Boring holes in Hard Metal

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On my Colchester Chipmaster metal lathe, the bore in the headstock spindle is a strange size – a number #4½ Morse Taper. To fit a chuck or centre to the spindle, I needed an adapter sleeve, from #4½ MT to #2 MT or #3 MT. The sleeve that came with the lathe had long since parted ways, so I had to source one. Toolquip searched for me and I searched the Internet. #4½ MT is a standard size – the specs appear in Machineries Handbook, but I wasn't able to source one.

Anyway, Bill Parrack arranged for me to have some over-size ones turned down. I bought two reducers, a #5 to #3 MT and a #5 to #2 from Toolquip. These are hardened, so Bill recommended that the only way to machine these accurately was to mount them on a mandrel and grind them down. Due to the amount of grinding required, this was fairly expensive, but the outcome was good. (Bill is a good guy to speak to about such things, as he has many years of experience owing a machining business.)

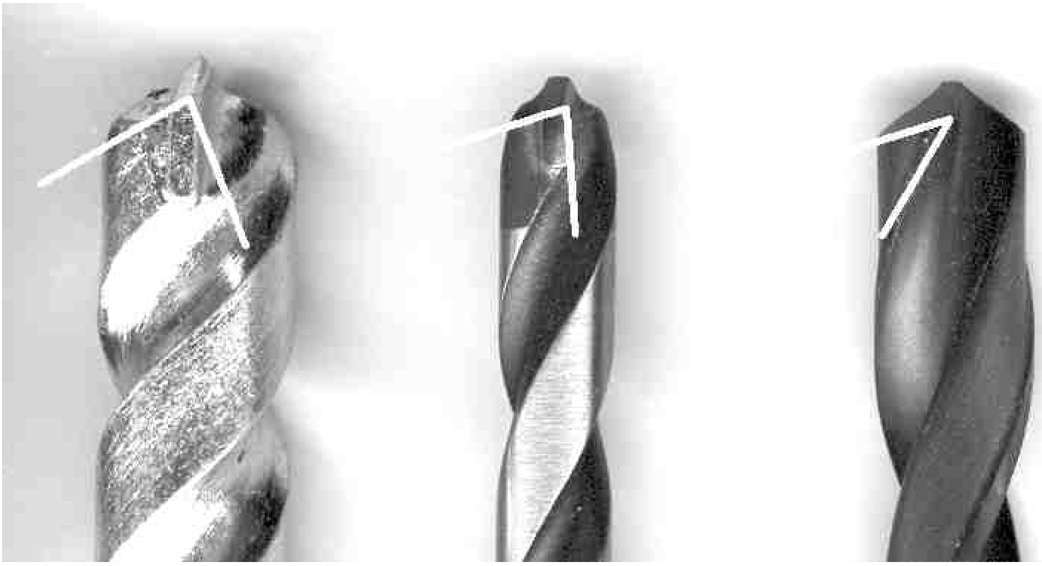
Subsequently, I bought a #3 MT milling chuck from Toolquip to make some parts from solid aluminium. To hold the taper in, provision is made for a drawbar that threads into the back and passes though the spindle. I made a locating bush to fit onto the other end of the spindle. A length of 12mm threaded rod joins the two. However, the reducing bushes don't have a through hole, so I needed to drill one.

I remembered what Bill had said about the hardness of the material, but I thought perhaps High Speed Steel would cope, feeding slowly, with lots of lubricant. I mounted the #5 to #3 reducer back to front, in the 3-jaw chuck and centred it using a solid centre in the tailstock. I then inserted a drill chuck into the tailstock, and fitted a 5mm HSS twist drill to start the pilot hole. The drill bit managed about two shavings and then stopped cutting. I pulled it out and found the cutting edges rounded over, as though they were mild steel! This reinforced the wisdom of Bill's previous advice to grind down the tapers. I wasn't entirely surprised, as I have seen this before when drilling stainless steel.

Plan B: Use a carbide drill. However, these are rather pricey in carbide tips - R148 for a 5mm and R290 for a 12mm drill from Toolquip.

Plan C: Try a carbide-tipped masonry drill. These are not ideal, but at R10- each in 5mm and R50 in 12mm, it was worth a try. Out of the box, the tips are in the shape of a blunt chisel, so I reground a used 5mm one into the classic shape on the top. Unfortunately, the rake is fixed at 90º so the edge is not as sharp as it could be. Then I made some progress – still rather slow, and several sharpenings were required, before the tip of the 5mm bit disintegrated after about 20mm. I then ground another, new one, which was better quality. It lasted out the 50 mm hole. Progress was slow, due to the hardness of the material. A twist drill relies on pressure to displace the material at the centre of the hole, at the point of the V. Even with a carbide tip, the steel was so hard, that it took over an hour to drill a 5mm diam x 50mm deep hole.

I then took a 12mm masonry drill, sharpened the tip and completed the hole in another 20 minutes – this was much quicker due to the pilot hole, despite the larger amount of material removed.



The picture shows an unused masonry bit on the left. The white lines show the angle of the cutting edges. The middle bit shows the 12 mm bit I used, with the white lines showing the sharpened angles. The right hand bit shows the ideal angles on a conventional HSS bit. In each case the left hand line shows the relief angle. The lower the angle from the horizontal, the greater the relief angle. The right-hand line shows the rake angle. This determines how aggressively the bit cuts. The masonry bit on the left doesn't really cut, but bludgeons its way through the brickwork. The right hand bit has a significant rake angle. The angles as I used on the middle bit were not ideal, but they did work. Some metals such as brass should be drilled with zero or negative rake angle.

If time were money, then the proper carbide drill would have been the way to go. Also, as you can see from this picture, there is substantial clearance between the carbide tip of a masonry drill and the shank. A proper drill would have produced a more accurate hole, but this didn't matter as the Morse Taper provides all the accurate location needed. The hole was just to provide clearance for the draw bar. Although the hardness of the reducer made things difficult, it is actually a virtue, as when I took the reducer out of the chuck, there were no visible marks on the body.

So, if you are stuck trying to drill some hard metal, a carbide-tipped masonry drill may do the job if you grind it to the right shape. It is not ideal, as the carbide for masonry bits is selected for toughness and abrasive resistance, not the ability to take and hold a sharp cutting edge.