The author using a step and repeat jig to make the framework of a scale model of Ledbury Viaduct, using a top-bearing cutter

Router table joinery

Peter Sefton Furniture School routing tutor Chris Yates looks at the application of bearings to router cutters

In this article, I will look at the application of bearings to router cutters and discuss their uses and applications. I will also suggest how and when they can be used to assist in routing tasks, as well as examining ways in which to extend the usefulness of your existing router cutters by the judicious use of bearings. Lastly, I will cover safety issues in the use of bearing-guided router cutters.

PHOTOGRAPHS BY LEWIS KWOK

Types of bearing-guided router cutter

These days almost anyone owning a router will have some router cutters that have bearings fitted. The many 'introductory sets' of router cutters that many of the major suppliers list usually include at least one or more bearing-guided cutters, and once a new router tyro starts to tackle projects, it will probably not be long before the discovery is made that lots of router cutters are available with bearings, and that they look as though they could really be very helpful for all manner of routing tasks. What, therefore, are the main types of bearing-guided router cutter and their principal applications?

There are four main configurations of bearing-guided cutter: bottom mounted, with the bearing retained by a fixing screw into the end of the router cutter; top-mounted, with the bearing mounted on the shank of the router cutter, and held in place by a collar; centre-mounted, with cutters above and below the bearing, with, usually, one or more of the cutters and the bearing mounted on an arbor, possibly with spacers and shims to adjust the configuration; and lastly some cutters that are relatively new to the market, with bearings mounted at both the top and bottom of the cutter. Of these four main types, the first two are by far the most common, and most widely applicable to routing tasks, and we will focus on these in this article.

Choosing your cutter

In choosing the cutter, the relative length of cutter, thickness of workpiece and thickness of template must be considered. The interplay of these factors is not quite as obvious as might be expected. Ideally the cutter length is slightly longer than the workpiece thickness, which when using a top-bearing mounted cutter and working freehand on your workbench, will require the workpiece to be placed on spacers to lift it off the workbench. If this is not practical, then a sacrificial workbench cover could be used instead. I prefer the former, as it avoids the problem of grooving the sacrificial cover, which adds extra load to the cutting operation. In this instance it is preferable to use a cutter with a plunge cutting edge on the end, as this will reduce any tendency to interfere with the guidance of the router.

Next, the top bearing on the cutter should be able to seat comfortably on the edge of the template. There are two things to note in this respect. Firstly, depending on the thickness of the template material, it may be that the cutter cannot be inserted into the collet to the K safety mark, while leaving the cutter part in the ideal position for cutting the edge of the workpiece. If this is the case, the only options are to use a different cutter, thinner material for the template or a router with a greater plunge depth. Do not be tempted to extend the router cutter further from the collet. Note that the bottom of the edge of the template may be sacrificed – not usually a major problem, although it may make positioning the template accurately on subsequent workpieces more challenging.

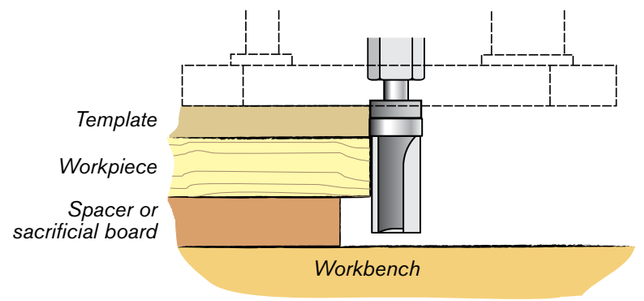
The diameter of router cutter may not matter if the edge to be trimmed is either straight or has no radii smaller than half the cutter diameter. Therefore, use the largest diameter cutter that meets the other requirements discussed above, which you have available.

All of the cutter shank above the K mark needs to be contained within the collet

Use a cutter with plunge cutting capability if working into a sacraficial board

Top-bearing mounted cutters. Straight cutters in various sizes, including two down-shear cutters, from Trend, Excalibur, Titman, CMT & Wealden on ¼in, 8mm and ½in shanks

Setup for a top-bearing cutter



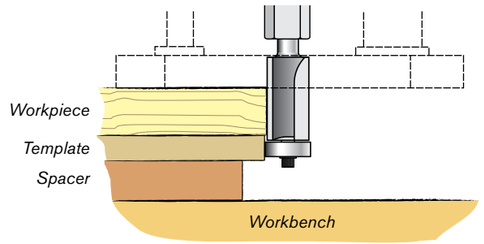
Using a bottom-mounted bearing

If instead of using a top-mounted bearing we chose to use a bottom-mounted bearing, we must ensure that the template is thick enough to enable the bearing and securing bolt to pass above the worktable without contact and that the cutter is long enough to cut the workpiece. Using this configuration, setting the depth of the cutter in the router collet may be easier. The slight disadvantage of using this approach is that the template edge is hidden, but you may feel that this is outweighed by slightly less risk of the router tipping during the cut, and spoiling the workpiece. You have a choice!

If you want to profile an edge on a workpiece, it is likely that you will use part of the workpiece edge itself as the guide – for example putting an ogee on a table-top. In this case, you will probably have less choice of cutter to use, as the size of cutter will be critical. The variable is the diameter of the – probably – bottom-mounted bearing. This can be substituted by either larger or smaller diameters to alter the shape of the cut. Most of the cutter suppliers list a wide range of shaped cutters, often with the only difference being the diameter of the bearing fitted. This is not a problem when you buy the first cutter, which you will size for the job in hand, but you may be able to save money when tackling similar jobs that require a slightly different shape by just buying a replacement bearing.

Bottom-bearing mounted cutters

Setup for a bottom-bearing cutter



Types of bearing-guided router cutter

Almost any shape of router cutter may have a bearing mounted, the purpose of which is either to give positional control to the cutter relative to an edge and/or to provide a controlled and precise mimic or offset from such an edge. Whether the edge is above or below the workpiece in the preferred working position will usually be the decider in whether to use a top or bottom-mounted bearing-guided cutter.

So what do I mean by edge? This is likely to take one of several forms. If you want to cut any shape other than along a straight line, when any straight edge that can be firmly clamped to the workpiece will do to guide the router base, then you will probably make a template first. It is often easier to make the template in exactly the same dimensions as the desired finished workpiece, typically from MDF. This can then be clamped firmly to the workpiece and a straight, bearing-guided cutter used. I usually prefer to have the template on top of the workpiece, so when my router is mounted in a table this requires a bottom-mounted bearing, which should be precisely the same diameter as the cutter. If a different diameter is chosen, then the workpiece will end up a different size. If this is the desired outcome, fine, but be very careful of using a bearing of smaller diameter than the cutter, as it will undercut the template and this may lead to a number of potentially bad outcomes.

Shaping an edge

Round-over cutters with bearings – a selection of round-over cutters from Titman, Wealden, CMT and Trend on ¼in and 8mm shanks

Another task that shapes an edge of a workpiece is the simple round-over, although it is sometimes difficult to achieve exactly what you want, especially if you are rounding over both faces of a workpiece. Usually, the diameter of the bottom bearing will be the same as the narrowest diameter of the round-over cutter, but the diameter of the round-over will be constrained by the thickness of the workpiece. Generally, anything less than around 12mm will be difficult to do with a freehand router using a bottom-mounted router cutter, because the rounding over will encroach onto the narrow central land of the edge on which the bearing needs to run. Try it on a thinner piece of stock and you will quickly find that the workpiece gets progressively smaller from the second and subsequent passes! Thus you may find that you cannot achieve a large enough radius of round-over using this method, and you will have to use another approach, such as using a round-over cutter in a routing table. You will also be unable to achieve a full semi-circular rounding-over of the edge. This problem arises partly because almost all round-over cutters that I have seen have a significant gap between the bottom of the cutter and the top edge of the bottom-mounted bearing. The world awaits a range of round-over bearing-guided cutters with a smaller gap between the cutter and the bearing. The same applies to other bottom-mounted cutters, but they don't seem to cause me the same problems.

A gap between the bottom of the cutter and the top edge of the bottom-mounted bearing can make a perfect semicircular profile impossible to achieve

Removing the bearings

I mentioned above the use of a bottom-mounted bearing-guided round-over cutter in a router table. This is a good time to suggest that if you are using the fence on the table to guide the workpiece, it may be better to remove the bearing. If the bearing is left in place to guide the workpiece as well as the fence I find that occasionally a workpiece glides past the cutter bearing without quite touching it; this results in a slight imperfection in the routed surface at the end of the cut; usually at the right-hand end when facing the table. The bearing serves no purpose in this configuration, so I avoid this unlooked-for complication by simply removing it. However, do not do this if you are relying on any other method than the table fence for guiding the workpiece. You need the bearing to limit the depth of cut if you are using a lead-in pin or workholding jig.

In fact, you can remove bearings from any cutter to widen their application so long as you do not attempt a cut that relies on the presence of a bearing for safety. This doesn't immediately mean that you need lots fewer router cutters than you thought you did, but you should be able to save on some. Remember, however, that you can never use a bottom-bearing cutter to plunge cut, and that the bearing shank may well get in the way.

Different names

Bottom-mounted bearing straight cutters are often referred to as trimmers and top-mounted bearing cutters as profilers. However, these names do not imply limited applications – the configuration of templates, jigs, routers or fences is what determines their use. Further, some cutters which have the same configuration are designed for other very specific applications, such as rebate or tenon cutters. These typically have a larger diameter – often up to around 35mm or more – and are often sold with sets of different diameter bearings. In all cases, the depth of cut is given by half the difference in diameters of the cutter itself and the bearing fitted. These can be very useful as trimmers if an offset from the guiding surface is required, as well as for their stated purposes. However, because of their configuration it is possible to attempt very deep cuts and these are to be avoided – the usual rules about progressive removal of stock by repeated passes should be followed – and this can be aided by repeated substitution of progressively smaller diameter bearings, which are almost always bottom-mounted, making such changes convenient. Also, because of the larger diameter of the cutters, the manufacturers' guidelines on cutter speed should be followed carefully. Mention should be made of one variation on the theme of rebate cutters, namely the biscuit cutter. This is sold as a substitute for a biscuit jointer, or for use in confined spaces where there is insufficient space to use a biscuit jointer. The cutter is 4mm-thick and by changing the bearings, recesses for the three common patterns of biscuit, namely 0, 10 and 20 may be slotted using a router.

Available alternatives

What about alternatives to bearing-guided cutters? Guidebushes serve broadly the same purpose and work well. They give more choice in the use of offsets between the edge guide and the workpiece cut edge at lower cost than a selection of cutters and bearings, but they take a little bit longer to set up and they also require the router to be cantilevered over the edge guide slightly further, although this can be a definite advantage if using a jig that contains the router cutter, such as a kitchen worktop jig, where it is important to reduce the risk of damage by nicking the guide edge. However, any jig used must take account of the offset to the cut edge inherent in using guidebushes, although using guidebushes also means you may have more options to change the depth of cut as you are not reliant on the bearing for guidance. So once again, more choice.

The other option, of pin-guided cutters, is seen rather less these days. These have a solid extension of the cutter shaft in lieu of a bottom-mounted bearing. In use, as might be expected, they tend to burn the surface with which the pin is in contact, but the diameter of the pin is usually much smaller than the equivalent bearings, enabling much tighter internal radii to be followed. I have a few old pin-guided cutters, but only use them if I can't see another way of doing a job.

Where can you get bearings suitable for router cutters? All the main suppliers of cutters also sell replacement and additional bearings, although they tend to be a bit pricey. Another option is to buy bearings directly from bearing manufacturers and suppliers – they are after all standard industrial products and are widely available on the internet – just Google 'small roller bearings'. If you follow this route you will need to specify the correct pattern, which apart from the precise dimensions – inside and outside diameter and depth – should be 'sealed'.

Piloted cutters – a selection of cutters with bottom-mounted pilots

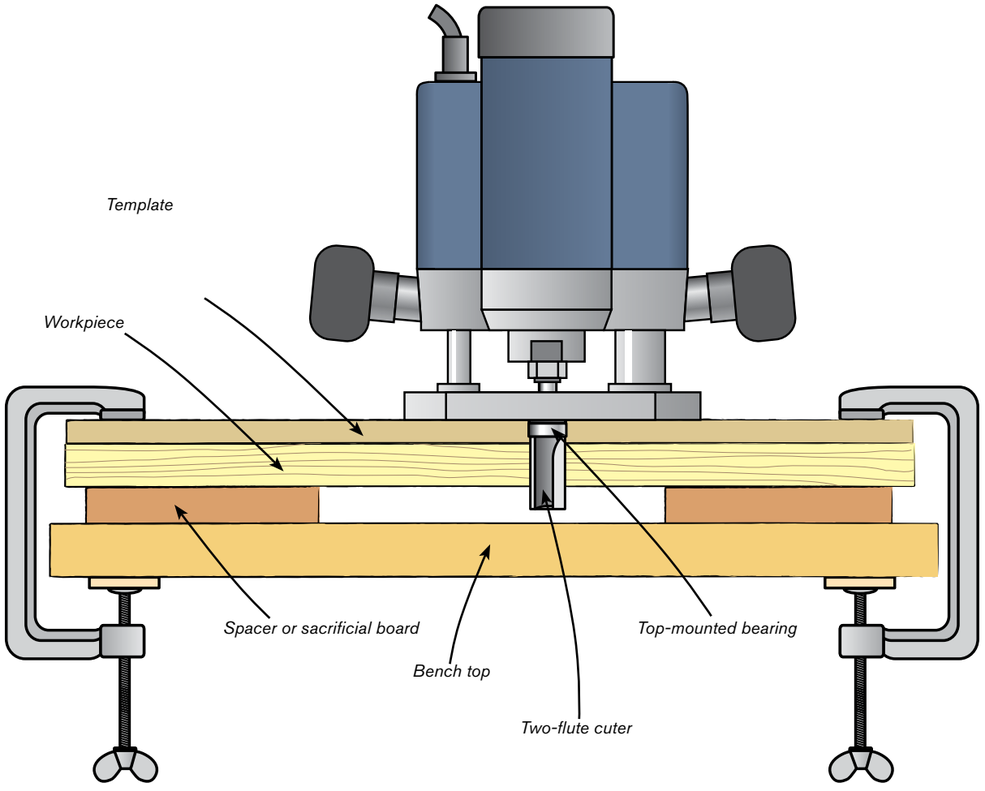
The off-set between the edge of the cutter and guide bush need s to be taken into acount

Be gentle with your bearings

This leads nicely to the next point to consider about bearings. They are usually quite small; therefore, treat them with respect and take gentle cuts only. In the case discussed at the beginning of this article, of a bearing-guided cutter replicating a shape cut on a template, remove wood from the workpiece to within around 3mm of the desired edge – if using a jigsaw for this task, be careful not to impinge on the desired finished edge if working in deep stock by the jigsaw blade cutting off-vertical on the bottom face – it happens! When routing, it is easy to overlook the speed of rotation of the cutter – typically around 20,000rpm – and the energy contained in the spinning mass of the router motor and collet and the cutter. That is a lot of force on the cutter and bearing, so be gentle.

The bearing is there to guide the cutter and to limit the depth of cut. It can only do this if it is in the right position relative to both the template and the workpiece, so take extra care in setting the depth of plunge. Another factor to consider when planning routing operations involving a bearing-guided cutter is that of balance. As noted above, there is usually less tendency for the router to tip if a bottom -mounted bearing is used, but other options exist, such as using an offset base to improve balance and grip. A recent development by the router cutter manufacturers is the provision of routers with two bearings mounted together to give a greater bearing surface and hence more stability and flexibility. There is so much more choice in routing compared to most other tools!

A typical setup for working with a template and bearing-guided cutters with a hand-held router on top of your workbench



The diagram on this page illustrates a typical setup with a template mounted above the workpiece and using a top-mounted bearing-guided cutter in a hand-held router. It shows clearly the need for spacer blocks to keep the bottom of the router cutter above the workbench. The cutter shown is actually a standard straight cutter, but other variants can be used in the same setup. For example, a down-cut shear or spiral cutter could be used to give a smoother finish on the routed edge, and particularly to give a clean finish on the top edge of the workpiece. The corollary is that there may be some breakout on the bottom edge of the workpiece. Alternatively, an up-cut shear or spiral cutter can be used to give improved machining of the bottom edge of the workpiece – and yes, there are cutters available that are combined up and down-shear cut, protecting both edges. However, with these it is even more important to take repeated shallow passes, to enable the wood shavings to clear the cut, as these cutters tend to compress them into a very narrow band level with the centreline of the workpiece. Whichever cutters you use, remember that safety requires that you never exceed the manufacturers' advice on maximum rotational speed. For small cutters, this is typically around 20,000rpm, the max setting on most hand-held routers, but if bigger cutters are in use, this can drop to half that speed. If in doubt, check!

Storage and maintenance

I have a small partitioned storage box in which I keep various spare bearings from particular cutter sets, as well as a range of other bearings I have bought over the years to give me a range of incremental sizes with the various common internal diameters for mounting them. I also keep a set of hex and Torx keys of the correct sizes for fixing the collars and retaining screws in the same box. As well as useful for fine-turning routing setups, it has probably saved me quite a lot through avoiding buying extra cutters.

Lastly, a word on safety. Bearings will get dirty, so keep the outer surface clean and ensure they stay free-running. Check for signs of wear and discard them at the first sign of damage. When replacing bearings fitted to bottom-mounted cutters, ensure that you use the same depth of bearing, otherwise it may not fix safely and securely. Also, take care to refit any washers that may be fitted on cutters. It may be possible to use a different depth of bearing on top-mounted cutters, just by fixing the retaining collar in a slightly different position, but this can only be done if the cutter has a plain shank, although most do. Every time you go to use a bearing-guided cutter, check that it is free to rotate, is mounted firmly, retained securely in position and is clean. Check clearances and position of the bearing and cutting edges relative to the workpiece and any templates or guides before you start. *F&C*

A selection of bearings and fixing tools

Common sizes of router cutter bearings

Note that all bearings should be the 'sealed' type

	Inside diameter	Outside diameter
Shank sizes (top bearings)	¼in; 8mm; ½in	3/16in upwards × 1/16in steps
Shank sizes (bottom bearings)	3/32in; 1/8in; 3/16in; 4mm; 5mm; 6mm;	5mm upwards × 1mm steps

Note that fixing screws may be either metric or UNC and therefore the hex keys required will be either metric or imperial A/F. See manufacturers' websites and catalogues for details

Suppliers

Axcalibur router cutters
Web: www.brimarc.com

CMT Woodworking Tools
Web: www.cmtutensili.com

Titman Tip Tools
Web: www.titman.co.uk

Simply Bearings Ltd
Web: www.simplybearings.co.uk

Trend Machinery & Cutting Tools
Web: www.trend-uk.com

Wealden Tool Company
Web: www.wealdentool.com