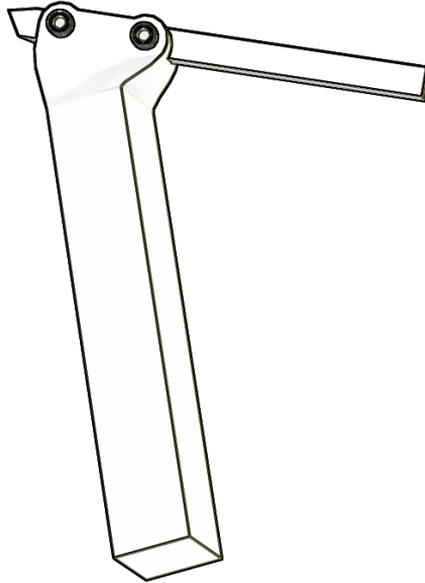


Wimberley

TH-500 Tool Holder

TH-500 Tool Holder



Instruction Manual

Package Contents:

TH-500 Tool Holder (Qty 1)

2mm Hex Key (Qty 1)

3/16 Square HSS Tool bit (Qty 1)

Made in USA 

Dimensions (overall L x W x H): 3.9" x 0.9" x 0.9" in Weight: 4.7 oz (133g)

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5 Year Warranty – for details see www.tripodhead.com

Instructions for the Wimberley Toolholder

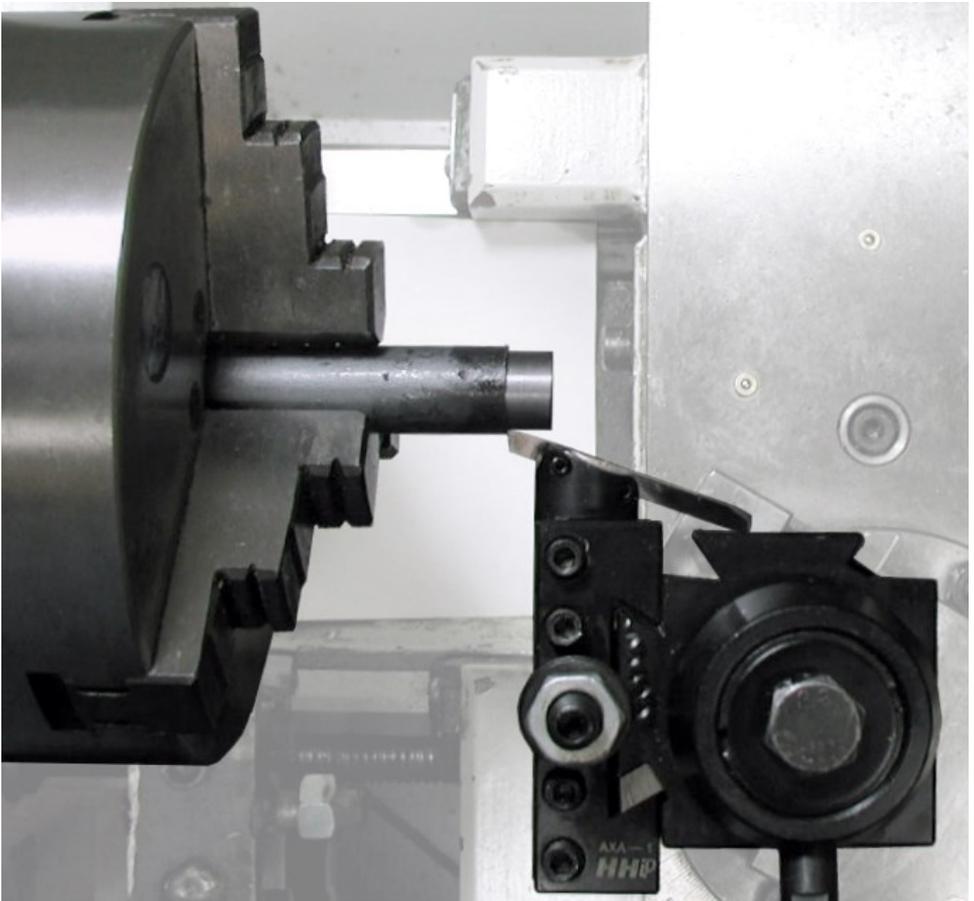
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SAFETY

Some of the tools shown in these instructions are intrinsically dangerous and can cause serious injury or death. Always exercise appropriate caution for the safety of you and those around you when using power equipment. For the purposes of these instructions some machine guards may have been removed.

These instructions are intended to educate the reader about the use of the Wimberley toolholder and how to sharpen the bit for the toolholder and are not intended as a tutorial in shop practice.

The Toolholder in place in the Lathe



NOMENCLATURE — CLASSIC HHS TOOL BIT

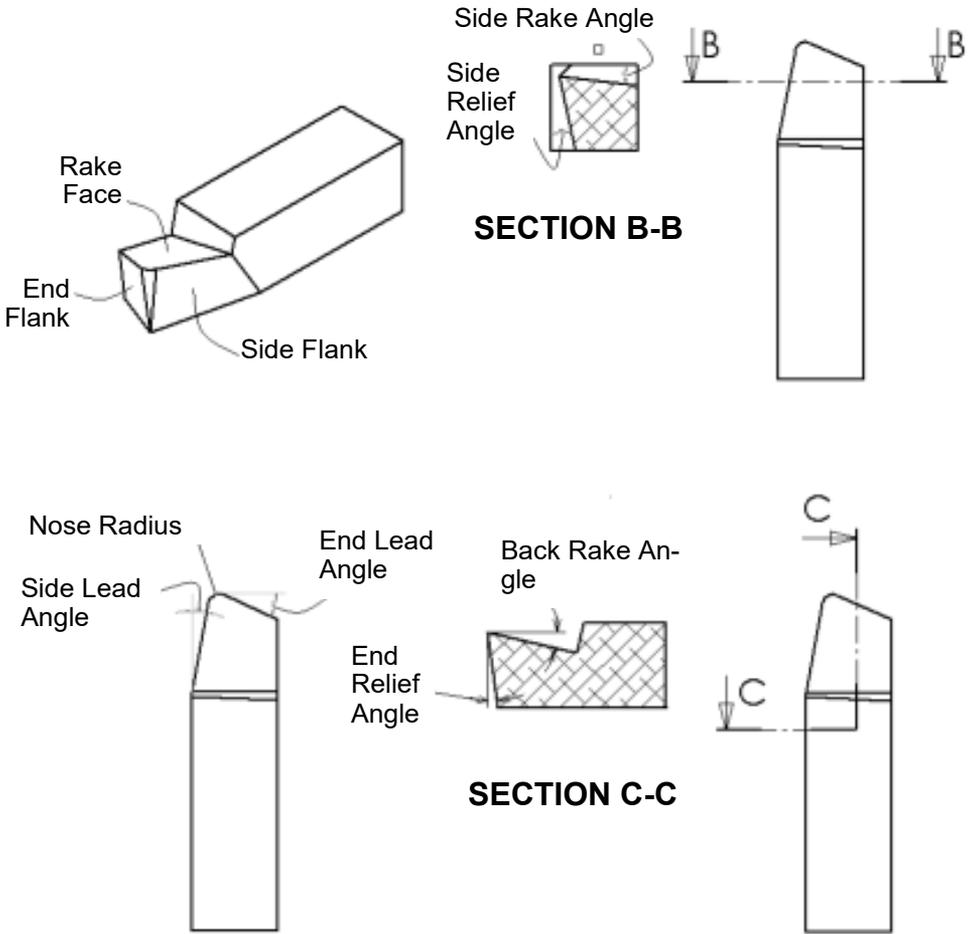


Figure 1

Figure 1 depicts the classic high speed steel lathe tool bit. This figure is included to explain the various angles of the bit. The axis of this tool is horizontal and perpendicular to the axis of the lathe. This tool is designed to cut from right to left.

The end lead angle can also be considered a clearance angle because this tool is used only for turning.

GEOMETRY OF THE TOOLHOLDER

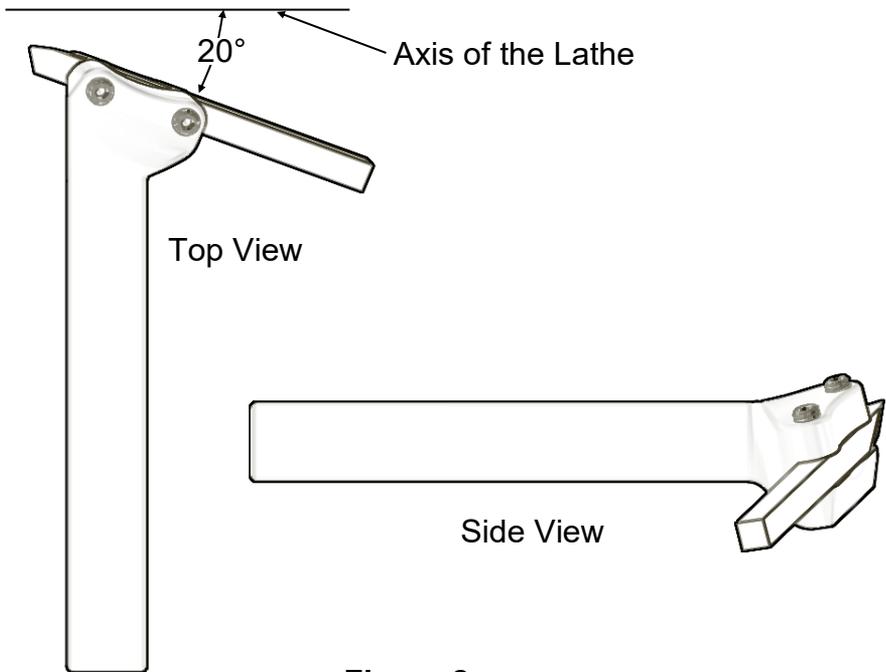


Figure 2

Figure 2 shows two views of the toolholder with a tool bit ground to provide a negative 5° lead angle for both turning and facing. The shank is $1/2$ " square. The toolholder uses a $3/16$ " square tool bit. The bit is held in place with setscrews. As you can see, the butt (the end opposite the nose or tip) of the tool bit is lower than its cutting tip, and the bit is rotated counterclockwise looking from the butt end.

The side rake and back rake angles are both 14.43° . (This derives from a symmetric rake plane that is inclined 20° to the horizontal.) 14.43 is not a magic number, but it is a good compromise for cutting various steel and aluminum alloys. If you are dealing with particularly hard steel, you can simply reduce the spindle speed. The toolholder is also very effective for plastic, wood and other materials, but would not be appropriate for a material that calls for zero rake angle, such as some brasses.

Viewed from above, the tool bit is oriented only 20° from the (rotational) axis of the lathe. This means that this toolholder is not very useful for profiling complex contours or facing a piece that is held by a center. Fortunately, most lathe work is not of that sort. For ordinary turning and facing, this tool is ideal.

TOOL BIT GEOMETRY

We will next demonstrate two tool bit configurations, one with **negative lead angle** that can produce a square inside shoulder, and one with **positive lead angle**. Tool bits of each configuration can both turn and face without being reoriented. A myriad of additional bit geometries can be produced by simply varying the clearance and lead angles of the bit.

NEGATIVE LEAD ANGLE TOOL BIT GEOMETRY

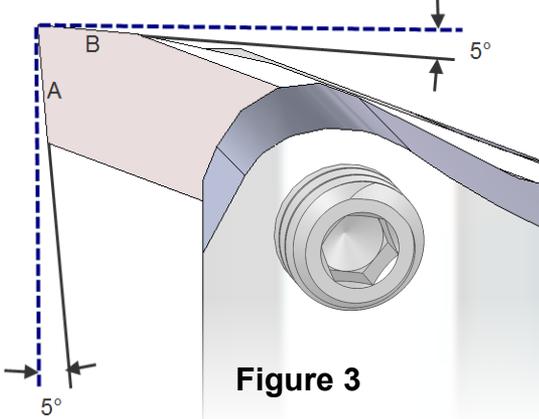


Figure 3

When turning edge A of Figure 3 is the cutting edge and has a negative 5° lead angle, whereas edge B has a 5° clearance angle. Similarly, when facing, edge B is the cutting edge and has a negative 5° lead angle, and edge A has a 5° clearance angle. This geometry allows the bit to produce a square inside shoulder and of course to turn and face in the same orientation. (The bit can also produce a radiused end on the workpiece when the two hand wheels are manipulated at once. The ability to turn and face is similar to that of an 80° diamond-shaped carbide insert with at -5° lead angle.

Because the tool bit is oriented only 20 degrees from the axis of the lathe, the facet that contains edge B is longer and of greater surface area than the facet that contains edge A, and is thus harder to grind. It is therefore recommended that cutting edge B be only a little longer than the deepest facing cut anticipated.

You may want to use the -5° lead angle bit for general-purpose work. You should understand, however, that the negative lead angles, especially combined with high rake angles and a great depth of cut, may tend to pull the tool bit into the work, either by dislodging the tool bit, or using the play in the lead screw to move the cross slide. Therefore, care must be exercised using this geometry, when attempting aggressive cuts in a worn and loose lathe. On the other hand, taking relatively small cuts this geometry allows for the achievement of very accurate diameters.

POSITIVE RAKE TOOL BIT GEOMETRY

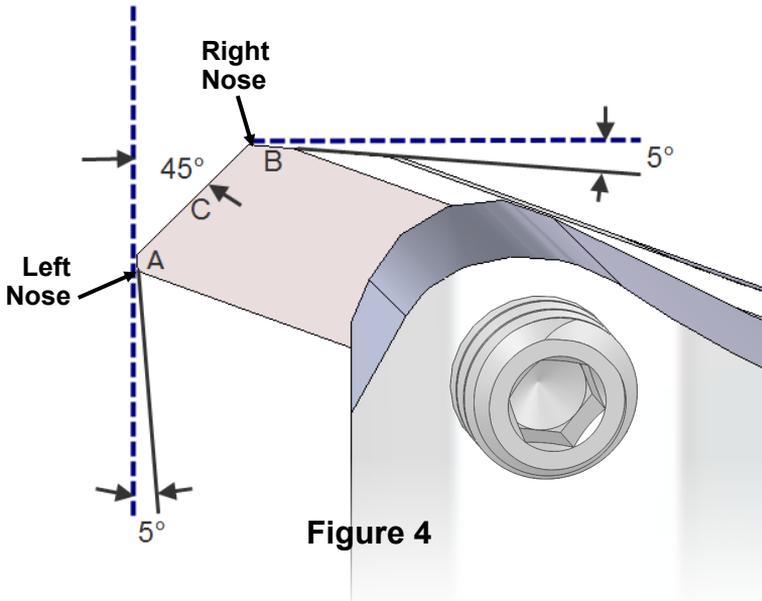


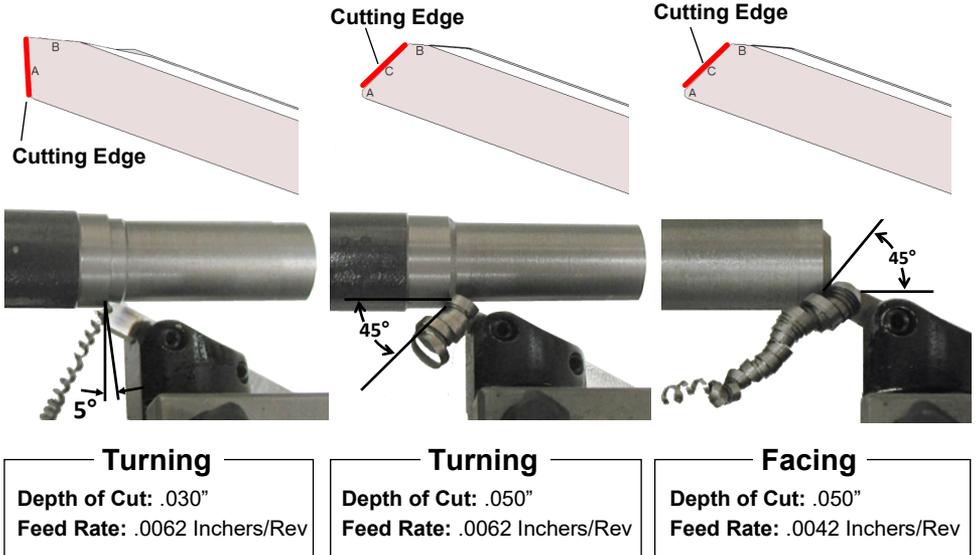
Figure 4

This is a highly unorthodox geometry that incorporates two tool bit noses, allowing this bit to both turn and face (but not turn to a shoulder). Because the back rake is equal to the side rake, a lead angle of 45° creates a horizontal cutting edge, making the two noses equal in height.

A bit ground in this manner does not tend to get pulled into the work and actually tends to get pushed away a bit. Further, a positive lead angle is more efficient because, for a given depth of cut a greater length of the cutting edge is employed which results in a thinner chip. Therefore, a substantially deeper cut can be taken. In this case, the effective rake angle (perpendicular to the cutting edge) is 20 degrees and the cutting is very easy.

A, B, and C are the three edges that must be created in grinding this configuration. Edge C is the cutting edge, and edges A and B, are associated with clearance angles. Compare edges A and B to those in the previous figure relating to negative lead angle geometry. They are oriented precisely the same, but are much shorter. As previously stated, each of these edges is characterized by a clearance angle and does not cut. It is desirable to keep these edges quite short so that they do not needlessly reduce the length of the only cutting edge, C. Cutting edge C has a lead angle of 45° both for turning and facing. This configuration limits the depth of cut to about .120", which should be quite adequate. It also allows one step chamfers of up to about .170" long. (Longer chamfers can be made in multiple steps.)

TOOLHOLDER IN USE

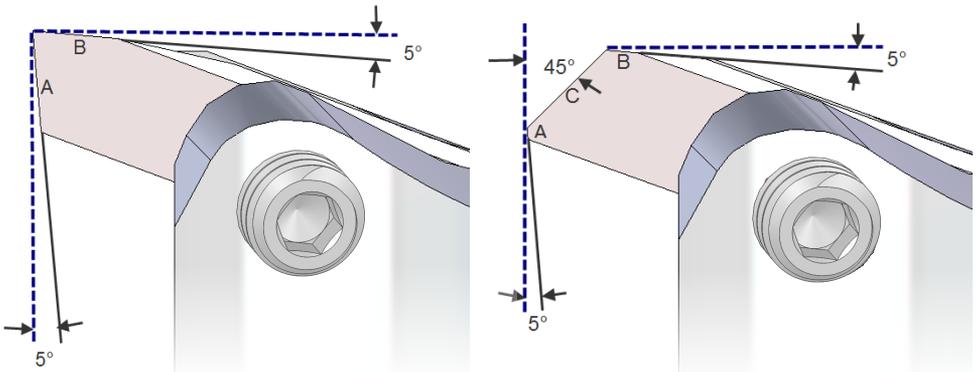


The toolholder is shown cutting 3/4" diameter hot rolled steel with a spindle speed of 410 RPM.

SHARPENING - HOW IT WORKS

A principal virtue of the Wimberley toolholder is that the tool bit can be sharpened very easily. Built in side rake and back rake angles are equal. I recommend that the side and end relief angles both be 8° for general-purpose work (greater relief angles may be employed for softer materials, but are not necessary).

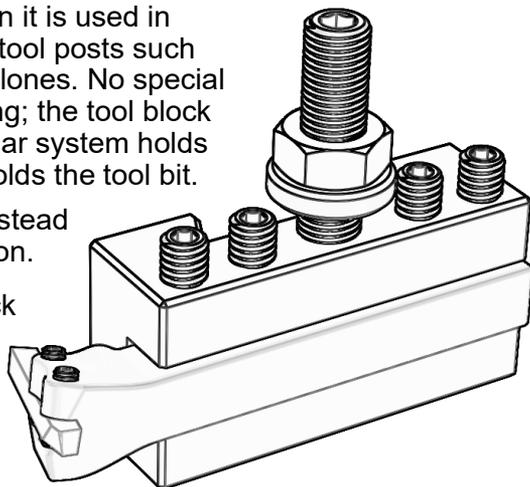
Two or three facets, represented by edges A, B, and C from the previous figures (shown again below) must be ground.



The toolholder works best when it is used in conjunction with quick change tool posts such as the Aloris, Multifix, or their clones. No special fixture is required for sharpening; the tool block that is part of the Aloris or similar system holds the toolholder which, in turn, holds the tool bit.

The term **tool block** is used instead of toolholder to reduce confusion.

A tool holder held in a tool block is shown to the right.



The sharpening process is very similar to that used in creating the flanks of a conventional single point cutting tool. To sharpen the bit, loosen the set screws and slide the bit along its axis so that the tip is about 3/4" from the left surface of the toolholder. The tool block is placed on the table of an appropriate grinder adjusted so as to provide 8° of relief, (The angle between the grinding surface and the table would then be 98°.) The facets can be ground by eye or with the aid of marks on the table or other means to establish the lead and clearance angles. The same inclination of the table is used to create the nose radius or facet.

Generally wear occurs on the flanks of the tool. Therefore only enough material needs to be removed to clean up this wear, and very little material is removed in the sharpening process. A high speed steel tool bit will last a very long time. Grinding the flanks of a tool bit in the Wimberley toolholder is good practice for grinding a conventional tool bit, and thus gives the user an introduction to conventional tool bit grinding while eliminating the wasteful and somewhat difficult task of grinding the rake face.

After grinding the flanks and nose, the tool may be honed.

As stated, there is no need to create a rake face; any one of the long factory-prepared sides of the bit can serve as the rake face. The sides of the bit tend to be very smooth and are sometimes even polished. Furthermore, because the entire side of the tool bit serves as the rake face, it is easy to further refine that surface with some 280 grit or finer wet-dry paper on a flat substrate or with a fine hand stone. It would be very difficult to get an equivalent degree of rake-face smoothness in a conventionally ground tool bit.

The coarse wheel on an ordinary bench grinder can be effectively used for roughing out the tool bit, provided the wheel is occasionally dressed with a star wheel dresser. (See page 17 for more details)

ESTABLISHING TOOL STICK-OUT

The tip of the tool is specified as $15/64$ " to the left of the leftmost surface of the toolholder. This distance, which we call the stick-out is shown in figure 5.

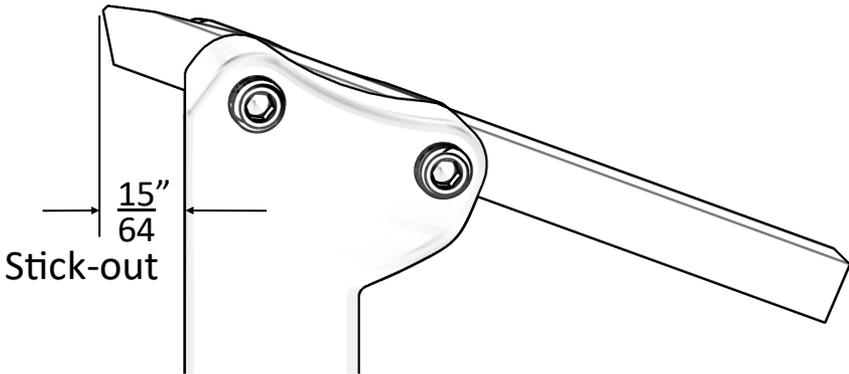


Figure 5

The stick-out is established as follows. A surface perpendicular to the axis of the lathe must be available. This could be the end of the chuck or the faced end of a workpiece. With a $15/64$ " drill bit or transfer punch in one's left hand, the left edge of the toolholder is brought close to the perpendicular surface. The butt of the drill bit is placed between the toolholder and the surface, and the lathe's carriage moved to the left until the drill bit is trapped. The carriage is locked if need be. The cross slide is then backed out allowing the drill bit to rotate until it is no longer trapped between the toolholder and the perpendicular surface. At this point, the distance between the toolholder and the perpendicular surface has been established. The freshly sharpened bit is then inserted into the toolholder and, while completely seated in the groove of the toolholder, slid axially until the tip touches the perpendicular surface. At that point, the proper stick-out is established and the set screws can be tightened. When the stick-out is correct, the height of the tool bit is also correct so there is no need to reestablish the height of the tool bit.

It is important to note that the tip of the tool bit will be almost precisely level with the top of the $1/2$ " shank for the negative lead angle tool bit. The tip will be about $.041$ " lower for the positive lead angle tool bit. Therefore, if you are using a single toolholder, and swapping between these two bit geometries, you will need to adjust the height of the tool holder with the Aloris or other tool block.

(Alternately you could use different stick-out values for the two tools, .234" for the positive lead angle tool, and about .125" to .145" for the negative lead angle tool, depending on nose radius.)

The cutting tip of the tool bit is always to the left of the toolholder and tool block. This is convenient for two reasons. First, the tip of the tool is easily visible. Second, having the tool tip to the left of the toolholder reduces the likelihood that some other portion of the lathe will unexpectedly strike the chuck while the tip is still in safe territory.

If you have a single toolholder, you can just swap bits to obtain the two described tool tip geometries. If you have two toolholders, you can dedicate a toolholder and tool block for each of these two geometries. Of course a vast array of other lead angles can be experimented with, but the two geometries herein presented should take care of nearly all of your turning and facing needs.

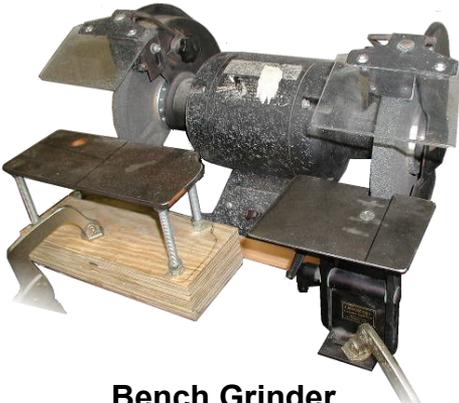
TOOLS AND TECHNIQUES FOR SHARPENING THE BIT

The bit can be roughed out on the coarse wheel of a bench grinder, on the contact wheel or platen of a belt grinder.

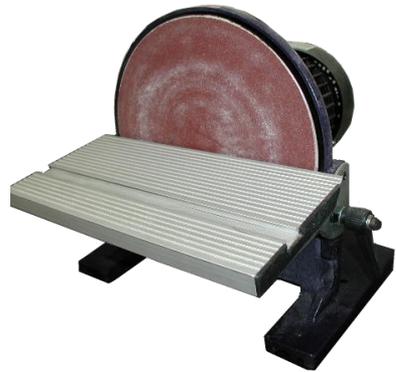
Belt grinders are not ideal for finish grinding because it isn't possible to create a crisp facet, given that the belt is not firmly attached to the platen or substrate. Similarly, a disk sander whose sanding disc is not stuck to the substrate everywhere will not create a perfect facet.

When grinding, the bit should be moved back and forth across the abrasive surface to even the wear.

A great variety of tools could be used to grind a tool bit, but the most commonly available are the bench grinder, the disk sander, and the so-called carbide grinder with an aluminum oxide wheel to replace the original silicon carbide wheel.



Bench Grinder



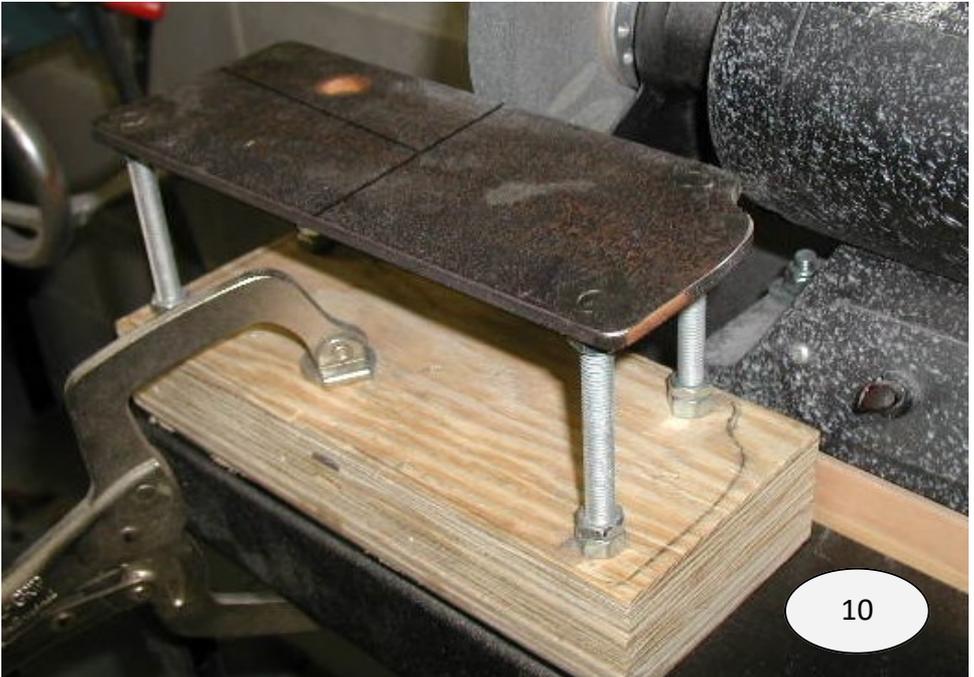
Disk Sander



Carbide Grinder with Aluminum Oxide Wheel

USING THE BENCH GRINDER AND HORIZONTAL TABLE

The least expensive option, and the tool that most people will already have, is the bench grinder. The problem with a bench grinder is that the work support table will almost certainly be too small. You have two options. One is to purchase an aftermarket table, but even the aftermarket table will probably be too small, so you may need to fasten a larger thin plate to the existing table. The second option is to fashion a horizontal table in front of the wheel. The top of the table must be located at such a height that that the tip of the bit will be 8° (or whatever relief angle you have selected) above the axis of the wheel.



In preparing for the DVD, I made the table shown in photograph 10. I used plywood for the base of this portable table. All metal construction is preferable, but a casual experiment demonstrated that it's pretty difficult to char a piece of plywood with the sparks generated by a bench grinder. If you do use wood in the construction of the table, you should obviously keep in mind that you are exposing a flammable material to very hot, if tiny, objects in the form of sparks.

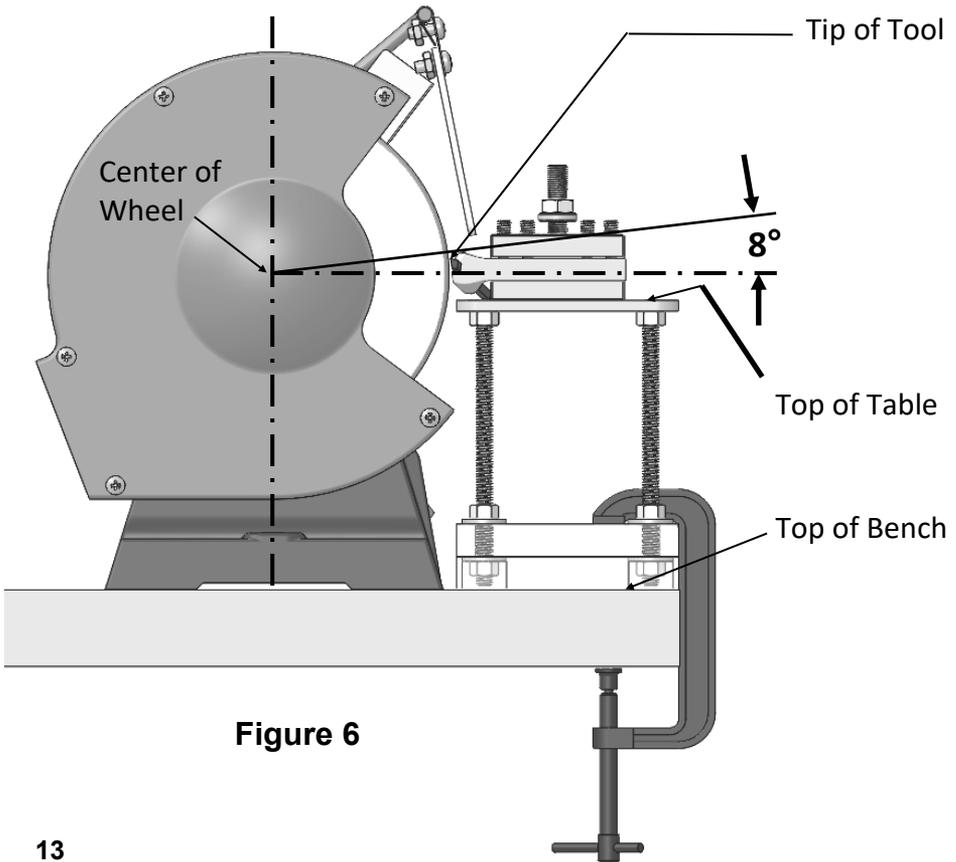
Building The Table

The table is made of a piece of 1/4" or so steel, four 3/8" threaded rods and 3 nuts per rod (more if you use jam nuts). Four holes are drilled in the bench upon which the grinder is mounted. The holes in the tabletop are threaded.

The threaded rods make the table Adjustable in height. (The height of the table will have to be adjusted from time to time to compensate for wear of the wheel.)

I used four threaded rods, but it makes more sense to use 3 rods, for example 2 on the left, front and back, and one on the right midway between front and back.

Figure 6 shows an adjustable height horizontal table in front of a bench grinder. A tool block holds a tool bit that contacts the wheel creating 8° of relief.



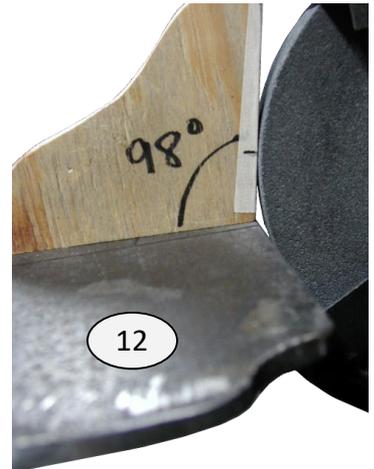
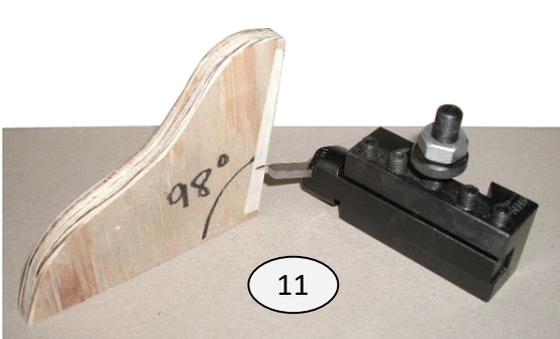
The height of the table (The distance between the top of the table and the top of the bench) equals

- the distance from the top of the bench to the center of the wheel
- plus the distance between the center of the wheel and the tip of the tool ($\sin(8^\circ) \times \text{diameter wheel} / 2$ [$\sin(8^\circ)$ is approximately 0.139])
- minus the distance between the tip of the tool and the bottom of the tool block

For example if the Distance from the top of the bench to the center of the wheel is 7", the diameter of the wheel is 7.75", and the distance between the tip of the tool and the top of the table is 0.9", the distance between the top of the table and the top of the bench should be $7 + (.139 \times 7.75/2) - .09 = 6.339$ inches.

It should only be necessary to construct a horizontal table for the fine wheel; the tool can be roughed out on the coarse wheel without the benefit of such precision.

After completion, the height of the table is checked using an angle block as shown in Photographs 11 and 12. In photograph 11 a mark has been created on the edge of the plywood angle block at the height of the tip of the tool bit. In photograph 12, you can see that the table height is set correctly because the edge of the plywood angle block is tangent to the wheel at the height of the tip of the tool bit.



The angle block is made from a plywood scrap. A machinist's square and steel angle blocks of 5° and 3° create the 98° angle. Masking tape over the edge allows you to mark the angle block without marring it.

You can also print an easily found online PDF of a protractor to measure your 98 degrees.

Determining How Much Stick-Out to Use in Grinding

In photograph 11 you'll notice that, for the sharpening process, the tool bit stick-out has been substantially increased, to 3/4". The increased stick-out accomplishes two things. First, it provides clearance for the toolholder so you don't inadvertently grind the lower portion of the toolholder. Second, it elevates the butt of a long tool bit so that it does not extend beyond the lower surface of the tool block.

Once you are familiar with the process you may choose to experiment with a shorter stick-out in some circumstances, for example with a short tool bit, but this will require adjusting the table on a bench grinder. (A smaller stick-out would not require adjustment of a tilting table on a tool such as a disk sander or carbide grinder where the grinding surface is planar.)

Getting the Angles Right

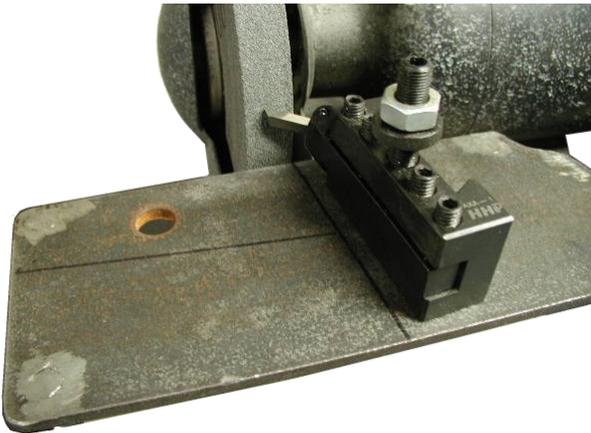
Grinding the tool bit by eye is not difficult, but guidelines are easy to create and helpful.



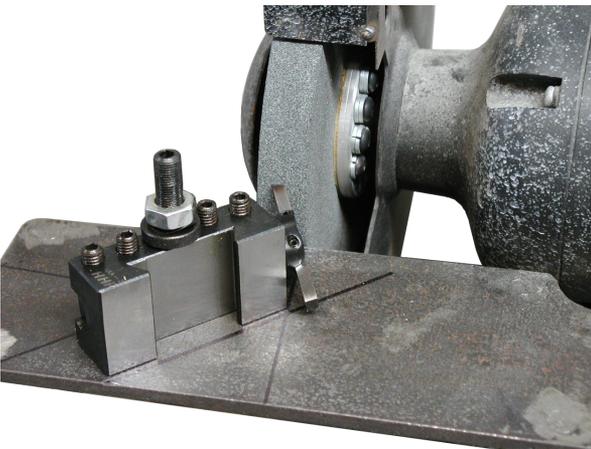
Drawing guidelines on tool support tables is facilitated by using index cards trimmed to the relevant angles. These can easily be created with a scale, an angle block, and a utility knife, as shown in photograph 13. You can also use a protractor.



Photograph 14 shows a guideline facilitating the grinding of the facet associated with edge A in figures 3 and 4. The guideline being used is 5° clockwise of parallel to the face of the wheel.



Photograph 15 shows a guideline facilitating the grinding of the facet associated with edge B in figures 3 and 4. The guideline being used is 5° counterclockwise of perpendicular to the face of the wheel. (The angle between the two guidelines shown is 100° .)



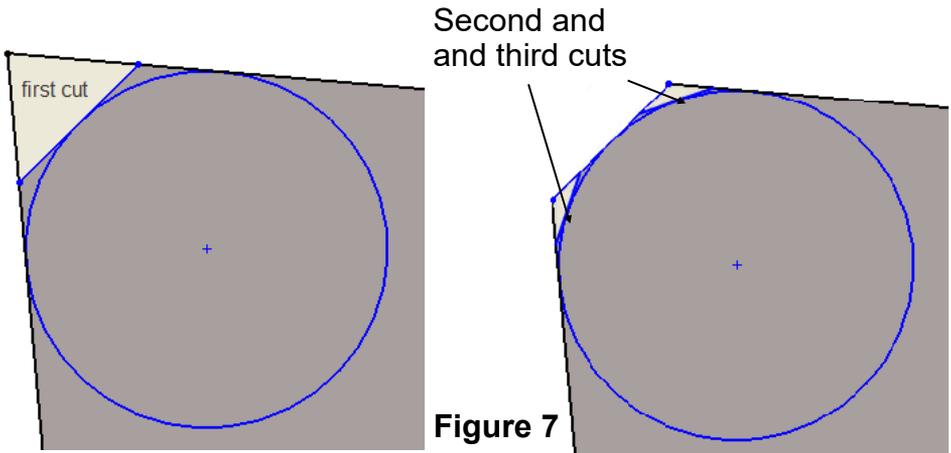
Photograph 16 shows a guideline facilitating the grinding of the facet associated with edge C in figure 4 and the nose facet in Figure 3 (discussed below). The guideline being used is 45° from parallel to the face of the wheel.

It is good practice whenever possible to move the work back and forth across the face of the wheel so that wear occurs evenly as you grind.

Refining the Nose or Noses of the Tool Bit

Lathe tool bits generally incorporate a radiused nose, but a simple flat, such as the first cut below, that is .015 to .020" wide is perfectly adequate for most purposes. (The "noses" on drill bits and end mills, that is, the outside corners, are not radiused.) Referring to figure 4, the tool bit has with two noses and a lead angle of 45° . The angles between the edges A and C, and edges C and B are about 130° . The corner created by the intersection of the two flanks associated with these noses can be used as-is, or lightly stoned. The obtuse 130° angle eliminates the need for any substantial refinement.

Now refer to figure 3. This tool has a single nose and a lead angle of -5° . The first, and potentially last step in defining the nose of this tool is to, as shown in photograph 16, create a tiny facet which creates the same angles mentioned above. Such a facet is shown on the left of Figure 7. Once this facet has been created, you can simply use the bit as-is, stone the corners as described above, or more closely approximate a radius if you wish. You can produce two intermediate facets as shown to the right in figure 7. At this point, four corners have been produced which can then be stoned.



I generally use a very small radius, on the order of $1/64$ ", which means the length of the edge produced with the first cut in figure 7 would be about .015". This radius is just large enough to protect the point of the tool. Of course you can create a larger radius if you wish to. Because of the mass of the tool block and the friction of the tool block on the grinding table, it is difficult to produce a radius in one sweeping motion as one might do with a loose tool bit. Therefore I prefer the faceted approach discussed above. Very little material is removed in this process. Therefore I turn the grinder off, and while it is coasting, grind the facets. The first facet will remove the bulk of the material.

Of course the inclination of the table remains the same throughout. (It is common, but incorrect, practice to change the angle of the table when grinding a radius or flat at the tip of the tool, but it is contrary to the description in Machinery's Handbook, and it is obvious that commercial carbide inserts are not made this way.) If your "radius" is small, you may notice that it does not extend all the way down to the bottom surface of the bit opposite the rake surface. This is normal and to be expected. It is, however, something that you have to keep in mind when you are honing the bit.

Honing the Bit

Honing the bit is simple. It is also probably unnecessary, given the fact that many experts skip this step. On the other hand, it does give you the satisfaction of creating what seems like a nearly perfect edge. I have found that the best stone for honing the bit is a fine 1/4" square cross-section aluminum oxide stone. An ordinary fine pocket stone or other small hand stone with a flat working surface will work fine. I find it useful to wear Optivisors® or other magnifying glasses while honing the bit.



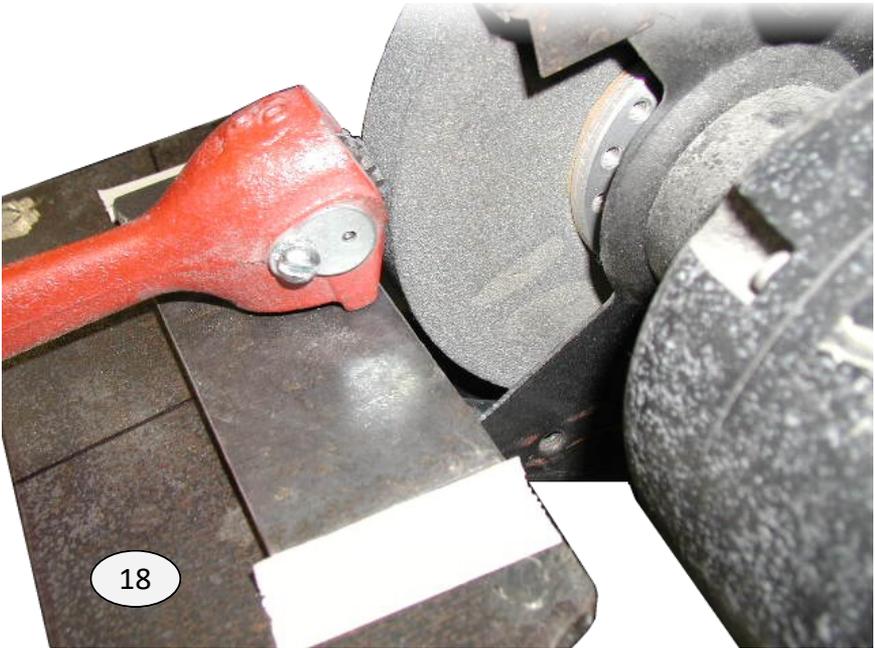
Photograph 17 shows the bit being honed. If you are right handed, hold the stone in your right hand and the bit in your left hand, rake face up. Start with the closest flank which will be the end flank. Adjust the surface of the stone and the flank of the bit until they are completely coincident, with the stone extending beyond the bit above and below. Gently hone the bit by moving the hone parallel to the end cutting edge. Work your way around the radius to the side flank, paying special attention to stay on the ground facets if your nose radius facets do not extend all the way to the bottom of the bit.

Re-Sharpening

If you are re-sharpening a bit, very little material will have to be removed. In contrast to the original sharpening, however, there will generally be some build up on the tool from previous usage. The first step will be to remove that build up, either with a hard abrasive hand stone, or with some 280 (or so) grit silicon carbide paper on a flat surface such as the table of a milling machine. (Make sure there are no particles between the abrasive paper and the flat surface.)

Once the rake face has been cleaned with a stone or abrasive paper, re-sharpening a bit is simply a matter of touching up the flanks and nose and honing as desired. As previously stated, very little material will need to be removed unless the bit has been abused, and if for example, a crater has been produced on the rake face.

Dressing the Grinding Wheel



The aluminum oxide wheels that typically come with a bench grinder are much more efficient cutting instruments if they are occasionally dressed with a star wheel dresser such as that shown in photograph 18. A 3/8" thick plate has been taped to the tabletop to ensure that the center of the star wheel is above the center of the grinding wheel.

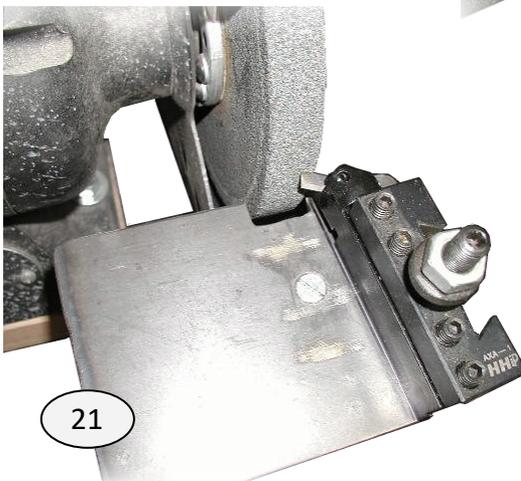
19 See www.kut-rite.com/dressers.php for instructions on how to use the star wheel dresser.

Using the Bench Grinder with Tilting Table



Photograph 19 shows an aftermarket table, the Veritas® grinder tool rest sold by Lee Valley, with an added steel table, .100" thick.

Photograph 20 demonstrates how the angle of the work table must be adjusted using the previously shown shop-made angle block. The wheel must be tangent to the edge of the angle block at the height of the tool bit tip above the table.



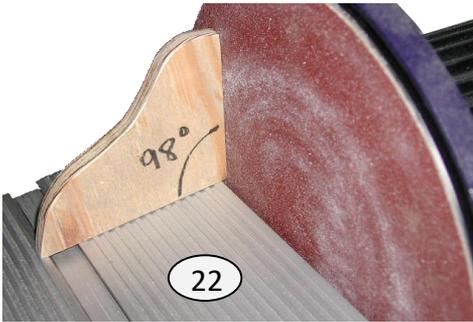
In Photograph 21, the end flank (The facet that includes edge B in figures 3 and four) is being ground on the bench grinder using the Veritas® adjustable table with steel plate attached. Note that a much smaller stick-out dimension is being used for this demonstration.

(Keep in mind that reducing the stick-out reduces the height of the tool tip and will therefore lowers the mark on the angle block used in photograph 20 to adjust the table angle.)

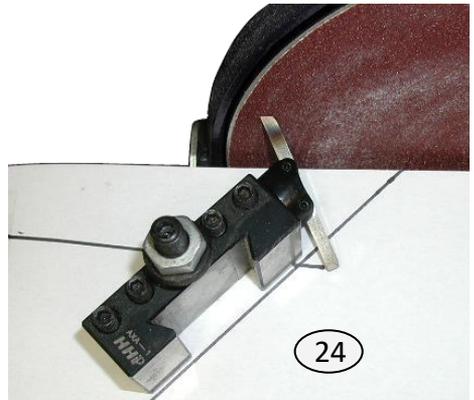
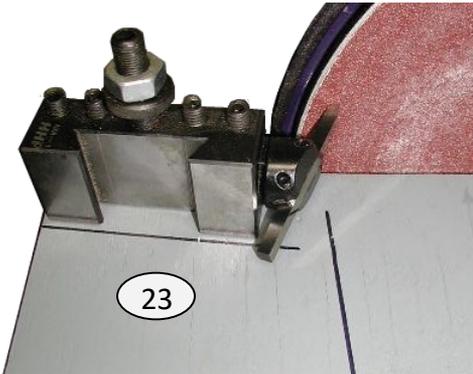
Using the Disk Sander

The next option is a disk sander. It would be nice to have a sander that is reasonably good-sized although a small disk sander of sufficient rigidity would work. I selected a nominally 10" disk sander (actually 25 cm) from Harbor Freight for demonstration.

It arrived a little beat up so I had to spend quite a while adjusting the disc with a hammer and dial indicator to get it to run true. I also removed and straightened the brackets under the table, and removed the plastic dust guard, given the fact that the tool would be used for grinding rather than sanding. The locking levers were the type that allows adjustment of the position of the lever. I disabled that function with epoxy. Having done all those things, the table on the sander is surprisingly easy to adjust.



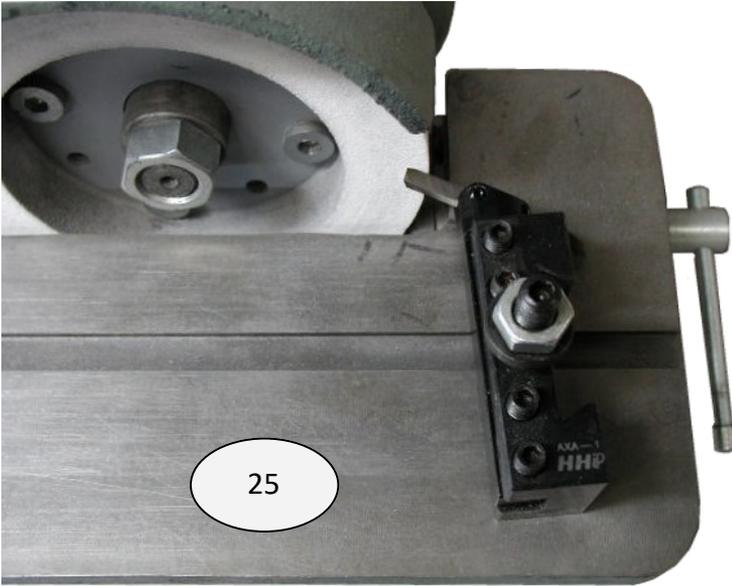
In photograph 22 an angle block is being used to set the angle of the work table on the Harbor Freight 10 inch disk sander.



In photographs 23 and 24 the disk sander (rotation counterclockwise) has been fitted with a table extender upon which guidelines are drawn. In photograph 23, the left flank or the facet that contains edge A in figures 3 and 4 is being ground. In photograph 24 the facet that includes the cutting-edge (C) is being ground. The table extender makes sharpening a tool bit much easier. This extender has a tongue that rides in the miter slot thus avoiding the need for fasteners.

Using the Carbide Grinder

The final and most expensive option is the so-called carbide grinder. These grinders come with two silicon carbide wheels. These wheels are not suitable for grinding high speed steel. I replaced one of the wheels with an aluminum oxide wheel. I've seen a good YouTube video on tuning up an inexpensive import version of this grinder. Of course a Baldor version of this grinder would be nice to have.



Photograph 25 demonstrates grinding the end flank (The facet that includes edge B in figures 3 and 4) on the right-hand side of the carbide grinder (I usually use the left side of the wheel.) The tool block is oriented about 5° counterclockwise from perpendicular to the face of the wheel without using a guideline. Note that the wheel would have to rotate in reverse direction.

You can set the table inclination with the angle block. I leave mine set at 8° . If the grinder is set up properly, the slot will be perpendicular to the rotational axis of the grinder, and thus can be used with a shop-fabricated diamond dresser to true the wheel. After the wheel is true, you can rough it up with a Norbide (boron carbide) stick if you wish.

The carbide grinder is quite versatile. I do most of my grinding on the left side of the wheel, but the rotation the wheel can be reversed allowing for grinding on the right-hand side of the wheel. (The direction of the grinding surface must be downward relative to the bit being ground.)

Grinding High Speed Steel

Many people have followed well-intentioned advice to never grind high speed steel hot enough to create oxidation colors. I am indebted to Ed Huntress, whose posts on **rec.crafts.metalworking** in 2001 set me straight. Ed advocates for a return to the way things were done in ordinary machine shops in the heyday of high speed steel.

One of the cardinal characteristics of high speed steel is its ability to withstand the high temperatures that are generated by machining at high speed, hence the name. The minimum tempering temperature for high speed steels is about 1000°F. Therefore, you can grind until the bit has achieved a dull red next to the grinding wheel. Oxidation colors are certainly no problem. Not only is there no need to quench the tool, but you can damage the cutting-edge by generating small fractures if you quench the tool intermittently; high speed steel should be ground dry in the home shop setting.

Here's what Ed said about applying pressure to the tool bit. "If you can handle it you aren't applying enough pressure to grind it efficiently. HSS requires some pressure. I hold HSS bits with Vise-Grip pliers when I'm grinding them. Sometimes I clamp them in a toolholder and hang onto that."

CUTTING PARAMETERS

Routine cuts in hot rolled steel are shown in the table 2.

| Lead Angle in degrees | Surface Feet Per Minute | Depth of Cut in inches | Feed Rate in inches/rev. |
|-----------------------|-------------------------|------------------------|--------------------------|
| -5 | 80 | 0.030 | 0.0062 |
| 45 | 80 | 0.050 | 0.0062 |

Table 2



-5 Degree Lead Angle



45 Degree Lead Angle

The surface feet per minute can be adjusted according to material. It can be increased for free machining steel, and can be tripled for aluminum. The surface feet per minute should be significantly reduced (e.g. halved) when machining hard materials. Machinery's handbook is a good source of information in this regard.

The above parameters result in respectable rates of removal of material without overly stressing the tool bit. Furthermore, a surface feet per minute rate of 80 ft./m or less minimizes chip welding on the rake surface of the tool bit. All of this assumes that the bit is adequately lubricated with cutting oil. Pushing the tool bit, the toolholder, and the lathe excessively, as you should know, is dangerous, and completely unnecessary in a home shop environment. Pushing the negative lead angle bit can cause the tool to be pulled from the holder or cause the carriage to be pulled toward the work resulting in inaccurate cuts or worse.

MAKING A HEX DRIVER

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Photograph 26 shows two handy hex drivers that make working with your Wimberley toolholder more enjoyable. To make a driver like these, heat the bend of a long (not short) hex key to red heat and straighten it on an anvil or the equivalent. Cool the hex key and clean the oxide layer from the straightened half of the key with sandpaper. Chamfer the straightened end of the hex key lightly with a grinder. Clean the hex key with alcohol or detergent and water, and set aside. Turn a handle to a convenient size and shape. (The driver on the left, made of walnut, is 1.1" in diameter and 3.5" long.)

The drill bit should be the size of the hex key across the corners, in the case of a 2 mm hex key, .086", or a number 44 drill bit. Drill the hole for the hex key in the handle to a depth of one half of the length of the straightened hex key. Countersink the end of the handle to facilitate the application of epoxy if you wish.

Hold the handle, hole side up, in a vise between soft jaws. Mix up a generous batch of epoxy. Using a discarded butter knife, force epoxy into the hole. Use a small wire to ram epoxy into the hole and coat the inside of the hole to its full depth. You will be driving the hex key into this hole. If you drive it too far you may split the handle. Therefore, place a piece of masking tape on the undisturbed half of the hex key about a quarter of an inch away from the center of the hex key as a reference. Coat the straightened half of the hex key with epoxy. Drive the straightened end of the hex key into the hole until half of the key is in the handle. Wipe off any extra and lean up with denatured or isopropyl alcohol. Allow the epoxy to cure.

If you wish to install a ferrule, you may want to do it after the hex key has been installed. There should be an interference fit of about .004" between the handle and the ferrule. The back side of the ferrule is chamfered or deburred on the inside to facilitate installation.

In use, you will notice that the tool winds up slightly as you tighten a set screw.

AUTHOR'S PREFERENCES

I use a Multifix style toolholder that allows the tool block to be positioned in 9° increments. I prefer this to the Aloris style, but I designed my toolholder with the more common Aloris system in mind. One of my tool blocks has a carbide insert-style cutoff tool which I like because it has built-in side clearance and back rake. Another tool block is set up to hold a $1/2$ " shank boring bar. Additional tool blocks are handy for the occasional odd application. I have made a couple of simple tool holders that are held in the tool block. These are designed to easily and securely accommodate high-speed steel tool bits from $1/8$ " to $1/4$ ". One holder orients the tool bit conventionally (bit axis perpendicular to the axis of the lathe); the other provides about 14° of back rake. These tool bit holders might seem unnecessary, but they are surprisingly handy; it is no simple task to install a $1/8$ inch tool bit in an Aloris tool block.

As a hobbyist, I do not believe in the golden chip rule. Instead of pushing things until the chips are a golden hue, I might push things until the oil starts to smoke a little and then back off. It's also nice to keep things tame enough so that there is little or no chip welding. I find that if I keep the surface speed at about 80 ft./s or below, I can avoid chip welding when machining hot rolled steel. If you are not in a production environment, there is usually no reason to be dealing with excessively hot chips. Furthermore, the generous rake angles provided by these tools make it easy to take off a lot of material without creating overly hot chips. On the other hand, you can get away with higher spindle speeds than I am advocating, if you can tolerate a little smoke and chip welding.

I almost always use cutting lubricant, generally coconut oil. It is pleasant smelling and does not readily smoke. It works well in all but the most demanding service. If your shop is in the basement or, as in my case, near an office environment, you probably do not want to use malodorous sulfur-bearing oil.

