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Making Cutting Tools - Part 1 - The 'D-bit'

You may often find it useful to be able to make your own cutting tools in the model engineering workshop.

Although we tend to rely on high-tech cutting tools and processes such as HSS, Carbide Sintered inserts, laser cutting, water cutting and EDM, there is an important place for home made cutting tools. These can be made from high carbon steel such as Drill Rod (Silver Steel in the UK), Gauge Plate, and various other high carbon tool steels, that are oil or water hardening steels.

There are three major processes in making D-bits and other cutting tools:

- Machining or shaping
- Hardening and tempering
- Sharpening

D-bits - Introduction

The D-bit is a very simple cutting tool, which can be used for many purposes. However, it is likely the artificer will have to make the tool in their workshop, as purchased bits are only available in a few standard sizes. They are nearly impossible to acquire commercially, unless you approach a toolmaker and ask them to make one or more for you, and that will turn out to be very expensive. Therefore being able to produce them from scratch is a worthy and useful workshop activity. Finally, if you master the D-bit, it forms a basic skill for making many other workshop cutting tools[1].

A D-bit cuts only on its end. The name comes from the cross section of the tool, which must be marginally more than a semicircle to ensure that it does not cut on its edges. Because the D-bit cuts its own precision guide as it goes, it makes accurate sized holes with a good surface finish. Some writers claim that a D-bit will produce better results than a reamer, which is not bad considering that they cost a few pence to make.

Of all precision tools, D-bits are the one of the easiest to manufacture from the scrap-box. They are the true and proper destiny for the final two inches of any self-respecting round bar of silver or tool steel.

Ways to use a D-bit

D-bits can be used to:

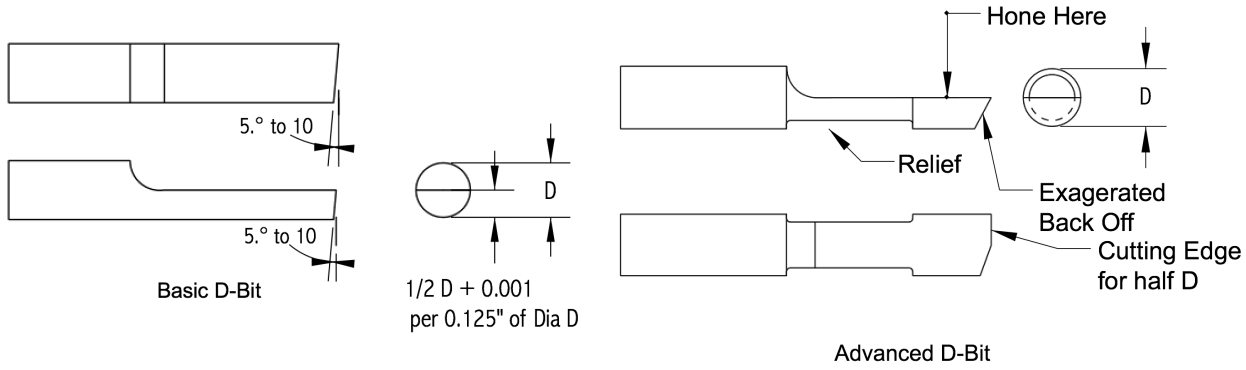
1. Open up a hole to a given size.
2. Ream a hole.

[1] Additional shop-made cutting tools will be the subject of upcoming Hints and Tips sheets.

3. Square the bottom of a drilled hole. (This is useful for non-return valves, found on steam engines and boilers).
4. Create a small diameter internal taper.
5. Machining operations where 'reach' or 'diameter' are non-standard.
6. Use as a primitive milling cutter in the vertical mill, or a lathe.

D-bit Manufacture

Manufacturing is straightforward, simply machine, grind, mill or file away a **few thou less than half of the diameter** of a piece of round silver steel of the correct diameter. Shape the to provide clearance and form the cutting edge. An angle right across the end (Figure 1a), cuts a little more freely; while the partially straight end (Figure 1b), will allow you to finish holes with a square bottom.



(a) Basic D-bit

(b) Advanced D-bit

Figure 1: D-bits

The tool should be hardened by heating to a good red heat, then quenched, using a gentle stirring action, end-first, in clean water or oil (depending upon whether water or oil hardening carbon steel). Don't just grab it with pliers, and shake it around in the water. as if it is of thick section, it may well crack or distort. Don't worry about soak-heating the tool as it is not critical to harden it to the core, indeed prolonged heating may burn out the vital carbon from the cutting edges and diminish its harden-ability. If you coat the tool in washing up liquid, or with a mixture of boric acid and methylated spirits prior to heating, it will be easier to clean it up due to minimal carbonization. To get the coating to stick, wrap the tool in soft iron wire. Clean up using wire wool, emery or Scotchbrite.

The tool will now be glass hard, brittle enough to shatter if dropped on a hard surface. It must be tempered to make a useful cutting tool

To temper there are two methods:

1. Temper in a domestivc oven. Check the oven by placing an oven thermometer in the oven and confirm the the oven is at the correct tempering temperature of 240C or 460F. Place the D-bit on a cooking sheet, and leave it in the oven for 20 to 30 minutes. There is no need to quench the bit. but it can be cooled in water if you are in a hurry.
2. Starting with a bright shank. Apply gentle heat to the shank, well above the cutting edge, until the metal starts to form a coloured oxide film. The colours will run down the shank to the tip,

and just as a ‘light straw’ colour reaches the end, quench the tool again.

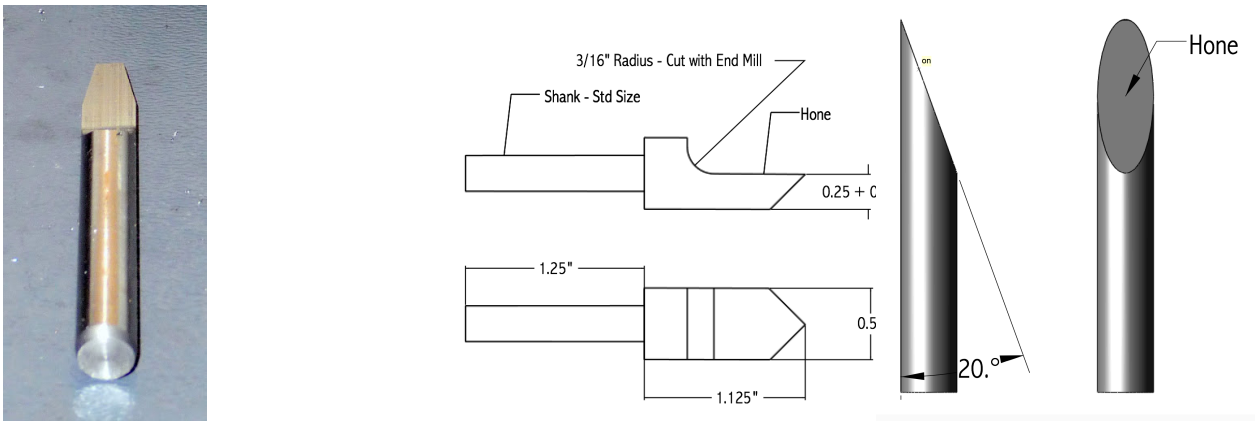
Finally put a good finish and edge on the flat end and the flat side of the bit with a well lubricated slip stone. Make sure you keep the flat faces on the stone as you sharpen. Do not take any metal off the curved surface.

Using the D-bit

As it has no top rake heavy cuts are out and a D-bit is best used to finish a pre-existing hole. It does no harm to create a short pilot hole the same nominal diameter as the bit diameter to get everything off to a good start. Beware overheating the tip during machining, as this will draw its temper and the bit will rapidly become blunt. The secret is to keep the speed modest (half the speed of an equivalent diameter of a HSS drill) and use plenty of cutting lubricant. Swarf soon builds up on the face of the tool, so regularly withdraw it, and slap on another dab of cutting oil.

Alternate Cutting Shapes

You can make D-bits for other purposes as well. Tapered D-bits can make accurate tapered holes (Figure 2a). Turn up a handful of matching taper plugs with the lathe at the same setting, and they can be used to make taper cocks. A round ended D-bit can be used to make round sockets and rivet sets. One which is flat across the end can be used to cut or renew ball based non-return valve seats. Or a countersink can be created as shown below in Figure 2b.



(a) Taper D-bit (b) Countersink D-bit (c) Toolmakers Reamer

Figure 2: D-bit Variations

Toolmaker’s Reamer Using D-bit Manufacturing Method

One final thought – a toolmaker’s reamer, shown in Figure 2c, is an even simpler tool. In this case the blank is cut across at about 20 degrees, hardened, tempered and the flat honed with a slip stone to a good finish. These reamers will take a very accurate final skim (0.001” to 0.005”) from an under-size hole.

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