



Pulling power

Getting to grips with rare earth magnets

Aaron Moore demonstrates two methods for incorporating rare earth magnets into your work, which will add to the functionality of the piece without compromising its appearance

Rare earth magnets have become increasingly popular over the years and have been incorporated into a variety of woodworking projects and jigs. However, the appearance of a shiny magnet on a project can be distracting. Selecting the proper magnet can also be confusing, which can result in a holding force that is too weak or too strong. In this article I will share a few examples where these magnets are useful, explain how to select the right magnet for the job and finally demonstrate two methods I use for installing them without compromising the final appearance of the piece.

Project examples

So where can these magnets be put to use? Here are a few examples to get you thinking. My first woodworking endeavour using rare earth magnets was a wall-mounted knife block for my wife using a strip of scrap bubinga (*Guibourtia demeusei*). Similar knife blocks are readily available online, but they often have obvious plugs or exposed magnets that I'm not fond of and they almost always have generic 'zones' for the knives; this means there might be one large magnet every 50-75mm where a single knife can be stored. I have a serious aversion to this design, which is a nice way

of saying 'I hate it!' Most kitchen knives are of various sizes and I don't want to be obligated to place them in a specific spot that may be too close or too far away from the next knife on the block. I also wanted to utilise more of my available wall space, which meant I needed a longer knife block than I could find online. This all led me to designing my own custom-sized knife block with no visible plugs and free of zones. After making the knife block, I used some of the leftover magnets to make a few bottle cap openers that catch the caps as they fall. Both of these projects were made using the 'plug method' described later. ➤

I have found several uses for these magnets in my workshop as well, including a rack for my chisels. I wanted something that gave me quick access to my tools while keeping the tips protected and magnets offered the solution, but this time I went with a different construction technique I refer to as the 'resaw method'. I should point out that unlike the knife block, my bench chisels are specific sizes, which I do not have plans to replace in my lifetime. For the chisel rack, I deliberately created zones from columns of magnets that keep the chisels vertical as well as evenly spaced from one another. As with most woodworking projects, the beauty of making something yourself is being able to customise every aspect that matters to you.



Rare earth magnets catch bottle caps as they fall



A simple project that can be made to any size in any wood you like, completed in style



The small chamfer disguises the glue seam from resawing the face

Magnetic chisel rack provides open access to the tools and keeps their tips protected

Selecting magnets

If you're ready to incorporate magnets into your next project, how you go about selecting them is important and can be confusing. And while it may not be the most exciting thing to read about, knowing what differentiates one magnet from another will help you size them correctly without a lot of trial, error and wasted money. The first thing to be aware of with any magnet is its physical dimensions. The larger the surface area and the thicker the magnet, the higher force it will have. I typically use disc magnets so the diameter and thickness are my only concerns, but if you're using rectangular magnets, you'll have one more dimension to consider. Second is the magnet's grade – typically N35-N52 – with the higher number correlating to a stronger magnet. Third, you need to account for what the magnet is attaching to. A magnet being pulled against a steel plate will be different from a magnet between two plates, both of which yield a

substantially weaker force than two magnets pulling against each other. You also need to consider the distance between the magnet and the object it's holding. This is probably the most important factor to be aware of because I like to use a thin layer of wood covering the magnet and the thicker that layer gets, the more the pull force of the magnet drops off – and it drops off exponentially. Finally, consider your placement pattern. If you are planning to have multiple magnets providing a hold on a single item, then you should divide the total desired hold force by the number of magnets acting on the single item.

Sizing magnets

Before actually selecting your magnet, you need to decide on a target pull force for your given application. I typically end up looking for something between 2-9N but every project is different. Once you have settled

on a target pull force, the best advice I can give on understanding how all these factors impact the magnet's strength is to spend a little time using the magnetic calculator on my preferred website. I use K&J Magnetics – www.kjmagnetics.com/calculator.asp. Start with your preferred magnet diameter, guess at a thickness and pick a mid-level grade, such as N45. For the distance, start with 0.5mm – more on that later – plug these factors in and hit 'calculate', then look at your Pull Force Case – usually Case 1 – and see where you fall. Start to vary the thickness and grade rating until you reach a pull force you're comfortable with. If this doesn't get you where you need to be, then change the diameter and try again, but make sure the diameter is something that matches a drill bit you own or can easily purchase. Now that you're familiar with sizing magnets appropriately, let's look at how to install them.

The 'plug' method

The first technique for installing the magnets I refer to as the 'plug method'. It can be more labour intensive than the second method I will be describing and the back face will have visible plugs, but this method does have one major advantage. Unlike every other technique for installing magnets that I've seen or could think of, this one preserves the grain pattern from the show face to all four adjacent sides and if the back is mounted against a wall, the plugs will never be seen anyway. Take the bottle cap opener, for example. The spalted maple (*Acer saccharum*) has clear patterns wrapping around the edges, which would be noticeably disturbed using the 'resaw method' described later. Another bonus is that the only tool you really need for this method is a drill press and sacrificial drill bit.

Start by prepping your board in the usual manner, getting the show face and sides flat, squared or bevelled – whatever you like. When you're ready for the magnets, lay out their position on the back face and mount a brad-point bit in your drill press that matches the diameter of the magnets. Set the depth stop on your drill press so that the tip of the bit just touches a 0.5mm shim, then drill all the

holes. Next, take a sacrificial bit of the same diameter and grind off the tip as well as any scoring spurs. You're aiming for a flat-tipped bit. When the bit is ready, mount it in the drill and set the depth with the same 0.5mm shim. Redrill the holes, cleaning out the bottom surface to a perfectly flat base. This does add a little time and effort to the project, but it's the only way to get a clean, flat hole with only 0.5mm of material between the magnet and the metal it will be holding. Even Forstner bits have a tip that will poke through the show face, so grinding a cheap bit and drilling each hole twice is the most effective way to get the desired result. You can leave more than 0.5mm, but you'll need a substantially stronger – and more expensive – magnet due to the exponential force loss that occurs as that distance grows. Aiming for less than 0.5mm isn't really necessary and you will find it's better to maintain enough material that the wood fibres retain some integrity so they don't fracture or leak glue when the magnets are installed.

With the holes prepped, drop in the magnets keeping all the North-South poles in the same orientation to avoid creating a non-

uniform magnetic field. If the magnets are a tight fit to the holes, press them down with a piece of scrap wood or other non-magnetic item you have lying around. This is a good time to test the holding force of your magnets. If you've never used rare earth magnets before, you may want to install some on a test board to dial in your pattern and practice the installation process. When the test board feels right, it can be split apart so the magnets can be retrieved and used in the final product. To secure the magnet in its hole, add a little glue and tap in a dowel as a plug. I emphasise using a small amount of glue because excessive glue will get pressed down by the dowel and can be driven around the magnet and through the face of the board. You only need a drop of glue to prevent the dowel from falling out. I also wrote 'tap in a dowel' rather than 'drive in a dowel' because there's only 0.5mm of material and if you pound the dowel into position, you will likely deform or even split out the front face. Just tap the dowel until you feel resistance or hear the taps change pitch. Saw off the plugs with a flush cut saw, do some light sanding and you're done.



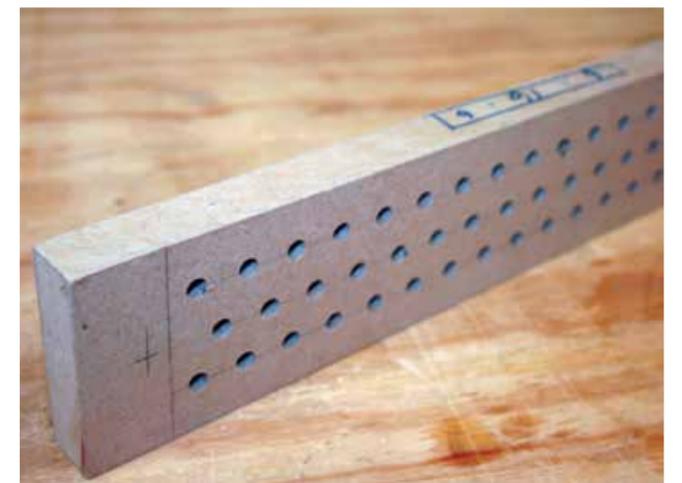
Note the continuous grain lines running from the face through the edges of the board, made possible using the 'plug method'



Install a sharp bit and set the depth stop on your drill press to stop the bit when the tip just touches a 0.5mm shim



A comparison of two holes shows the advantage of drilling a second time with a flat bit. Now the magnet can sneak right up to the front face



If you're unsure of the best spacing for your magnets, practice some different patterns in MDF. When you're satisfied with the results, split the MDF apart and reuse the magnets in your final project

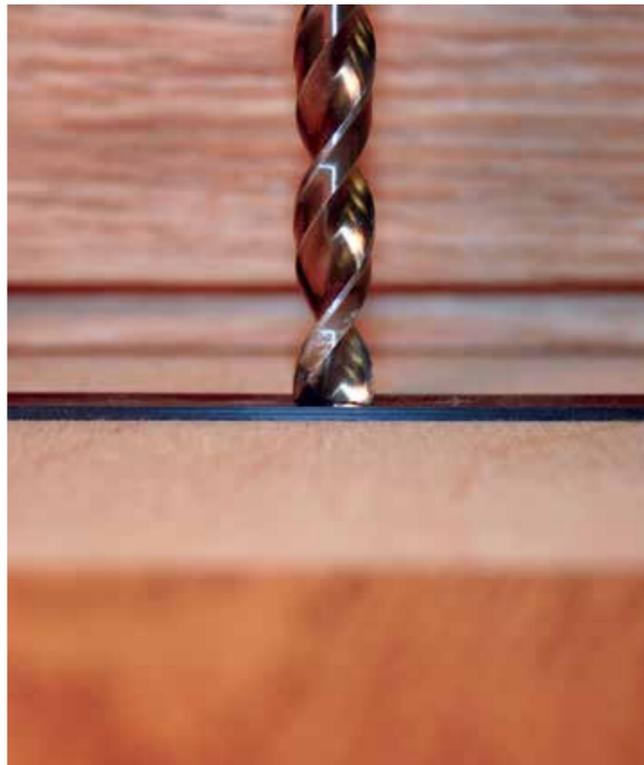


Lots of holes to plug, but the results are worth it



Drill all your holes, then install the flat-ground bit

“Regardless of which method you use to install the magnets, they can serve a useful purpose and still maintain a clean look”



Set the drill press to stop the flat-ground bit when it touches the same 0.5mm shim, now go back and redrill each of your holes



Twist bits or Forstner bits can be ground flat for cleaning out the bottom of holes



It's no secret where the magnets were installed using the 'plug method', but since this face will be against a wall they will never be seen

The 'resaw method'



After resawing, remove the saw marks to leave a clean, flat surface for installing the magnets and reattaching the face



Drill the holes just deep enough for the magnets to sit flush in the body, then glue the face back on



Lay out the pattern for your magnets - dividers help - then get to drilling

This second technique is fairly straightforward and the title pretty much gives it away. The 'resaw method', as I call it, is generally easier and faster for any project requiring more than a few magnets. It also has no visible plugs, so if the back of your project will be seen in its finished state, this would be my preferred approach in most cases.

Start by resawing a thin strip of wood off the face of your board. The strip should be as close to 0.5mm as possible, but this may prove difficult, depending on your equipment. If you have to go thicker, that's fine - you can thin it out again once it has been reattached to the body. With the face ripped free, clean up the saw marks so you have a flat glue surface later on, then lay out and drill the holes for the magnets, preferably with a Forstner bit. Drill the depth of the hole to the exact thickness of the magnets, which you can check with a depth gauge or by placing a magnet in the hole and laying a non-magnetic straightedge across it, if the magnet is flush or just below the straightedge you're in business. Drill the holes, add the magnets, then glue the resawn strip back to the body.

When the glue dries, you can clean up the edges and address a few final details. If the face that was glued to the body was left too thick after the resawing, now is the time to thin it out. This can be tough as you're aiming for a minute target thickness. Taking off too much will result in your equipment grinding into one or more magnets and your project will be ruined. Proceed carefully until you reach your goal or until you're happy with the feel of the pull force the magnets are providing - there is no sense in taking off more than you need to. With everything cleaned up, I like to plane a small chamfer around the edges that ends right at the glue seam; this masks any visible glue line as merely the break line of the chamfer.

An alternative for resawing your own board is to simply add a piece of veneer to an existing board; this saves the resawing trouble and leaves a perfectly uniform strip of wood covering the magnets. The downside is simply that the grain pattern and colour will differ between the board body and the face. Maybe this is an opportunity to play with deliberately contrasting woods for the body

and face, but I'll leave that up to you. If you're hoping for an even look, then resawing your own board should be the approach for quality work.

Conclusions

So which method is best? It really depends on what you're making. Adding a few magnets, especially when the back will be hidden? I would use plugs. Adding a lot of magnets? I would resaw, unless I'm using wood with pronounced grain lines I want to preserve, then it's back to plugs. What if you want to use the plug method, but the plugs will be visible? Go with face-grain plugs you can make yourself - search for 'snug-plug cutters' on www.leevalley.com. Be sure to cut the plugs from a piece of scrap off the same board your project is made from; this will ensure that the colour is a perfect match.

Regardless of which method you use to install the magnets, they can serve a useful purpose and still maintain a clean look. Once you've tried them you will likely find more and more ways to incorporate them into your projects, so get started and good luck. *F&C*