THE NOSE RADIUS AND THE POINT ANGLE pdf

1: What makes an air bend sharp on the press brake? - The Fabricator

There are many parameters to consider when choosing a turning insert. Carefully select insert geometry, insert grade, insert shape (nose angle), insert size, nose radius and entering (lead) angle, to achieve good chip control and machining performance.

The most common tool bit is the general all-purpose bit made of high-speed steel. These tool bits are generally inexpensive, easy to grind on a bench or pedestal grinder, take lots of abuse and wear, and are strong enough for all-around repair and fabrication. High-speed steel tool bits can handle the high heat that is generated during cutting and are not changed after cooling. These tool bits are used for turning, facing, boring and other lathe operations. Tool bits made from special materials such as carbides, ceramics, diamonds, cast alloys are able to machine workplaces at very high speeds but are brittle and expensive for normal lathe work. High-speed steel tool bits are available in many shapes and sizes to accommodate any lathe operation. Basically, a single point cutter bit is a tool that has only one cutting action proceeding at a time. A machinist or machine operator should know the various terms applied to the single point tool bit to properly identify and grind different tool bits Figure The shank is the main body of the tool bit. The nose is the part of the tool bit which is shaped to a point and forms the corner between the side cutting edge and the end cutting edge. The nose radius is the rounded end of the tool bit. The face is the top surface of the tool bit upon which the chips slide as they separate from the work piece. The side or flank of the tool bit is the surface just below and adjacent to the cutting edge. The cutting edge is the part of the tool bit that actually cuts into the workpiece, located behind the nose and adjacent to the side and face. The base is the bottom surface of the tool bit, which usually is ground flat during tool bit manufacturing. The end of the tool bit is the near-vertical surface which, with the side of the bit, forms the profile of the bit. The end is the trailing surface of the tool bit when cutting. The heel is the portion of the tool bit base immediately below and supporting the face. Angles of Tool Bits The successful operation of the lathe and the quality of work that may be achieved depend largely on the angles that form the cutting edge of the tool bit Figure Most tools are hand ground to the desired shape on a bench or pedestal grinder. The cutting tool geometry for the rake and relief angles must be properly ground, but the overall shape of the tool bit is determined by the preference of the machinist or machine operator. Lathe tool bit shapes can be pointed, rounded, squared off, or irregular in shape and still cut quite well as long as the tool bit angles are properly ground for the type of material being machined. The angles are the side and back rake angles, the side and end cutting edge angles, and the side and end relief angles. Other angles to be considered are the radius on the end of the tool bit and the angle of the tool holder. After knowing how the angles affect the cutting action, some recommended cutting tool shapes can be considered. Rake angle pertains to the top surface of the tool bit. There are two types of rake angles, the side and back rake angles Figure The rake angle can be positive, negative, or have no rake angle at all. The tool holder angle combines with the back rake angle to provide clearance for the heel of the tool bit from the workpiece and to facilitate chip removal. The side rake angle is measured back from the cutting edge and can be a positive rake angle or have no rake at all. Rake angles cannot be too great or the cutting edge will lose strength to support the cutting action. The side rake angle determines the type and size of chip produced during the cutting action and the direction that the chip travels when leaving the cutting tool. Chip breakers can be included in the side rake angle to ensure that the chips break up and do not become a safety hazard. Side and relief angles, or clearance angles, are the angles formed behind and beneath the cutting edge that provide clearance or relief to the cutting action of the tool. There are two types of relief angles, side relief and end relief. Side relief is the angle ground into the tool bit, under the side of the cutting edge, to provide clearance in the direction of tool bit travel. End relief is the angle ground into the tool bit to provide front clearance to keep the tool bit heel from rubbing. The end relief angle is supplemented by the tool holder angle and makes up the effective relief angle for the end of the tool bit. Side and cutting edge angles are the angles formed by the cutting edge with the end of the tool bit the end cutting edge angle , or with the side of the tool bit the side cutting edge angle. The end cutting edge angle permits the nose of the tool bit to make contact with the work and aids in feeding the tool bit into the work.

THE NOSE RADIUS AND THE POINT ANGLE pdf

The side cutting edge angle reduces the pressure on the tool bit as it begins to cut. The side rake angle and the side relief angle combine to form the wedge angle or lip angle of the tool bit that provides for the cutting action Figure A radius ground onto the nose of the tool bit can help strengthen the tool bit and provide for a smooth cutting action. Shapes of Tool Bits The overall shape of the lathe tool bits can be rounded, squared, or another shape as long as the proper angles are included. Tool bits are identified by the function they perform, such as turning or facing. They can also be identified as roughing tools or finishing tools. Generally, a roughing tool has a radius ground onto the nose of the tool bit that is smaller than the radius for a finishing or general-purpose tool bit. Experienced machinists have found the following shapes to be useful for different lathe operations. A right-hand turning tool bit is shaped to be fed from right to left. The cutting edge is on the left side of the tool bit and the face slopes down away from the cutting edge. The left side and end of the tool bit are ground with sufficient clearance to permit the cutting edge to bear upon the workpiece without the heel rubbing on the work. The right-hand turning tool bit is ideal for taking light roughing cuts as well as general all-around machining. A left-hand turning tool bit is the opposite of the right-hand turning tool bit, designed to cut when fed from left to right. This tool bit is used mainly for machining close in to a right shoulder. Tool bit shapes The round-nose turning tool bit is very versatile and can be used to turn in either direction for roughing and finishing cuts. No side rake angle is ground into the top face when used to cut in either direction, but a small back rake angle may be needed for chip removal. The right-hand facing tool bit is intended for facing on right-hand side shoulders and the right end of a workpiece. The cutting edge is on the left-hand side of the bit. The direction of feed for this tool bit should be away from the center axis of the work, not going into the center axis. A left-hand facing tool bit is the opposite of the right-hand facing tool bit andis intend to machine and face the left sides of shoulders. The parting tool bit, Figure , is also known as the cutoff tool bit. This tool bit has the principal cutting edge at the squared end of the bit that is advanced at a right angle into the workpiece. Both sides should have sufficient clearance to prevent binding and should be ground slightly narrower at the back than at the cutting edge. Besides being used for parting operations, this tool bit can be used to machine square corners and grooves. Thread-cutting tool bits, Figure , are ground to cut the type and style of threads desired. Side and front clearances must be ground, plus the special point shape for the type of thread desired. Thread-cutting forms are discussed in greater detail later in this chapter. Thread cutting tool bit. Some of the more common of these tools are listed below. Tungsten carbide, tantalum carbide, titanium carbide. Standard shapes for tipped tool bits are similar to high-speed steel-cutting tool shapes. Carbide and ceramic inserts can be square, triangular, round, or other shapes. The inserts are designed to be indexed or rotated as each cutting edge gets dull and then discarded. Cutting tool inserts are not intended for reuse after sharpening Figure Specially formed thread cutter mounted in a thread "cutter holder Figure This tool is designed for production highspeed thread cutting operations. The special design of the cutter allows for sharp and strong cutting edges which need only to be resharpened occasionally by grinding the face. The cutter mounts into a special tool holder that mounts to the lathe tool post. Thread cutting tool holder and cutter. The common knurling tool, Figure , consists of two cylindrical cutters, called knurls, which rotate in a specially designed tool holder. The knurls contain teeth which are rolled against the surface of the workpiece to form depressed patterns on the workpiece. The common knurling tool accepts different pairs of knurls, each having a different pattern or pitch. The diamond pattern is most widely used and comes in three pitches: These pitches produce coarse, medium, and fine knurled patterns. Boring tool bits, Figure , are ground similar to left-hand turning tool bits and thread-cutting tool bits, but with more end clearance angle to prevent the heel of the tool bit from rubbing against the surface of the bored hole. The boring tool bit is usually clamped to a boring tool holder, but it can be a one-piece unit. The boring tool bit and tool holder clamp into the lathe tool post. There is no set procedure to grinding lathe tool bit angles and shapes, but there are general guidelines that should be followed. Do not attempt to use theliench or pedestal grinder without becoming fully educated as to its safety, operation, and capabilities. In order to effectively grind a tool bit, the grinding wheel must have a true and clean face and be of the appropriate material for the cutting tool to be ground. Carbide tool bits must be ground on a silicon carbide grinding wheel to remove the very hard metal. High-speed steel tool bits are the only tool bits that can effectively be ground on the bench or pedestal grinder when equipped with the aluminum oxide grinding wheel which is standard for most field and maintenance shops. Before grinding, shaping, or sharpening a high-speed steel tool bit, inspect the entire grinder for a safe setup and adjust the tool rests and guards as needed for tool bit grinding Figure 3- The common knurling tool. Boring tool bits and holders. Grinder setup for lathe tool bit grinding. Each grinder is usually equipped with a coarse-grained wheel for rough grinding and a fine-grained wheel for fine and finish grinding. Dress the face of the grinding wheels as needed to keep a smooth, flat grinding surface for the tool bit. When grinding the side and back rake angles, ensure the grinding wheel has a sharp corner for shaping the angle.

THE NOSE RADIUS AND THE POINT ANGLE pdf

2: Bending Basics: How the inside bend radius forms - The Fabricator

By definition, nose radius is the radius value at the tip of the cutting tool, measured on reference plane (Ï€ R). Values of nose radius The radius value for conventional single point turning tool (SPTT) usually ranges between - mm.

In this article we will study about Single point cutting tool geometry, angles, nomenclature and signature. What is Single Point Cutting Tool? As its name indicates, a tool that has a single point for cutting purpose is called single point cutting tool. It is generally used in the lathe machine , shaper machine etc. It is used to remove the materials from the workpiece. It is that part of single point cutting tool which goes into the tool holder. Or in simple language shank is used to hold the tool. It is the surface below and adjacent of the cutting edges. There are two flank surfaces, first one is major flank and second one is minor flank. The major flank lies below and adjacent to the side cutting edge and the minor flank surface lies below and adjacent to the end cutting edge. The portion of the shank that lies opposite to the top face of the shank is called base. It is the top portion of the tool along which chips slides. It is designed in such a way that the chips slides on it in upward direction. The edge on the tool which removes materials from the work piece is called cutting edges. It lies on the face of the tool. The single point cutting tool has two edges and these are i Side cutting edge: The top edge of the major flank is called side cutting edge. The top edge of the minor flank is called end cutting edge. Nose or cutting point: The intersection point of major cutting edge and minor cutting edge is called nose. It is the radius of the nose. Nose radius increases the life of the tool and provides better surface finish. It is a curved portion and intersection of the base and flank of the tool. Angles of Single Point Cutting Tool The various angles of the single point cutting tool have great importance. Each angle has its own function and speciality. End Cutting Edge Angle: The angle formed in between the end cutting edge and a line perpendicular to the shank is called end cutting edge angle. Side Cutting Edge Angle: The angle formed in between the side cutting edge and a line parallel to the shank. The angle formed between the tool face and line parallel to the base is called back rake angle. The angle formed between the minor flank and a line normal to the base of the tool is called end relief angle. It is also known as front clearance angle. It avoid the rubbing of the workpiece against tool. It is defined as the angle between face and minor flank of the single point cutting tool. This angle avoids the rubbing between workpiece and flank when the tool is fed longitudinally. Nomenclature There is three coordinate systems which are most popular in tool nomenclature. And these are 1. Normal Reference System NRS Signature The shape of a tool is specified in a special sequence and this special sequence is called tool signature. The tool signature is given below i Back rake angle iii Clearance or End Relief angle iv Side Relief angle v End cutting edge angle vi Side cutting edge angle vii Nose radius A typical tool signature of single point cutting tool is Here this tool signature indicates that the tool has 0, 7, 6, 8, 15, 16 degree back rake, side rake, end relief, side relief, end cutting edge, side cutting edge angle and 0. If you find anything missing or wrong than comment us.

3: Nose cone design - Wikipedia

The nose radius of a cutting tool determines the strength of the tool point and along with feed rate determines the part finish. A larger nose radius is stronger than a tool with a smaller radius. The larger radius tool will be better able to resist mechanical failure (chipping orbreaking).

Steve Benson Press brake guru Steve Benson describes how the method of bendingâ€"coining, bottom bending, or air formingâ€"is very influential on how an inside bend radius is achieved. In coining, the punch nose penetrates the neutral axis of the material thickness. The punch radius equals the resulting inside bend radius in the part. Metal thickness exaggerated for illustration purposes. Bend allowances, outside setbacks, bend deductionsâ€"if you can calculate all of these with precision, you have a much better chance of bending a good part on the first try. But to make this happen, you need to make sure every factor in the equation is what it should be, and this includes the inside bend radius. How exactly is this inside bend radius achieved? To uncover this, we must first look at the different methods of bending on a press brake: Coining Note that there are three bending methods, not two. Bottom bending and coining often are confused for the same process, but they are not. Unlike bottoming, coining actually penetrates and thins the material. Coining is the oldest method and, for the most part, is no longer practiced because of the extreme tonnages it requires. Coining forces the punch nose into the material, penetrating the neutral axis see Figure 1. Technically, any radii may be coined, but traditionally coining has been used to establish a dead-sharp bend. Coining forces the entire tool profile to less than the material thickness, and thins the material at the point of bend. It requires dedicated, special tool sets for each bend and bend angle. The punch nose produces the inside radius, which is used to establish the bend deduction. Bottom Bending Bottom bending forces the material around the punch nose. It uses various punch angles along with a V die see Figure 2. In coining, the entire face of the punch is stamped into the workpiece. In air forming described more fully later , the punch ram descends to produce the required bend angle plus a small amount to account for springback. Then the punch backs out of the die, and the material springs back to the desired angle. Like air forming, bottom bending requires the ram to descend to a point that produces the bend angle plus a small amount. But unlike in air forming, the ram continues past this point and descends farther into the die space, forcing the workpiece back to the set angle of the bend. As a side note, special dies like Rolla-Vs and urethane tooling also force the punch nose radius into the material. Like in coining, the punch nose radius establishes the inside radius of the material, which will be used to establish the bend deduction. But unlike coining, bottoming can be used to produce inside bend radii up to three times or more the material thickness. Air Forming So far it all seems pretty straightforward. With coining and bottom bending, the punch nose radius establishes the inside bend radius value to be inserted into the formulas for the bend deduction. But air forming adds some complexity, because the bending method produces an inside bend radius on the part in a completely different way see Figure 3. In this bottom bending setup, there is an angular clearance between the punch and die. The punch descends left until the material wraps around the punch nose center , after which the ram continues to apply downward pressure, forcing the material to the desired bend angle right. In air forming, the radius is produced as a percentage of the die opening regardless of the die style, be it a V, channel, or acute. The die opening determines the inside bend radius on the part. This states that to produce a desired radius, or to find the resulting inside radius, the material thickness must be a certain percentage of the width of the die opening. Yes, with many alloys today, including new and recycled metals, it is impossible to determine a standard percentage multiplier with complete accuracy. Nevertheless, the rule gives you a good starting point. The 20 percent rule percentages are as follows: Multiply the opening by the percentage to obtain the developed inside radius of the part. The final result will be the inside radius value you need to use when calculating for the bend deduction. If you have a 0. So in this case, a 0. When your die opening changes, so does your inside radius. If the die opening is 0. So, that same 0. As before, when you change the die opening, you change the inside bend radius. If you change the material, you change the percentage. If you work with material not listed here, you can look up the material on the Internet and compare tensile strengths to the baseline value of 60, PSI for AISI cold-rolled steel. If the tensile value is , PSI, then your estimated percentage value will be two times that of cold-rolled steel, or 30 to 32 percent. Sharp Bends in Air Forming Unlike in bottoming or coining, there is a minimum radius that can be produced with air forming. This value is best set at 63 percent of the material thickness. Understanding the effects of sharp bends is arguably one of the most important things an engineer and press brake operator need to know. Not only do you need to understand what is physically happening when the bend is sharp, but you also need to know how to incorporate that information into your calculations. The radius is produced as a percentage of the die opening, regardless of the die style. If you are working with a material thickness of 0. For this material, this is the minimum producible inside radius with air forming. This means that even if you were air forming with a punch nose radius that was less than 63 percent of material thickness, the inside radius on the part still would be 63 percent of its material thickness, or 0. Therefore, do not use any inside radii less than that 63 percent value in your calculations. In this case, the minimum producible inside bend radius is 63 percent of that 0. This means that any punch nose radius less than 0. Sharp bends are a function of material thickness, not the punch nose radius. And this issue needs to be addressed in your calculations if you expect the bend deduction, and therefore your first part, to be correct. A Plan of Action In bottoming or coining, use the punch nose radius as the inside bend radius in your bend deduction calculations. But if you are air forming, the inside bend radius is produced as a percentage of the die opening. If you work in engineering, try getting a list of all the tooling available in your shop. Talk with the operators and find out which methods they are using with which material types, and design your future parts around those parameters. Once the bend deductions are calculated and the flat parts are produced, note that information in the job jacket or work folder. Be sure to include the tooling type and size and the radius that you want the operator to achieve based on the forming method. Getting all this to work requires buy-in from shop floor workers. Including them in the process and asking them for input will make them much more willing to accept that engineering is telling them which tools to use. Ideally, this will all match with the values calculated at the press brake controller and by your CAD system. If the radius is achievable, if the part is calculated for that radius, and if the operators use the tooling the job is designed for, they will produce a perfect part on the first try. If you use a sharper punch radius, you will only force a ditch in the center of the bend. The resulting inside bend radius on the part will remain at 63 percent of material thickness. The calculation to use depends on the application and information available:

THE NOSE RADIUS AND THE POINT ANGLE pdf

4: CNC Training, Rose Training, Swiss-Turning, Fundamental CNC, Tooling & Production

For single point cutting tool most important angle is back rake angle. The back rake angle affects the ability of Effect of Tool Nose Radius and Rake Angle in.

Tool Signature The elements of tool signature or nomenclature of single point cutting tool is illustrated in the figure below i Back rake angle: Back rake angle is the angle between the face of the single point cutting tool and a line parallel with base of the tool measured in a perpendicular plane through the side cutting edge. If the slope face is downward toward the nose, it is negative back rake angle and if it is upward toward nose, it is positive back rake angle. Back rake angle helps in removing the chips away from the workpiece. Side rake angle is the angle by which the face of tool is inclined side ways. Side rake angle is the angle between the surface the flank immediately below the point and the line down from the point perpendicular to the base. Side rake angle of cutting tool determines the thickness of the tool behind the cutting edge. It is provided on tool to provide clearance between workpiece and tool so as to prevent the rubbing of workpiece with end flake of tool. Schematic illustration of single point cutting tool iii End relief angle: End relief angle allows the tool to cut without rubbing on the workpiece. Side rake angle is the angle between the portion of the side flank immediately below the side edge and a line perpendicular to the base of the tool measured at right angles to the side. Side relief angle is the angle that prevents the interference as the tool enters the material. It is incorporated on the tool to provide relief between its flank and the workpiece surface. End cutting edge angle is the angle between the end cutting edge and a line perpendicular to the shank of the tool. It provides clearance between tool cutting edge and workpiece. Side cutting edge angle is the angle between straight cutting edge on the side of tool and the side of the shank. It is responsible for turning the chip away from the finished surface. Convenient way to specify tool angles by use of a standardized abbreviated system is known as tool signature. It indicates the angles that a tool utilizes during the cut. It specifies the active angles of the tool normal to the cutting edge. This will always be true as long as the tool shank is mounted at right angles to the workpiece axis. Elements of tool signature The seven elements that comprise the signature of a single point cutting tool are always stated in the following order:

THE NOSE RADIUS AND THE POINT ANGLE pdf

5: Nose Radius in Cutting Tool - Its Function, Value, Advantage & Disadvantage

y is the radius at any point x, as x varies from 0, at the tip of the nose cone, to L. The equations define the two-dimensional profile of the nose shape. The equations define the two-dimensional profile of the nose shape.

Bull gear[edit] The term bull gear is used to refer to the larger of two spur gears that are in engagement in any machine. The smaller gear is usually referred to as a pinion. It is measured along the mutual perpendicular to the axes, called the line of centers. It applies to spur gears, parallel axis or crossed axis helical gears, and worm gearing. In the usual case with axes at right angles, it contains the worm axis. The composite action test must be made on a variable center distance composite action test device. When not otherwise specified, the short term cone distance is understood to be outer cone distance. Mean cone distance in bevel gears is the distance from the apex of the pitch cone to the middle of the face width. Inner cone distance in bevel gears is the distance from the apex of the pitch cone to the inner ends of the teeth. Conjugate gears[edit] Conjugate gears transmit uniform rotary motion from one shaft to another by means of gear teeth. The normals to the profiles of these teeth, at all points of contact, must pass through a fixed point in the common centerline of the two shafts. Crossed helical gear[edit] A crossed helical gear is a gear that operate on non-intersecting, non-parallel axes. The term crossed helical gears has superseded the term spiral gears. There is theoretically point contact between the teeth at any instant. They have teeth of the same or different helix angles, of the same or opposite hand. A combination of spur and helical or other types can operate on crossed axes. It is properly the radius of curvature of the pitch surface in the given cross section. Examples of such sections are the transverse section of bevel gear teeth and the normal section of helical teeth. Face tip angle[edit] Face tip angle in a bevel or hypoid gear, is the angle between an element of the face cone and its axis. A face gear has a planar pitch surface and a planar root surface, both of which are perpendicular to the axis of rotation. Face width[edit] Face width The face width of a gear is the length of teeth in an axial plane. For double helical, it does not include the gap. For a cylindrical gear, effective face width is the portion that contacts the mating teeth. One member of a pair of gears may engage only a portion of its mate. For a bevel gear , different definitions for effective face width are applicable. Form diameter[edit] Form diameter Form diameter is the diameter of a circle at which the trochoid fillet curve produced by the tooling intersects, or joins, the involute or specified profile. Although these terms are not preferred, it is also known as the true involute form diameter TIF , start of involute diameter SOI , or when undercut exists, as the undercut diameter. This diameter cannot be less than the base circle diameter. The surface of the gear blank at the inner ends of the teeth is customarily formed to such a front cone, but sometimes may be a plane on a pinion or a cylinder in a nearly flat gear.

THE NOSE RADIUS AND THE POINT ANGLE pdf

6: Single Point Cutting Tool: Nomenclature and Tool Signature

Lip Angle/ Wedge Angle: It is defined as the angle between face and minor flank of the single point cutting tool. 6. Side Rake Angle: the angle formed between the tool face and a line perpendicular to the shank is called side rake angle.

It is usually made from H. The main requirement of tool material is hardness. It must be hard enough to resist cutting forces applied on work piece. All these properties should be high. We discuss about tool material in another thread very soon. Classification of cutting tools A] According to number of cutting edge. Examples â€" shear tools, lathe tools, planer tools, boring tolls etc. Multi point cutting tool In this two or more single point cutting tools arranged together as a unit. Example- milling cutter, drills, brooches, grinding wheels, abrasive sticks etc. The chip slide along the face. Terminology of single point cutting tool Shank â€" It is main body of tool. The shank used to grippesd in tool holder. Flank â€" The surface or surface below the adjacent of the cutting edge is called flank of the tool. Face â€" It is top surface of the tool along which the chips slides. Base â€" It is actually a bearing surface of the tool when it is held in tool holder or clamped directly in a tool post. It is curved portion at the bottom of the tool. Cutting edge â€" It is the edge on face of the tool which removes the material from workpiece. The tool with proper angle, reduce breaking of tool, cut metal more efficiently, generate less heat. Longer nose radius produce chatter. CrazyEngineers Jobs Finder Find the latest and the best jobs for engineering freshers and working professionals.

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7: actionscript 3 - Find the point with radius and angle - Stack Overflow

The control reads the start point, angle size and the ending diameter. All calculations for the angle's end position is completed by the control. Use,R to program a radius break of the sharp corners.

Geometry[edit] Typical hand ground cutting tool angles for the lathe. Back rake is to help control the direction of the chip, which naturally curves into the work due to the difference in length from the outer and inner parts of the cut. It also helps counteract the pressure against the tool from the work by pulling the tool into the work. Side Rake along with back rake controls the chip flow and partly counteracts the resistance of the work to the movement of the cutter and can be optimized to suit the particular material being cut. Brass for example requires a back and side rake of 0 degrees while aluminum uses a back rake of 35 degrees and a side rake of 15 degrees. Nose Radius makes the finish of the cut smoother as it can overlap the previous cut and eliminate the peaks and valleys that a pointed tool produces. Having a radius also strengthens the tip, a sharp point being quite fragile. All the other angles are for clearance in order that no part of the tool besides the actual cutting edge can touch the work. The front clearance angle is usually 8 degrees while the side clearance angle is degrees and partly depends on the rate of feed expected. Minimum angles which do the job required are advisable because the tool gets weaker as the edge gets keener due to the lessening support behind the edge and the reduced ability to absorb heat generated by cutting. The Rake angles on the top of the tool need not be precise in order to cut but to cut efficiently there will be an optimum angle for back and side rake. Steels[edit] Originally, all tool bits were made of high carbon tool steels with the appropriate hardening and tempering. Since the introductions of high-speed steel HSS early years of the 20th century , sintered carbide s , ceramic and diamond cutters, those materials have gradually replaced the earlier kinds of tool steel in almost all cutting applications. Most tool bits today are made of HSS, cobalt steel, or carbide. Carbides and ceramics[edit] Main article: Tipped tool Carbide , ceramics such as cubic boron nitride and diamond, having higher hardness than HSS, all allow faster material removal than HSS in most cases. Because these materials are more expensive and brittler than steel, typically the body of the cutting tool is made of steel, and a small cutting edge made of the harder material is attached. The cutting edge is usually either screwed or clamped on in this case it is called an insert , or brazed on to a steel shank this is usually only done for carbide. Tipped tool Almost all high-performance cutting tools use indexable inserts. There are several reasons for this. First of all, at the very high cutting speeds and feeds supported by these materials, the cutting tip can reach temperatures high enough to melt the brazing material holding it to the shank. Economics are also important; inserts are made symmetrically so that when the first cutting edge is dull they can be rotated, presenting a fresh cutting edge. Some inserts are even made so that they can be flipped over, giving as many as 16 cutting edges per insert. There are many types of inserts: Others are made for specialized jobs like cutting threads or grooves. The industry employs standardized nomenclature to describe inserts by shape, material, coating material, and size. Form tools[edit] This form tool is for a shift knob on a motorcycle. O-rings went into the grooves after machining from T6 Aluminum. This tool has an 8-degree rake from top to bottom for clearance. A form tool is precision-ground into a pattern that resembles the part to be formed. A form tool turns one or more diameters while feeding into the work. Before the use of form tools, diameters were turned by multiple slide and turret operations, and thus took more work to make the part. For example, a form tool can turn many diameters and in addition can also cut off the part in a single operation and eliminate the need to index the turret. For single-spindle machines, bypassing the need to index the turret can dramatically increase hourly part production rates. On long-running jobs it is common to use a roughing tool on a different slide or turret station to remove the bulk of the material to reduce wear on the form tool. There are different types of form tools. Insert form tools are the most common for short- to medium-range jobs 50 to 20, pcs. Circular form tools are usually for longer jobs, since the tool wear can be ground off the tool tip many times as the tool is rotated in its holder. There is also a skiving tool that can be used for light finishing cuts. Form tools can be made of cobalt steel, carbide, or high-speed steel. Carbide requires additional care because it is very brittle and will chip if chatter occurs. A drawback when using form tools is that the feed into the work is usually slow, 0. Wide form tools create more heat and usually are problematic for chatter. Heat and chatter reduces tool life. Also, form tools wider than 2. Despite the drawbacks, the elimination of extra operations often makes using form tools the most efficient option. Toolholders[edit] By confining the expensive hard cutting tip to the part doing the actual cutting, the cost of tooling is reduced. The supporting tool holder can then be made from a tougher steel, which besides being cheaper is also usually better suited to the task, being less brittle than the cutting-edge materials. The tool holders may also be designed to introduce additional properties to the cutting action, such as Angular approach - direction of tool travel. Spring loading - deflection of the tool bit away from the material when excessive load is applied. Variable overhang - the tool bit may be extended or retracted as the job requires. Rigidity - the tool holder can be sized according to the work to be performed. Direct cutting fluid or coolant to the work area. Holders used on lathes[edit] Bit holder and toolpost[edit] The toolpost is the part of a metalworking lathe which either holds the tool bit directly or holds a toolholder which contains the tool bit. There are a great variety of designs for toolposts including basic toolposts, rocker toolposts, quick-change toolposts, and toolpost turrets and toolholders with varying geometry and features. A box tool is mounted on the turret of a turret lathe or screw machine. It is essentially a toolpost that brings its follower rest along with it. A tool bit or several tool bits and a compact follower rest usually V-shaped or with two rollers [2] are mounted opposite each other in a body which surrounds the workpiece forms a "box" around it. As the tool bit puts a lateral deflecting force on the workpiece, the follower rest opposes it, providing rigidity. A different and popular type of box tool uses two rollers rather than a follower rest. One roller is called a "sizing roller" and the other roller is called a "burnishing roller". The rollers turn with the stock to reduce scarring on the finished turn. Holders used on shapers, slotters, and planers[edit] Clapper box[edit] Shapers , slotters, and planers often employ a kind of toolholder called a clapper box that swings freely on the return stroke of the ram or bed. On the next cutting stroke, it "claps" back into cutting position. Its movement is analogous to that of a butterfly-style check valve. Holders used on milling machines[edit] Fly cutters[edit] Fly cutters are a type of milling cutter in which one or two tool bits are mounted. The bits spin around with the rotation of the spindle, taking facing cuts. Fly cutters are an application of tool bits where the bits are part of a rotary unit whereas most other tool bit use is linear. History[edit] Tool bits have been used for centuries, yet their further technological development continues even today. Before about , almost all tool bits were made by their users, and many machine shops had forges. Tool bits were made of carbon tool steels , which have high enough carbon content to take hardening well. Each bit was forged with a hammer, quenched, and then ground with a grindstone. The exact details of the heat treatment and tip geometry were a matter of individual experience and preference. A substantial technological advance occurred in the â€" period, when Frederick Winslow Taylor applied scientific methods to the study of tool bits and their cutting performance including their geometry, metallurgy, and heat treatment, and the resulting speeds and feeds , depths of cut, metal-removal rates, and tool life. Along with Maunsel White and various assistants, he developed high speed steels whose properties come from both their alloying element mixtures and their heat treatment methods. His cutting experiments chewed through tons of workpiece material, consumed thousands of tool bits, and generated mountains of chips. After Taylor, it was no longer taken for granted that the black art of individual craftsmen represented the highest level of metalworking technology. This was part of a larger trend during the 19th and 20th centuries by which science was mixed with art in the material culture of everyday life applied science. Stellite soon joined high speed steels as a material for single-point cutters. Although diamond turning had been around for a long time, it was not until these new, expensive metals came about that the idea of cutting inserts became commonly applied in machining. Before this, most single-point cutters were forged entirely of tool steel then ground at the tip. Now it became more common to attach a separate tip of one material to a holder of another. With the development of commercially available cemented carbide s and ceramic inserts post-WWII , this trend accelerated, because carbide and ceramic are even more expensive and even less suited to serving as a shank. The technological development, however, did not immediately displace the older ways. Between and , it was still not uncommon for a machinist to forge a tool from carbon tool steel. Today, among the single-point cutters used in mass production such as of automotive parts , insert tools using carbide and ceramic far outnumber HSS or cobalt steel tools. In other machining contexts e. An entire system of industry-standard notation has been developed to name each insert geometry type. The number of carbide and ceramic formulations continues to expand, and diamond is used more than ever before. Speeds, feeds, depths of cut, and temperatures at the cutting interface continue to rise the latter counterbalanced by copious cooling via liquid, air, or aerosols , and cycle times continue to shrink.

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The lead or entry angle is the angle between the direction of the cutting tool feed and the cutting edge. The tool nose radius is the angle formed by the point of the tool.

One of the more challenging shapes to program can be a partial arc radius. On a complete radius the feature begins at a specific point and travels 90 degrees to its ending point. The beginning and ending points are easy to calculate when you know the size of the radius. How do you calculate the beginning and ending points when the radius is only a partial arc? The first step is to sketch the theoretical sharp point between the front face and the angle the red lines. For this example we are giving the diameter at this sharp point as 2. There are 5 important points, identified on this print. P1 The arc start point in Z. P2 The arc center point in Z. P3 The arc starting point in X. P4 Arc ending point in X. P5 Arc ending point in Z. When the coordinates for each of these points are known, it is much easier to program the radius feature. P1 Arc start point in Z: This point is easy to identify. The arc starts on the front face and the front face is Z0. From the front face, move to the arc center -- this length is the radius, 0. The remaining points use the theoretical sharp point 2. P3 Arc start point in X: Construct a triangle between the arc center, the sharp point and the arc start point. Bisect that angle for the Use trigonometry to calculate the length of the opposite side. Construct a triangle from the arc ending point as shown. The hypotenuse is the radius 0. Use the cosine function to calculate the length of the adjacent side. For more detailed images of the triangles and trigonometry, see our web site, www.

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and nose radius and rake angle for surface roughness. Ranganath M S et. al [35] had predicted the surface roughness model for CNC turning of EN 8 steel using response surface methodology.

What makes an air bend sharp on the press brake? But what truly determines the point at which a bend turns sharp is the relationship between the punch nose radius, the tonnage required to form, and the shear strength of the material. Figure 1 This chart shows different multipliers to use when calculating punching tonnage for different materials. I found your article about the 63 percent rule helpful. For example, the land area is 0. This gives us 0. According to my bending chart, it takes 3. Does this mean that for thin materials, you will always be creating a ditch and losing bend consistency and stability? Or am I using your calculations incorrectly? Is that related to material thickness or a constant? I would like to understand this topic well, as I want to know the deeper theory behind what I do on a press brake. You are on the right track, but we need to clarify a few points. First, what does the 63 percent represent? That material is as middle-of-the-road as it gets. That is the baseline material upon which our calculations are based. Air forming is our baseline method of forming. Note that 63 percent is a rule of thumb, and as with any such rule, there will be exceptions. What truly determines the point at which a bend turns sharp is the relationship between the punch nose radius, the tonnage required to form, and the shear strength of the material. With that information in hand, the first step is to determine the forming tonnage, or the tonnage required to bend the workpiece: Step two, we determine the land area. In a punching situation, this is the point where the rollover would stop and the shearing begin. For this, we use a standard tonnage calculation formula used for the punching process, incorporating a material multiplier, as shown in Figure 1. Unlike forming tonnage, punching tonnage actually uses 50,PSI-tensile-strength material as a baseline as described later. This requires us to use a material multiplier, giving us a punching tonnage a little higher than you originally calculated: Once created, the crease is simply, for lack of a better description, an amplifier of the inconsistencies within the material, like variations in grain direction, hardness, and thickness. These and similar variables are the root cause of angular variations from workpiece to workpiece. The 25 Constant So where does the 25 in this formula come from? It is a constant that represents the average shear strength of KSI mild cold-rolled steel. The shear strength of stainless is about 75, lbs. Compared to mild steel, stainless will take 1. Please note the tonnage to break the material surface is only a reasonably precise estimate, as this formula was not intended for press brake applications. However, the numbers are close enough for our purposes. Sharp Bends Should you find yourself with a sharp bendâ€”which your example isâ€”it is best to avoid it. Avoiding a sharp bend whenever possible will make your bends more consistent and stable from workpiece to workpiece. First, when working on this scale, there is a very fine line between air forming, bottom bending, and coiningâ€”a few thousandths of an inch, in most cases. This could mean that if your bends are stable, odds are you are bottom bending. Being universally accepted, this concept means that for a 0. So unless you are bottoming with your 0. But our theory also states, and our data has confirmed, that the tonnage required to form 2. So for all intents and purposes, it is amplifying the material variables. So how large does the punch radius need to be to avoid a crease? To find out, you can do a little mathematical trial and error with the punching tonnage formula, replacing the punch radius value with a larger value until the punching tonnage exceeds the forming tonnage: So what does this do for you then? It simply explains why sometimes when bending this basic 1-to-1 material thickness-to-radius relationship, you can still have dramatic swings in bend angle rather than having the stable angles we would normally expect from bend to bend. If a material has a different tensile strength, you need to incorporate a material factor. The first step is to find the material factor for the forming tonnage formula. We will estimate this value by dividing its tensile value by the KSI value of our baseline material: In this case, we will be using a 0. All three of these values are then inserted into our basic forming tonnage calculations as follows: Starting with a 0. Because this material is not listed in Figure 1, we calculate the multiplier by comparing it to our KSI baseline: Knowing this, we start our calculations. If you then were to apply the 1. Next, bearing in mind that sharp bends are a function of the material and not the punch nose radius, we calculate the minimum inside radius for our given piece of material. As we did in the previous example, we first perform several trial-and-error math problems, replacing the inside radius with a progressively larger value until the tonnage to form is less that the tonnage to pierce the material. The tonnage to form the material is 1. So what is the naturally floated inside radius for this air bend? Comparing our KSI material with the baseline, that percentage will be only about 3 percent, making our estimated floated radius very small indeed, and significantly less than where the bend turns sharp. In this case, we calculate the floated radius based on our rule of thumb about where the bend turns sharpâ€"at 63 percent the material thickness of our baseline KSI mild steel. Again, the percentage will be much lower for our soft KSI material. Because the material is so much softer, it will carry a much smaller inside radius then our baseline material would, just as stainless would carry a larger inside radius in the part. To determine it, we run a comparison with our baseline material: So according to this, the minimum radius is 13 percent of our 0. This estimate is less than our previously calculated 0. With a punch nose radius of 0. When working with sharp bends in air forming, you need to use the minimum radius value for your bend allowance BA and the bend deduction BD calculations. Because if you use the wrong radius valueâ€"for example, any punch nose radius less than the minimum inside radiusâ€"your calculations will be off. Applies to Air Bending Only Remember, this discussion does not apply to bottom bending or coining. The springback factor represents the slight opening of the inside radius of the bend as it is released from pressure. Best Practices Try to select a punch nose radius as close as possible to the naturally floated radius or minimum radius when air bending. The wrong inside radius will change your bend allowance, which will make your outside setbacks, and ultimately your bend deduction, incorrect; the resulting formed part will be either too big or too small. Remember, a bend deduction error of just 0. Overall, try to avoid forming parts to their sharp bend radius, or at the very least, do not use the sharp bend value in your calculations. Instead, use the minimum or floated bend radius. If you use the minimum radius value, instead of the sharp bend radius value, for your bend deductions, you will find that it leads to much better quality over time. You also may see a dramatic reduction in labor costs, as operators will no longer be fighting as many bend angle issues and correcting for dimensional errorsâ€"saving you hours of handworking parts back to a sellable condition. Besides the sharp and minimum bend radii, there are two more bend classifications: The bottom line is this: The sharper that you make this crease the smaller the land area , the greater the variations will becomeâ€"which ultimately causes quality to suffer. For more information, visit www. You May Also Like.

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