Some notes on grinding lathe bits, particularly with respect to radius.

As a generalization, the larger the tip radius the smoother the finish.

Obviously this can be taken to the point of silliness, a 1/2 inch radius on a tip is a form tool, at least on the lathes most of us mere mortals have in our shops. A larger radius requires more power, and a more rigid setup than a smaller radius.

As a gross simplification, if your radius is smaller than the advance per revolution of the cutter, you are cutting threads. Likely very fine ones, very torn ones, and not of a true thread form, but a threading operation all the same. If the radius is larger than the advance per revolution, you get a smooth(er) surface.

Here are some specifics:

I'll start out with carbide inserts. Not because I think you should use them or not as I have no idea of what you do or your equipment, but because we can compare defined radius tips on different machines, and extend that information to HSS cutters.

On a Taig, 222 inserts will bog down a 1/6 HP motor in steel, but give lovely results in aluminum or brass. A 221 does not bog down the motor in steel, but gives a rougher surface. The 221 can give as good results, but the feed rate is slowed to the point that you are really dropping out of the optimal cutting area of carbide. Score one for HSS, as the Taig is small and doesn't do well with cutters that are very far from photon splitting sharpness. A 222 insert can cut steel pretty well with a 1/2 HP motor on a Taig.

On a 9 inch lathe, 322 inserts give a good finish on steel, 321 inserts give a rougher surface, assuming a constant feed rate. 322 inserts are beautiful on aluminum and brass with heavy cuts, but a really heavy cut in steel will begin to chatter or bog the lathe down. It is darn near impossible to bog down the motor with 321 inserts in most materials unless you are being really silly with your depth of cut or feed rate. I can push my 1939 SB 9 harder than my 1995 JET, it is just a more rigid lathe.

On a big old 13 inch SB, I use 1/16 and 1/4 inch radius tools often, in steel and aluminum respectively.

If you gently stone the point of a well ground HSS bit that cuts well but gives a slightly rough surface to a small radius - say about 1/64 inch, you will likely see somewhat better results than you get with a truly sharp point. Don't change your cutter geometry, you still want to preserve all of your rake and clearance angles. You just want to gently smooth the transition from side to front clearance, so stone the entire length of the sharp juncture of these two planes, not just the upper portion. After than it becomes a matter of the material being cut and the available power and rigidity of your lathe. I usually cut aluminum with a steep (15 degrees or more) top rake, about 7 degrees of front and side clearance, and a radius just shy of 1/8 inch. Darn near a round nose tool. Works great. The same tool on steel has too much cutting edge engaging the work, so cutters for steel get a radius of perhaps 1/32 inch or so, and a shallower top rake.

Some general notes on tool grinding, beyond the original request for tip radius information:

GENERALIZATION: The tougher the material being cut the shallower the angles. A tough material puts lots of stress on the cutting edge. If the angles

are too steep, the cutting edge is poorly supported and will chip or wear rapidly. Obvious exception - brass likes zero top rake. Steel is tougher than brass, but likes 5 to 7 degrees top rake. For these sorts of reasons, I tend to keep a few tools ground for each material commonly cut, being lazy I'd try to make do if I didn't do this. Once you're grinding a few tools, what's a few more?

As I use a four way toolpost on the 9 inch lathe, the grinder table is left at 7 degrees. This lets me grind front and side clearances, then gently swing the tool through an arc to form the tip radius. Top rake is done after front and side clearance, on the table for steel and tilted up off the table to increase top rake for aluminum. The top rake extends away from the tip, so it not only runs downhill from the front, but also from the side, roughly along a line perpendicular to the tip tangent line. Don't loose track of whether you are grinding a left or right hand tool when doing the top rake, or you'll end up with a rather weird cutter geometry. If a friend is watching, the odds of flipping the tool over on the wrong side is much higher :-) If the side clearance you ground earlier isn't facing up, you've flipped the tool the wrong side down! The Taig toolpost also presents the tool straight on to the spindle centerline, so tools ground for the 9 inch lathes also work on the Taig.

If you use Armstrong style toolholders remember to account for the angle at which the tool is presented to the work by the holder. When using these, you tend to grind no top rake, and a steep front clearance. In use, the top rake ends up around 7 degrees and the front clearance 7 degrees less than ground. For brass you actually grind a 7 degree negative rake to get zero rake when installed.

1/2 inch toolbits are more rigid, but require more time to grind. I typically use 1/4 inch bits when possible, and reserve the 1/2 inch cutters for heavy work. Should you be so lucky as to have a lathe large enough to use 1 inch cutters, get a huge grinder;-)

Keep your grinding wheels dressed, a diamond point and dressing stick are good, a dressing stick alone is OK. Star dressers are OK to break a glaze, but will leave a wheel face in every configuration other than flat. If you use a star dresser you really have to do a pass with a dressing stick or diamond point in a holder to get the wheel face flat. Cheap grinding wheels stink. A 46K and a 60K or J pair of white wheels from a reputable company (Norton in the US makes some good wheels) will do well. Gray wheels may be OK depending on vendor, but will require more frequent dressing than the white Aluminum Oxide wheels, and tend to grind hotter as they are less friable.

A shop vac hooked to your grinder will save your lungs and your shop. Checking your wheels and always standing to the side as they spin up may well save your life. If you've ever seen a wheel disintegrate, you'll do this instinctively. If you haven't, I hope you never have the misfortune. A truly dangerous event. Always use the paper washers and correct bushings as required. Don't run with scissors :-)

Hopefully this is of some help, please let me know if something is unclear.

Stan Stocker
skstocker@adelphia.net