAL OR IMPROPER REST POSITIONING.

DEGREE AND MINUTES – UNITS OF MEASURE FOR ANGULAR ROTATION 360 DEGREES PER CIRCLE OR ONE COMPLETE REVOLUTION AND 60 MINUTES PER DEGREE.

DOVETAIL – A CUTTING DIAMETER THAT PROGRESSIVELY DECREASES FROM THE LEADING EDGE TO THE SHANK (ALSO CALLED BACK TAPER) DELIVERING WHAT ARE COMMONLY CALLED “DOVETAIL ANGLED” CUTS.

DOWNCUT – A CUTTING EDGE HELIX THAT SPIRALS OPPOSITE TOOL ROTATION. IT IS DESIGNED TO FORCE CHIP REMOVAL DOWN WITH PLUNGE.

FACE – CUTTING EDGE FACE – THE AXIAL CUTTING LENGTH OF A CUTTING TOOL

FLUTE FACE – FLAT PORTION OF A FLUTE PERPENDICULAR TO THE WEB AND TERMINATED BY THE CUTTING EDGE.

GRINDING WHEEL FACE – THAT PART OF A GRINDING WHEEL WHICH ACTIVELY ENGAGES THE WORKPIECE.

FADE OUT – (CUTTER SWEEP) – THAT PORTION OF THE FLUTE LEFT BY THE GRINDING WHEEL OF MILLING CUTTER AS IT RETRACTS OR WITHDRAWS FROM THE WORKPIECE. IT LIES IN THE TOOL NECK, AN AREA BETWEEN THE CEL AND SHANK.

FEEDRATE – THE SPEEDS AND FEEDS A MACHINE TOOL USES TO PERFORM SAFE, RESULTANT WORK. RPM – REVOLUTIONS PER MINUTE IS APPLIED TO ANY ROTATIONAL MOVEMENT; IPM – INCHES PER MINUTE IS APPLIED TO ANY LINEAR MOVEMENT.

FEED, CROSS – THE DISTANCE AND RATE OF HORIZONTAL FEED OF THE WHEEL ACROSS THE TABLE.

FEED IN (TRAVERSE) – THE DISTANCE AND RATE WHICH THE WHEEL IS FED INTO THE WORK.

FEED ELEVATION – THE VERTICAL FEED ON A TOOL GRINDER COLUMN WHICH WHEN LOWERED, LOWERS THE ENTIRE GRINDING HEAD; THE VERTICAL FEED OF A MILLING TABLE KNEE WHICH WHEN RAISED, RAISES THE ENTIRE WORKHEAD.

FEED INDEX – MEASUREMENT INDICATED BY THE CROSS-INDEX OF A MACHINE. THIS MEASUREMENT USUALLY REFERS TO THE WORKPIECE DIAMETER, BUT SOMETIMES THE RADIUS IS USED.

FLUTE – A STRAIGHT OR HELICAL GROOVE OF ANGULAR OR RADIAL FORM MACHINED INTO A TOOL TO PROVIDE CUTTING EDGES, PERMIT CHIP REMOVAL, AND ALLOW CUTTING FLUID CIRCULATION.

FLUTE LENGTH – THE LENGTH OF THE FLUTES MEASURED IN A STRAIGHT LINE ALONG THE AXIS.

FORM CUTTER – ANY CUTTER SHAPED TO PRODUCE A SPECIFIED FORM ON THE WORK (I.D. ROUND OVER)

FULL GRIP – REFERS TO THE TYPES OF COLLETS WITH SLITS FROM BOTH ENDS OF THE COLLET. THESE COLLETS TYPICALLY GRIP THE SHANK FOR 100% OF THE OVERALL LENGTH OF THE COLLET.

GRADE – THE DESIGNATION GIVEN TO A PARTICULAR GRADE OF CARBIDE.

HALF GRIP – REFERS TO THE TYPES OF COLLETS WITH SLITS FROM ONE END ONLY. THESE COLLETS TYPICALLY GRIP THE SHANK FOR ONLY 50-60% OF THE OVERALL LENGTH OF THE COLLET.

HAND OF MILLING CUTTERS & END MILLS – THE TERMS “RIGHT HAND” OR “LEFT HAND” ARE USED TO DESCRIBE HAND OF ROTATIONS OR HAND OF CUT, AND HAND OF FLUTE HELIX.

HAND OF ROTATION – OR (HAND OF CUT) – THE ROTATION OF A CUTTING TOOL REVOLVING SO AS TO MAKE A CUT WHEN REVIEWED FROM A POSITION IN FRONT OF A HORIZONTAL MILLING MACHINE AND FACING THE SPINDLE.

RIGHT HAND ROTATION – COUNTERCLOCKWISE ROTATION (OR WHEN TOOL IS VIEWED FROM SHANK, IT IS DESIGNED TO ROTATE TOWARDS THE RIGHT HAND).

LEFT HAND ROTATION – CLOCKWISE ROTATION (OR WHEN TOOL IS VIEWED FROM SHANK, IT IS DESIGNED TO ROTATE TOWARDS THE LEFT HAND).

HAND OF FLUTE HELIX – THE DIRECTION THE FLUTE TWISTS AWAY FROM THE OBSERVER AROUND THE TOOL AXIS WHEN VIEWED FROM EITHER END OF THE CUTTING TOOL.

RIGHT HAND HELIX – CLOCKWISE FLUTE TWIST (TO THE RIGHT HAND)

LEFT HAND HELIX – COUNTERCLOCKWISE FLUTE TWIST (TO THE LEFT HAND)

STRAIGHT FLUTES – TOOLS WITH THEIR CUTTING EDGES IN PLANES PARALLEL TO THE TOOL AXIS (NO HELIX).

HEEL , HEELING – THE HEEL IS THE AREA DIRECTLY BEHIND THE CUTTING EDGE. HEELING IS CAUSED BY INSUFFICIENT RELIEF BEHIND THE CUTTING EDGE.

HELIX – THE PATH A POINT WILL GENERATE AS IT MOVES AT A FIXED RATE OF ADVANCE (SPIRALS) ALONG THE SURFACE OF A CYLINDER.

HELIX ANGLE – THE CUTTING EDGE ANGLE WHICH A HELICAL CUTTING EDGE MAKES WITH A PLANE CONTAINING THE TOOL'S AXIS.

HELICAL (SPIRAL) – A TERM DESCRIBING A CUTTING EDGE OR FLUTE WHICH PROGRESSES UNIFORMLY AROUND A CYLINDRICAL SURFACE IN AN AXIAL DIRECTION.

HOOK – SEE RAKE.

IPM – INCHES PER MINUTE

LAND – THE NARROW SURFACE OF A PROFILE SHARPENED CUTTING TOOL IMMEDIATELY BEHIND THE CUTTING EDGE.

CYLINDRICAL – A NARROW PORTION OF THE PERIPHERAL LAND ADJACENT TO THE CUTTING EDGE, HAVING NO RADIAL RELIEF (CLEARANCE).

RELIEVED – A NARROW PORTION OF THE LAND, ADJACENT TO THE CUTTING EDGE WHICH PROVIDES RELIEF (CLEARANCE).

NOT RELIEVED – A NARROW PORTION OF THE LAND, ADJACENT TO THE CUTTING EDGE, HAVING NO RELIEF (CLEARANCE).

LEFT HAND CUT – A TOOL WITH THE FLUTES AND CUTTING EDGES SPIRALING LEFT. COUNTER-CLOCKWISE ROTATION.

LUBRICITY – THE PROPERTY THAT WILL ALLEVIATE FRICTION. SPECIAL COATINGS HAVE THE ABILITY TO MAKE THE TOOL VERY LUBRIFIC (SLIPPERINESS).

OVERLOAD BREAKAGE – CHIP LOAD PER TOOTH IS OVERLOADING THE CUTTER, WHICH RESULTS IN TOOL BREAKAGE.

PART NUMBER – THE NUMBER USED TO DESIGNATE A SPECIFIC TOOL DIAMETER AND DESIGN FOR PRINT, TRAVELER, CATALOG AND WARRANTY FILING AND REFERENCE.

RADIAL LOAD – THE HORIZONTAL DEPTH OF CUT PARALLEL TO THE CENTER LINE OF THE CUTTING TOOL, NORMALLY EXPRESSED IN A PERCENTAGE OF THE DIAMETER OF THE TOOL.

RAKE – THE ATTACK ANGLE OF THE TOOL.
(SEE PAGE 5 RAKE AND CLEARANCE)

RELIEF – (SEE CLEARANCE) THE RESULT OF THE REMOVAL OF TOOL MATERIAL DIRECTLY BEHIND OR ADJACENT TO THE CUTTING EDGE TO PROVIDE CLEARANCE AND PREVENT RUBBING (HEEL DRAG). IN THE INTEREST OF CONFORMITY, RELIEF IS THE ASME PREFERRED TERM FOR WHAT ONSRUD CUTTER REFERS TO AS “PRIMARY CLEARANCE”. IT GENERALLY LIES WITHIN THE FIRST 1/16” DIRECTLY BEHIND THE CUTTING EDGE AND IS EXPRESSED IN ANGLE AND LAND WIDTH.

RIGHT HAND CUT – A TOOL WITH FLUTES AND CUTTING EDGES SPIRALING RIGHT. CLOCKWISE ROTATION.

SE COMPRESSION – UP DOWNS OR 1+1 UP DOWNS

SHANK – THAT PROJECTING PORTION OF A ROUTER BIT OR OTHER END MILL WHICH LOCATES AND DRIVES THE ROUTER BIT IN THE MACHINE SPINDLE ON ADAPTER.

SPINBACK – A SECTION OF REDUCED DIAMETER FROM THE CUTTING EDGE AT THE FLUTE FADE OUT AND/OR A PORTION OF THE SHANK OF THE ROUTER BIT

SPINDLE – A PRECISION BEARING MOUNTED STEEL SHAFT USED TO TRANSFER MOTOR POWER AND RETAIN ARBOR, COLLET AND WORK PIECES.

SPIRAL – A TOOL WITH HELICAL CUTTING EDGES AND FLUTES.

TANGENT OF AN ANGLE – IN A RIGHT TRIANGLE IT IS THE RATIO OF THE SIDE OPPOSITE THE ANGLE TO THE SIDE ADJACENT. A LINE THAT TOUCHES A CIRCLE AT ONE SPECIFIC POINT ONLY ALONG ITS CIRCUMFERENCE.

TAPER – THE UNIFORM INCREASE OR DECREASE OF A TOOLS DIAMETER TO FORM A CONICAL OR WEDGE SHAPE – SPINDLES – TOOL HOLDER.

TRANSVERSE RUPTURE STRENGTH (TRS) – THE BREAKING STRENGTH IN STANDARD BENDING TESTS (SIDE PRESSURE STRENGTH).

UPCUT – A CUTTING EDGE HELIX THAT SPIRALS WITH TOOL ROTATION. IT IS DESIGNED TO FORCE CHIP REMOVAL UP AND OUT OF THE ACTIVE CUTTING AREA.

V-FLUTE – OFTEN CALLED Z-FLUTE WITH DE TOOLS

WEAR LAND – THE AREA JUST BEHIND THE CUTTING EDGE RESULTING FROM THE NORMAL DULLING REACTION. FORMS A BRIGHT SHINY FINISH BEHIND THE CUTTING EDGE AND IS A GOOD INDICATOR TO CHANGE THE TOOL OUT.

WEB – THE BODY MATERIAL ABOUT THE TOOL AXIS ON CENTER THAT REMAINS AFTER FLUTING AND CONNECTS THE WINGS.

WELDON SHANK – A STRAIGHT SHANK WITH SPECIAL FLATS FOR DRIVING AND LOCATING THE TOOL.

WING – THE BODY MATERIAL THAT TERMINATES THE WEB AND CONTAINS THE FLUTE FACE, CUTTING EDGE, CLEARANCE LAND, AND HEEL.



A member of the LMT group