

Everything You Ever Wanted To Know About Drilling

There are three basic types of drilling commonly in use by today's woodworker – and dozens of different types of drilling bits and accessories available to make your work easier and ensure the best results.

Most beginning woodworkers give very little thought to the drilling of holes. As a rule, they already have a set of common twist bits and a portable electric drill. Often, they don't discover that drilling a clean, smooth hole in a piece of wood can be a real challenge until they've created a sloppy, splintery hole in their first "real" woodworking project. This hole could be out-of-round, drilled at an incorrect angle or just look bad enough that they wouldn't want anyone to see it.

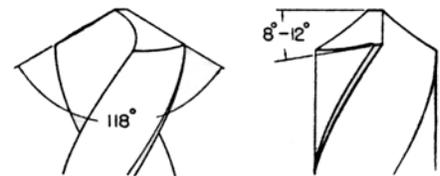
Using the right tool for the job (portable electric drill, vertical drill press or horizontal boring machine) – and choosing the proper bit – can make a big difference in your final product. In this article, we're going to take a look at both of these factors – plus – provide some valuable tips for setting everything up correctly to achieve the best, most consistent results.

Selecting the right drill bit for the job.

In woodworking, there are times when ordinary twist drills are perfectly acceptable for a job. This is especially true when you're building projects that would qualify more as "carpentry" than fine furniture or cabinet-making...or when you're drilling small holes (1/8" or smaller diameters) as pilots for screws, etc. However, there are other times when twist drills "just won't cut it". In these cases, you may need a specialized bit to create a better, cleaner hole...to locate it more accurately...or to drill special materials.

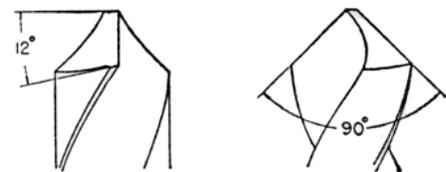
Let's take a look at the different types of drill bits available today...from the most common to the most highly specialized.

• **Twist Drills** are the most commonly available of all drill bits. Made primarily for general purpose drilling of metals, they are also suitable for some wood boring applications. Two prime examples would be small hole drilling (under 3/16" diameter) and drilling for framing-type applications where you might be joining 2" x 4" lumber together with bolts or screws or other types of jobs where the appearance of your holes makes little difference.



Common twist drill point

The majority of twist drills have points that are ground and sharpened to a fairly flat "included angle" – usually about 118-degrees. This is fine for drilling metals. However, when drilling wood, these flat angled tips have a tendency to wander off-center and create a hole with significant tear-out at the points of entry and exit. As mentioned previously, this is less of a problem with smaller diameter bits than with larger diameter bits.



Steep twist drill point for woods and plastics

Twist drills used for wood should have a steeper "included angle" – about 90-degrees is best. As a result, these bits will stay on-center and "wander" less while making a much cleaner entry and exit hole in woods and plastics.

There are two significant sub-categories of twist drills...both of which will be of interest to woodworkers on an occasional basis.

The first of these are **Hardened Twist Bits**. These bits are available in three types, 1): Cobalt Steel, 2): Titanium Nitride coated and 3): Zirconium Nitride coated. They are usually bright gold in color or have a slight gold tint and will hold their sharpness eight to ten times longer than conventional twist bits when drilling hard metal alloys.



Titanium Nitride

The second of these are **Plexiglas or Plastic Twist Bits**. These bits include a steep point angle to provide a cleaner entry/exit point without breakage when drilling plastic materials. If you're planning to drill plastics, these bits are well worth the investment.



Plastic Twist Bits



Spade Bits

- **Spade Bits** are flat, steel bits with an extremely sharp point. These points will help keep your bit on-center while their sharp flutes will cut through the wood very fast. Spade bits are usually only available in sizes from 3/8" up. When buying spade bits, look for ones with a long center point and a sharp "scoring" point near each outer edge. Short center points make these bits difficult to use in a portable drill. If you're slightly off perpendicular when drilling, you may not have enough point "buried" in your workpiece to hold the bit on-center as you drill. This is not a problem if you're using them in a drill press. The long center point will allow you to use the bits in a portable drill without The scoring points will score a sharp line around the diameter of your hole before the body of the bit enters the wood...producing a much cleaner entry hole.

A few cautions about spade bits: Watch your speed. Too fast and these bits will burn or chatter, producing a rough hole. Too slow and they'll tear the wood, producing ragged hole sides. To avoid severe splintering on the exit side of your hole, be sure to clamp a back-up board behind the exit point...or drill from one side until the point of the bit barely breaks through, then turn your workpiece over and finish your hole from the other side. **Caution:** If you use the latter of these techniques, be sure your workpiece is clamped firmly to the benchtop or held in a vise. Tilting a workpiece even slightly while drilling with spade bits can cause the bit to grab and "throw" your stock.

- **Auger Bits** look like twist drills, except with much deeper flutes or chip channels to remove the waste more quickly without clogging. Virtually all Auger Bits have sharp scoring lips to make a clean entry and sharp-edged flutes to shave the hole sides clean.

Some models of Auger Bits are designed for use in a “brace”...a crank-looking device that relies heavily on human “elbow grease” for its power. These bits typically have a screw-type feed point and a steeply tapered, 4-sided tip on one end that’s gripped by the chuck of the brace.

Machine Auger Bits may either have a threaded, screw-type point or a non-threaded point and a straight 6-sided shaft that’s gripped by your drill’s chuck.



Machine Auger

If your using an Auger Bit with a screw point on a powered drill press or in a portable electric drill, be aware of the fact that the screw point can dig quickly into your stock, grab it and spin it around, damaging your machinery or injuring you. This is especially true when boring dense, hard woods with larger sized bits. The larger the bit, the coarser the lead screw, which causes the wood to grab more. To avoid damage to your tools (or injury to yourself), clamp your workpiece firmly to your drill press table or benchtop...or drill a pilot hole in your workpiece that’s 1/32” or less smaller than the maximum diameter of your lead screw.

- **Brad Point Wood Bits** (often called “doweling” bits) are the very best all-around bits for drilling holes in wood. They feature a sharply pointed tip for keeping your hole position “on-target” throughout the boring process...precision ground edges to shave the hole sides clean and smooth...sharp side spurs to “score” the full diameter of the hole for super-clean entry and exit...and deep flutes to clear chips out of the hole fast. These are the reasons why woodworkers “in the know” use brad point bits.

They’re available in a wide range of sizes...usually from 1/8” through about 1” in diameter, and can be used in a portable electric drill or in a drill press with excellent results. As a result, a good set of Brad Point bits should easily handle 80% or more of all your wood boring needs.



Brad Point Wood Bits

- **Forstner Bits** are made for drilling jobs that other types of bits just can’t handle. They have virtually no center spur, so they’ll drill almost perfectly flat-bottomed holes. On the down-side, this means they can be difficult to hold “on-target” when used in a portable drill, and are therefore recommended for use primarily in a drill press. A benefit to this short spur is that you can usually drill to within 1/32” of the bottom of your workpiece without fear of drilling all the way through the bottom.



Forstner Bits

They’re also great for drilling exceptionally clean angled holes or overlapping holes; for relocating an existing hole by enlarging it; for making round-end mortises; for

boring into end grain; for drilling through knots, birdseyes and other unusual grain patterns without “wandering” off-center and for drilling large diameter holes in thin veneers and similar materials without splitting.

Forstner Bit sizes typically range from 3/8” through 1-1/2” or so. When using them, it’s best to run them at slow speeds and withdraw them from the hole frequently to clear the chips and prevent burning.



Forstner Bits

Special Purpose Drill Bits

In addition to the most common types of bits listed above, there is also a large variety of unique bits that make easy work of certain specialized operations. While most of these are readily available at your local home center or hardware store, others are a bit more difficult to find.

- **Long Bits** can be a real “life-saver” when you need to drill deep holes or holes through extremely thick pieces of stock. 12” long twist-style bits are easy to find...but long brad points are another story. Although the latter are available in lengths of 10”, 12” and even 18”, you’ll have to do some searching to find a source.



Long Bits



- **Screw Drills** are unique, “triple-function” bits that drill a tapered pilot hole for the screw threads, a countersink for the screw head and (if you prefer) a counterbore to accept a wooden plug that’s glued into place to hide the screw in certain types of projects. They’re available individually for screw sizes from #5 through #12...or in complete sets and most are fully adjustable for screw length as well as countersink and counterbore depth. They’re real time-savers and are well worth the investment if you use a lot of screws to hold your projects together. They work equally well in a drill press or portable electric drill.



Screw Drills

If you’re not using Screw Drills to bore pilot holes, counterbores and countersinks, it’s important that you know what size of hole to drill for which sized screw. Here’s a handy table that provides that valuable information.

- **Vix Bits** are the best choice for ensuring that your hardware mounting screw holes match-up exactly on-center with the holes in the hardware. Just hold your hardware in position on the workpiece and use your portable electric drill to bore the mounting holes. Each bit features a spring-loaded plunger with a tapered end that matches the countersink in your hinge or other piece of hardware. As you push your bit into the workpiece, the plunger end keeps your hole perfectly on-center. Pretty nifty !



Vix Bits

- **Hole Saws** are the best choice for cutting large diameter holes. They're readily available at most home centers and hardware stores in sizes up to about 3". They feature a center pilot drill to help you locate the center of your hole and keep it on-target throughout the boring process. As a result, they can be used in a drill press or in a portable electric drill. They're also available in standard (shallow) or deep boring models that will go through 2" or thicker lumber in a single pass – and with regular steel sawing teeth or with carbide teeth for boring through tough woods and non-ferrous metals.



Hole Saws

- **Plastic Bits** resemble standard twist-style bits...except they have a steeper, 60-degree point that provides a larger cutting lip for more surface area and improved performance when cutting through all types of plastics. This steeper point minimizes the chances of grabbing and chipping during the drilling process.



Plastic Bits

- **Glass Bits** are made of solid carbide and feature a spear-point shaped tip that will bore a super smooth hole through all types of glass. They should be used exclusively in a drill press at slow speeds. For best results, build a small, circular "dam" around the hole location with plumber's putty (stainless putty). Pour in a small amount of turpentine and start drilling. Feed the bit very slowly into the hole. Take your time and don't rush the process.



Glass Bits

Drilling Accessories

In addition to bits, you'll find a host of other accessories available to speed-up your jobs and improve your results. Here are just a few of those.

Countersinks are cutters with a tapered tip that matches the bottom angle of a flathead wood screw. Just chuck it into your drill press or portable electric drill and cut a shallow beveled hole to a depth that will allow your screw's head to rest flush with the top surface of your workpiece once it's driven into position.



Countersinks

- **Drill Stops** are small steel rings that slip over your bits and lock into position with an Allen setscrew to limit your hole depths when boring with a portable electric drill. They're an inexpensive accessory that is usually available in sets containing various sizes. Since your drill press has a depth-stop setting, they are of little use with stationary drill press operations.



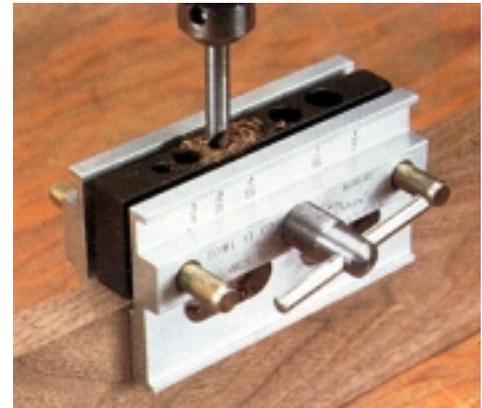
Drill Stops

Plug Cutters are used in a drill press (exclusively) to cut the small wooden plugs you use to hide the heads of screws that are recessed into counterbores on mating project components. Although you can usually purchase screw hole plugs or buttons, they are most commonly only available in birch. Occasionally, you can find cherry, oak, walnut and maple plugs. However, if your project is constructed of an exotic wood or one that's highly figured, matching plugs are impossible to find. That's when you need the ability to make your own plugs – from the same wood you're using. Plug cutters give you that ability.



Plug Cutters

- **Doweling Jigs** are special clamp-like devices that you tighten over the edges of boards you want to join together with dowels. They feature built-in bushings and/or guides (usually common 1/4", 5/16", 3/8", 7/16" and 1/2" dowel diameters) that are automatically centered over the board's width when the jig is tightened into position. These bushings/guides hold your drill bit perfectly perpendicular to the board's edge while you use your portable electric drill to bore the holes. Doweling Jigs are used exclusively with portable electric drills.



Doweling Jigs

- **Dowel Centers** often provide the best way to align the dowel holes in mating boards. First, drill the appropriate sized dowel holes in one of your mating workpieces. Drop the appropriate sized Centers into the holes. Align the two mating pieces and tap the board containing the centers lightly with a mallet. Doing so will cause the protruding points of the Centers to transfer their center locations precisely to the mating board. An inexpensive item for which there really is no alternative in certain situations. Usually available in sets containing two each, 1/4", 5/16", 3/8" and 1/2" sizes.



Doweling Centers

- **Combination Bench & Drill Press Vise.** Often, you need to hold objects on your Drill Press table while you bore holes in them. In these cases, a Drill Press Vise is your best choice. Look for small, lightweight models with quick-release tightening handles so you can insert and remove your project components quickly. They can be an invaluable aid for certain operations.



Combination Vise

A Quick Look At The Five Basic Drill Press Operations

The Drill Press is an extremely versatile machine. It will help you bore precise holes that are exactly perpendicular to your workpiece surface or edge – or at an ensured accurate angle, time-after-time. It's also extremely handy when you need to bore a succession of many holes in the exact same relative position on a series of workpieces. It's an amazing tool with many, many work-saving applications. Let's take a look at the basic Drill Press operations.

For more detailed explanations of the below operations, visit our January/February, 2001 issue of Shopsmith's on-line "Hands On" Magazine.

- **Through Drilling** is the process of drilling a hole all the way through a workpiece. Place a piece of scrap wood under your

Figure 7-38. Setups are invented to suit particular applications. Once this setup is made, any number of pieces can be accurately drilled.

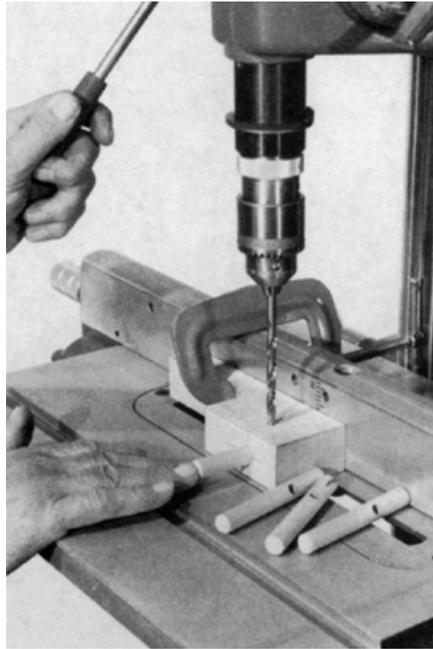


Figure 7-39. Another example of a hole locating setup. Bushings may be placed in drill guide holes to assure that holes will not become distorted by repetitive drilling. Bushings must be used when drilling metal.

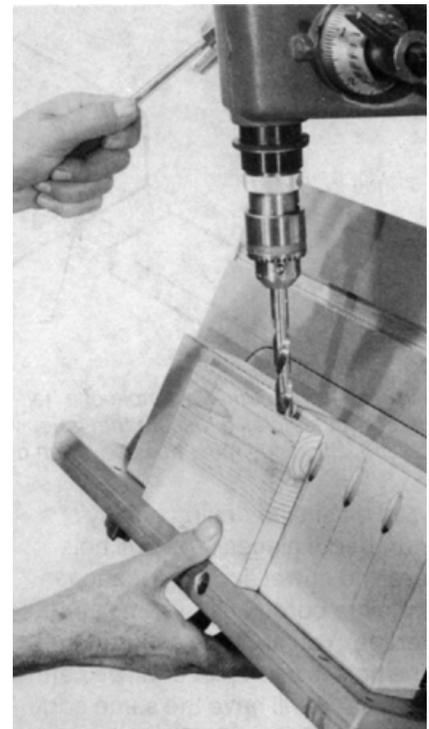
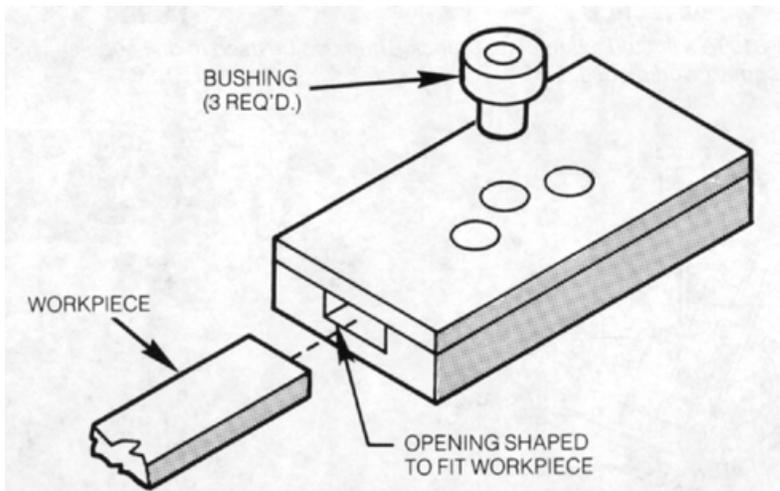


Figure 7-33. Use your Rip Fence as a holding jig and a scrap block to prevent bit "wandering" while drilling.

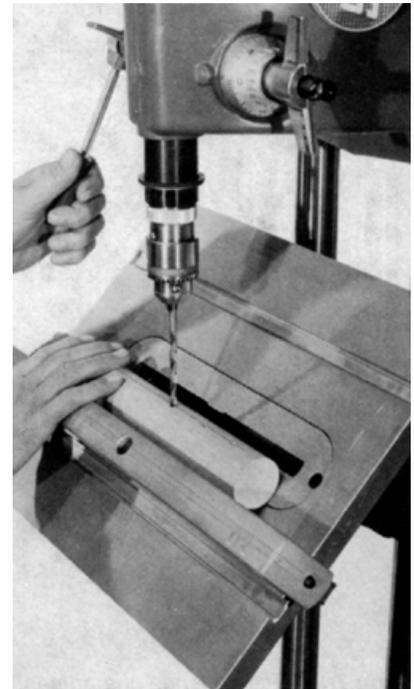


Figure 7-34. The table and the fence, ositioned this way, make a perfect V-block for holding a workpiece that requires diametrically accurate holes. Line the "V" with scrap blocks when drilling holes through the workpiece.

workpiece to protect your worktable and set your Drill Press's depth stop to control the depth of your hole.

- **Stop Drilling** is the process of drilling a hole that does NOT go all the way through your workpiece. Set up for this process in much the same way as for through drilling, setting your Drill Press's depth stop to limit your hole depth.
- **Angle Drilling** is used for operations like boring screw pockets. This is a technique that's often used to attach cabinet face frame rails & stiles together invisibly from the back side. (Fig.7-33)
- **Drilling Round Stock.** Use your Drill Press's worktable and Rip Fence to form a V-Block Jig for holding cylindrical or spindle-shaped workpieces during boring operations. (Fig. 7-34)
- **Jig Drilling** is a process whereby you build a simple jig or fixture to hold a series of workpieces in the same position while you bore holes in them. Jig drilling is the best way to save time and ensure the repeatability and accuracy of holes in repetitive drilling operations. (Fig. 7-38 and Fig. 7-39)

Horizontal Boring

Horizontal Boring is, as it sounds, the process of boring holes in the edges, faces or ends of workpieces with the drill bit approaching the stock from the side, rather than the top. This procedure is most commonly used for doweling operations, but can also be used for drilling workpieces that are too long or wide to be positioned conveniently between a conventional vertical Drill Press worktable and the Drill Chuck. Let's take a quick look at the three most common applications for Horizontal Boring:

- **Doweling** is the most frequently used application for Horizontal Boring. With this operation, the workpiece is laid flat on the worktable surface and the Rip Fence is used as a back-up to prevent the stock from moving while drilling. Mark the locations of your dowel holes on the mating pieces. Set your worktable height so you're drilling at the approximate centerline. **NOTE:** As long as you always keep the top (or bottom) surfaces of ALL boards flat against the tabletop when drilling, it isn't necessary for the holes to be centered perfectly on the edges between the top and bottom surfaces. (Fig.11-6)

Another doweling application involves reinforcing the mitered corners of a cabinet frame or picture frame. In this application, use your Miter Gauge to hold your workpiece in position while you drill your mating dowel holes. (Fig.11-8)

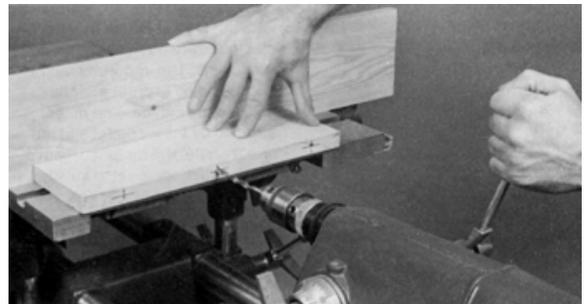


Figure 11-6. Feed the bit into the wood slowly and evenly, maintaining a light, pressure. Sopt when you feel the depth control halt the quill.

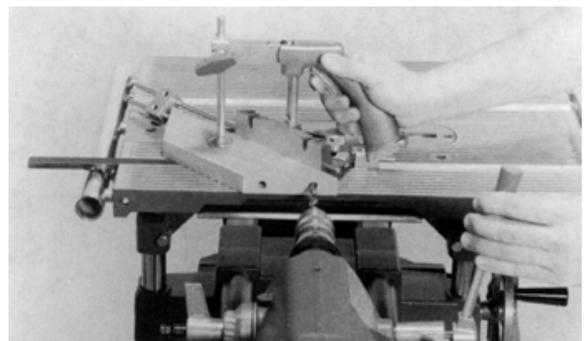


Figure 11-8. You can also bore at an angle by using the miter gauge. The miter gauge stop rod can be used to keep the bit from pushing the stock out of alignment.

- **Jig Boring.** In this application, your workpiece is held in position by a special jig or fixture while you drill your hole. (Fig 11-15)

In our example, a quarter section of a circular project component is held in a jig while dowel holes are drilled in the mating ends.

- **End Boring Long Workpieces.** Sometimes, it's necessary to drill holes in the ends of long workpieces. A couple of examples of this procedure include lamp standards – or joining long or tall turned bedpost sections together. When this is necessary, you can often use your worktable and Miter Gauge to form a jig to hold your stock firmly in position while you drill your hole. However, there are other times when this procedure might not provide the precision you need. In those cases, you may have to craft a special holding jig like the one shown here. (Fig.11-21 and Fig.11-23)

This type of fixture is perfect for drilling centered holes in either round or square stock. **TIP:** If you're boring an extremely deep hole using a 12" or longer bit, use a shorter, conventional bit to keep your initial ("pilot") hole on-track. Drill to the full depth of this bit, then switch over to your longer bit. Your first hole will serve as a guide for keeping your longer bit going straight as you deepen the hole.

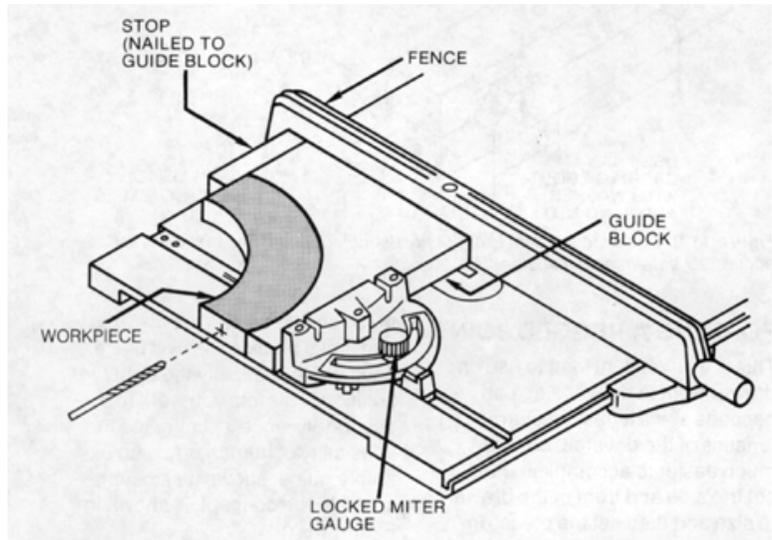


Figure 11-15. An example of a guide used for boring odd-shaped pieces.

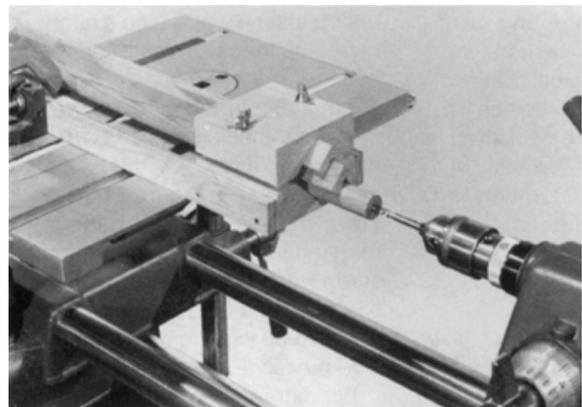


Figure 11-21. An extension V-block is used for extra-long workpieces.

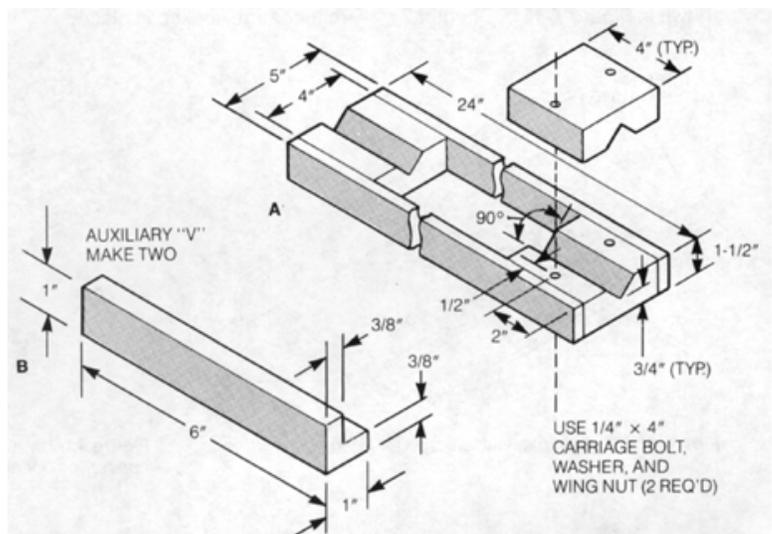


Figure 11-23. Construction details of the (A) extension v-block and (B) the auxiliary V's. The shape needed is actually a rabbet cut.

Drill Press Safety

As with all operations, there are some invaluable rules to follow to protect yourself from injury when using your Drill Press. Here is a list:

- **Read your Drill Press owner's manual and follow the guidelines presented there.**
- **NEVER** leave the chuck key in the chuck. **ALWAYS** remove it before turning on the machine.
- Wear proper eye, dust and ear protection
- Lock the table tilt trunion and down tubes firmly in position before you turn on the machine.
- Keep hands, fingers, etc. at least 3" away from the moving drill bit at all times.
- Roll your sleeves up above your elbows, remove all jewelry and tuck long hair under a cap.
- **NEVER** wear gloves when working with stationary power tools.
- Position the worktable so the stock is properly supported at all times.
- Whenever possible, clamp the workpiece to the worktable for added safety.
- **NEVER** try to stop the machine rotation by grabbing the Drill Chuck.
- Never try to chuck a drill bit with a tapered square shank in your Drill Chuck. Use only straight shanked bits.
- Always try to work with the table at mid-chest for maximum visibility and control.
- If you must use an auger-type bit with a screw-type lead (not recommended), always pre-drill a pilot hole that's the same diameter as the largest diameter of your screw lead to prevent potential grabbing. This is especially true when working with hardwoods. Auger bits with spur-type (non-screw) pilots are preferred.
- If you must create a hole that's larger than an available hole saw (our recommendation for boring large holes), use a scroll saw, bandsaw, saber saw, hand-operated saw or routing set-up. Shopsmith **Does Not Recommend** the use of adjustable, beam-type circle cutters or *flycutters*. These tools are very dangerous, even when your workpiece is clamped solidly to the worktable.
- **ALWAYS** turn off and unplug the machine before changing modes of operation or performing maintenance procedures.