Lathe Cutting Bits & Other Tools

You can buy the finest lathe in the world but you will not be able to produce finely finished cut surfaces if the bits you are using are not properly ground, adjusted to the correct angle to the work or composed of the wrong material for the metal you are trying to machine.

A huge industrial lathe can take very heavy cuts in a single pass, but they also weigh over a ton so they do not know what vibration is. With our little light weight model making lathes, we have to be a lot more conservative in our machining. Although they will easily machine steel, you may need to take lighter cuts of about .010" per pass and apply a lubricating/cutting oil to the freshly machined surface between cuts to achieve optimum results. It is not a shortcoming of these machines and it should become part of your regular routine. Lubricants like cutting oils will permit the bit to run cooler and allow the cutting edge to last much longer between sharpenings. A lot of the small engines and motors that we micro machinist enjoy making are mostly made out of easy to machine materials like mild steel, brass, bronze or aluminum. If you see yourself machining steel as much as the other non ferrous metals, you will need to purchase two types of bits. All of the non ferrous metals and leaded steel alloy (12L14) can be worked with either high speed steel or one in a C2 grade of carbide. C2 is a less brittle, not as hard and brittle a grade of carbide that will keep an keen edge longer. On regular cold rolled steel (1018) and stainless steels, you will need to upgrade to C6 grade carbide bits or some of the more exotic carbide alloys like Carboloy. High speed steel bits come unground in square sizes to fit any lathe tool holder. The grinding to the required profile has to be done by the operator and that is an art in itself and only best learned by the watching someone do it and then by the doing it yourself approach. Pre-ground high speed cutters are available so when sharpening time comes you just simply follow the initial angles ground by the factory. Carbide tools come in the form of a square steel shank with the carbide tip brazed on the end of it. You can not realistically expect to sharpen carbide tool in the home shop. Only a diamond hone can effectively sharpen carbide and these can be well out of most home shop machinist's budgets. Silicon carbide wheels (green) will sometimes do a good job on carbide tools. Bits come in many grades of quality so beware of cheap bargain basement offers often seen in tool catalog sales. The grade referred to as "import last cut "is the lowest, with the quality between individual bits differing greatly. Some may actually cut and most are useless. You can pick these up for just over a dollar a piece. Do yourself a favor by not bothering with these. Plan on spending at least three to five dollars a piece for American made brand name bits. They will obviously cost more but they will provide you with ten to twenty times the length of service, guaranteed!

High speed bits can be ground in an infinite number of cutting profiles but carbide tools tend to come in about six different and standard configurations. Two main specifications dictate the direction they are intended to cut, so there are bits that are meant to cut toward the right and those that cut toward the left. Most times you will be doing your turning cuts from the tail stock toward the head stock or toward the left, where most facing cuts

are made from the outer circumference toward the center of the work piece or from left to right with a right handed cutting tool. The first type of left and right cutting tools has front edge that it square to the shank. Another style presents the edges offset at an angle to the shank. Each one of these comes in left and right cutting forms. There are some pointed tool bits with sixty and eighty degree points used for thread cutting and or grooving. There are also round nosed tools which are good for that last fine finishing pass. There are also boring tool bits that are designed for enlarging as well as truing up a pre-drilled hole. These are almost always a round shank with a tapered front portion terminating with a carbide tip brazed to it. Some are also made with a cobalt steel tip. They always cut on the down direction or the left inner wall of the bore closer to the operator.

A good generic or all purpose cutter that I tend to use for machining almost all kinds of metals is easily ground as follows: Take a high speed tool blank with pre-ground 10^{o} ends, say 1/4" square and proceed to grind one end to an equilateral point of about 45^{o} included angle. Grind a generous amount of side relief on both sides of the point of 10 - 12^{o} and finish with a 1/64" nose radius. Because the bit's end already has a built in front relief, you just have to take a light pass on the grinder to clean up the radiused nose. The top is left flat, without any top rake or relief and it will do a great job on brass or bronze, but if intended to cut aluminum or steel, it must be further ground to a 10 -15^{o} positive front to back rake. To do this just hold the tool bit on its side with the top surface square to the grinding wheel and while holding at the approximate rake angle, grind the top against the side of the grinding wheel watching very carefully that you stop grinding as "SOON " as you reach the very front edge of the point, otherwise the tool point will be ground slightly below the center line of the spindle and you'll have to shim the tool bit back up to center. If oriented square to the work surface, it will cut either left or right. This bit will perform turning and facing cuts admirably and at least in my own experience, it has outperformed all other cutter profiles I have used in the past. A little time spent stoning of the cutting edge will only further improve the quality of the cut.

General practice says that the cutting tool's edge should not be squarely presented to the work but instead should be slightly angled so the major portion of the edge clears the surface of the work with only the front edge touching it. This optimum relationship will be discovered through trial and error as you progress through your first practice cuts. Something on sharpening high speed steel bits. I use a 60 grit wheel for the initial fast stock removal of metal but I switch to a 100 grit white aluminum oxide wheel for the final passes and refining of the edge. Just make sure that the tool steel blank is frequently dipped into a bucket of cold water during the grinding process. If it feels hot to you, dip it or you will ruin the temper! Before every grinding operation you should lightly run a wheel dresser across the surface of the grinding wheel to renew and even out its surface. A glazed, over worked wheel only helps to heat up the metal instead of removing metal. Many workers believe in honing the freshly ground edge and you can do it simply by stoning the edge with a fine 600 grit stone or if you can afford one, with a 600 grit diamond hone (they will last forever). I have been using a 100 grit white aluminum oxide grinding wheel and I find that I am getting a very good and relatively durable edge that I only have to touch up after machining a good deal of metal. The diamond coated hones,

depending on the surface area and grit size will cost you from $20. to $60. They are great as well as essential for the up keep of carbide tipped tools. There are many other highly specialized cutting bits that are used mainly in industrial applications but frankly, not suitable for our very precise and delicate type of work.

(from: http://www.homestead.com/tool20895/files/BITS.htm)

Sharpening Steel Lathe Tool Bits

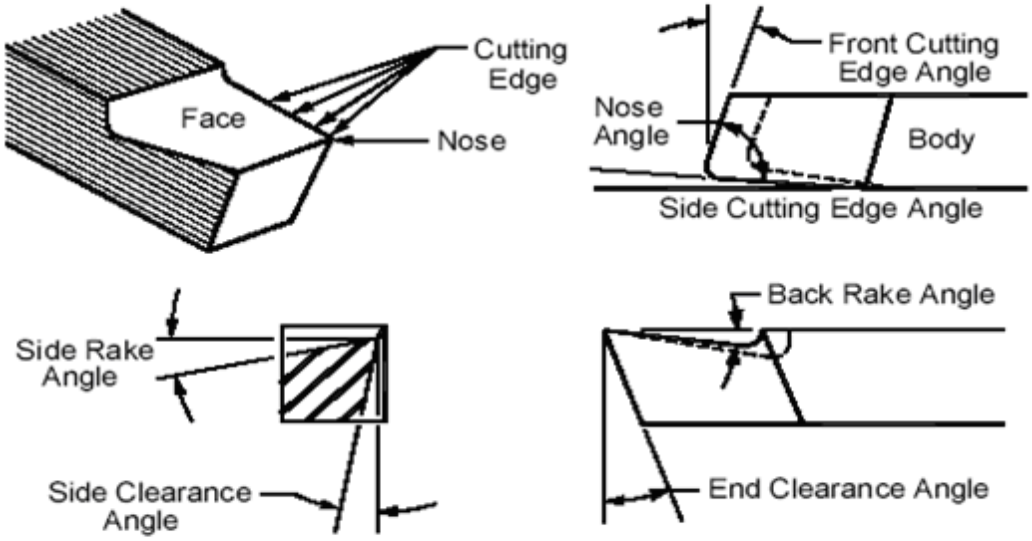

Figure A-I-1. Tool bit nomenclature.

What are typical rake and clearance (relief) angles for HSS tool bits?
See Table A-I-1.

Material	Side Relief	Front Relief	Side Rake	Back Rake
Aluminum	12	8	16	35
Brass	10	8	5 to −4	0
Bronze	10	8	5 to −4	0
Cast Iron	10	8	12	5
Copper	12	10	20	16
Machine Steel	10 to 12	8	12 to 18	8 to 15
Tool Steel (unhardened)	10	8	12	8
Stainless Steel	10	8	15 to 20	8

Table A-I-1. Relief and rake angles in degrees for common metals.

What is the procedure for grinding HSS general-purpose lathe tools?
Begin by dressing the grinding wheel. Next, look up the optimum angles for the workpiece material, and then follow the steps in Figure A-I-2. Dip the tool in coolant frequently to keep it from overheating and annealing. Any discoloration on the bit indicates it was drawn and is no longer hardened. Start over again from the beginning. Tool bit angles are not critical and most tools will cut material satisfactorily, just slightly less effectively.

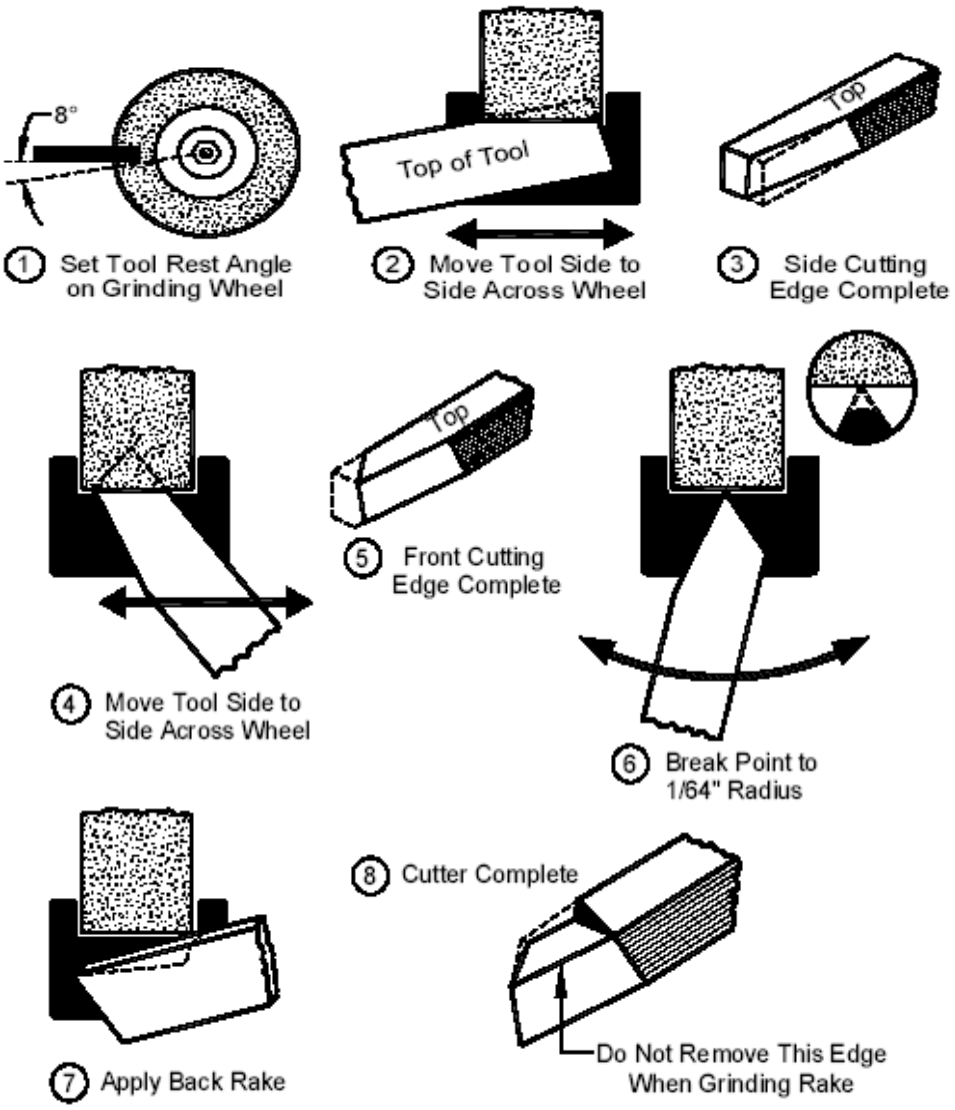

Figure A-I-2. Steps for sharpening HSS tool bits.