Jigs and Fixtures for the Scene Shop

By: John McCullough

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Contents

INTRODUCTION

Jigs and Fixtures for the Scene Shop

This thesis seeks to promote safety and efficiency in the scene shop by presenting commonly used and popular jigs and fixtures for the scene shop. This thesis aims to reduce the number of separate reference texts that must be kept by a technical director or shop foreman by compiling the jigs and fixtures most appropriate for the scene shop in one volume.

This manual does not mean to present an exhaustive list of every jig a technical director or shop foreman might ever need. It does present a foundation of knowledge that will help to develop processes to get from raw material to finished scenery in a safe and efficient manner.

What are Jigs and Fixtures?

The Merriam-Webster Online dictionary defines a **jig** as “a device used to maintain mechanically the correct positional relationship between a piece of work and the tool or between parts of work during assembly” and a **fixture** as “a device for supporting work during machining”. In most shops, the word jig simply refers to a shop accessory that aids a worker in performing a task. The jigs presented in this text were chosen for their utility, not because they fit into a particular dictionary definition of jig or fixture. For consistency and convenience, I will use the term ‘jig’ generically thoughout the text.

Why Jigs?

> “Despite the fact that power tools have accuracy and a good amout of built-in control, it is often necessary for the woodworker to invent accessories or learn techniques that enable him to precisely and safely duplicate project components with a minimum of fuss. Sometimes an idea is adopted for temporary use; more often, however, the project or idea becomes a lifetime accessory that deserves time and care when being constructed.” (DeCristoforo 13)

Jigs have been a part of my woodworking education from the very beginning, so to me there is no separation between woodworking and jig-making. The two are tightly connected; part of completing a construction project is to consider all the machining operations necessary to complete the project, and finding the best way to perform those operations. Often, the best way to machine a part involves using a jig, especially when multiple matching parts are required.

A scene shop, more often than not, is building custom projects on a show-by-show basis, and may never need to develop the diverse array of jigs that a more specialized shop may have for the stock items that it produces every day. However, even in a scene shop, there are operations that are repeated from show to show. Cross-cutting stick lumber, cutting circles from panel goods, and manufacturing sets of identical custom components are all common tasks which can be improved by adding a jig.

What are jigs good at?

Jigs can improve scene shop operations in many ways, from safety to accuracy and efficiency. Compiled below are descriptions of the primary functions of jigs.

In *50 Shop-made Jigs & Fixtures*, Danny Proulx calls out the most important jig function: Safety.

> “Power woodworking tools utilize sharp blades that are designed to cut wood, but they are

> also very good at cutting flesh. Blade guards can reduce the risk of accidents, but you can't completely cover the edge without compromising the efficiency of the cutting tool. Jigs and fixtures are additional devices that can increase your safety when working with power tools." (Proulx 9)

Jigs that let us keep our hands away from the point of operation, and that help to hold the work firmly against fences and guides can make otherwise dangerous tasks safe and efficient. For example, cutting small parts on the table saw without the use of a push stick is foolhardy at best.

> "Take care to place your hands properly, keeping them out of the danger zone, and guide the work deliberately and slowly, letting the cutting edge do the work. Take your time, set everything up properly, make sure the work is held in place securely, and you will end up with a well-crafted piece safely produced." (DeCristoforo 9)

When devising a new jig, or modifying a jig presented in this book for the tools in your shop, take care to analyze the operation of the jig; how close do your hands get to the blade? how well is the workpiece supported? does the jig move easily across the surface of the tool or table? These factors can all affect the safety of the operations. Adding handles and clamps to a jig can help to keep your hands away from the point of operation. No jig should be accepted for use if it does not meet the 'common sense' test for safety in operation.

In *Taunton's Complete Illustrated Guide to Jigs & Fixtures* Sandor Nagyszalanczy lists three fundamental jig capabilities: performing operations that are difficult or impossible to do freehand; machining parts with precision and repeatable accuracy; and expanding the capabilities of tools and machines.

Cutting perfect circles is impossible without the aid of a jig. Straight, accurate cuts with a circular saw are made possible by jigs. We rely on being able to perform these simple tasks in our work.

Accurately repeating parts is another important shop task. Whether you need to cut hundreds of toggles to the same length for a large batch of stock platforms, or you need to manufacture two interchangeable components, a well designed jig and manufacturing process can improve consistency and accuracy.

Technical directors are no doubt familiar with coping with limited resources. A shop-built jig that expands the functionality of a tool lets you do more with less. Circles without a band saw? No problem. That task can be performed with the router, jig saw or table saw with the right jig.

The final function of a jig is to improve the efficiency of a manufacturing process. Jigs that help align parts or tools can drastically reduce the amount of measuring and marking that needs to be done by a carpenter. By reducing the number of measurements that need to be made, you also reduce the chances that a carpenter will make a measurement error.

Now that the main functions of jigs are defined, the next section will introduce a process design method that will help to identify those operations in the shop which could most benefit from the addition of a jig.

Adding Jigs to a Manufacturing Process

Time spent on a well-thought out process and tool setup saves time during the operation, and ensures accuracy and repeatability. You can only make a jig to perform a task if you completely understand that task. You need to break down the operation into discrete, identifiable steps, and choose or build a jig that matches one or more of

the steps. The time you spend analyzing the process from beginning to end, from raw material to finished project, is just as important as the time you spend actually using the tools in the shop. A technical director or scene shop foreman must be able to design not only the finished product, but also the manufacturing process.

This section will go step-by-step through two example designs for a manufacturing process. These examples will not show the only possible solutions to the problems presented, but will show a possible solution.

When considering adding jigs and fixtures to a manufacturing process, ask the following questions:

- *What steps need to be taken to finish the part?*
  - *identifying all of the steps is necessary to understand and analyze the process*
  - *the order of the steps can have an impact on speed and accuracy*
  - *order steps in the process to minimize changing tools and bits*
- *Does the operation require a jig or fixture for safety reasons?*
  - *are the parts too small to handle safely?*
  - *is the cutting tool exposed or likely to come into contact with the operator?*
  - *will guiding a piece freehand risk binding or kickback?*
- *Is the operation possible to perform freehand?*
  - *cutting precise circles and clean, straight lines are best done with a jig*
  - *organic shapes generally are more appropriate for freehand applications*
- *Do the parts need to match precisely with an existing part, or do sets of identical parts need to be made?*
  - *does every dimension need to match, or can some tolerances be larger than others? For example, a plate may need one square corner to align it during assembly while the other corners require less precision*
- *Can the tools in the shop perform the operation without augmentation?*
  - *building a jig to expand the capabilities of a stock tool may be more cost-effective than buying or renting a special tool*
- *Is the operation inefficient to perform by hand?*
  - *jigs that remove measurement, adjustment, or alignment steps both save time and reduce the chance for human error*

By asking and aswering these questions, a safe, accurate and efficient process can be designed. When considering the questions in this list, keep in mind the following advice.

Designing a process so that a part is indexable, meaning that the part can be mechanically located in a jig and does not need to be measured/aligned during each step of the operation, allows for repeatability, and allows easy batching of parts. It is faster and more accurate to perform the same operation on several parts, then set up for the next step than to take each part to completion before starting the next part. (Johnson, January 2007)

Changing bits takes time, and every time a bit must be changed or adjusted, a source of possible error is introduced into your process. Design your construction process to limit bit and tool changes. (Johnson, January 2007)

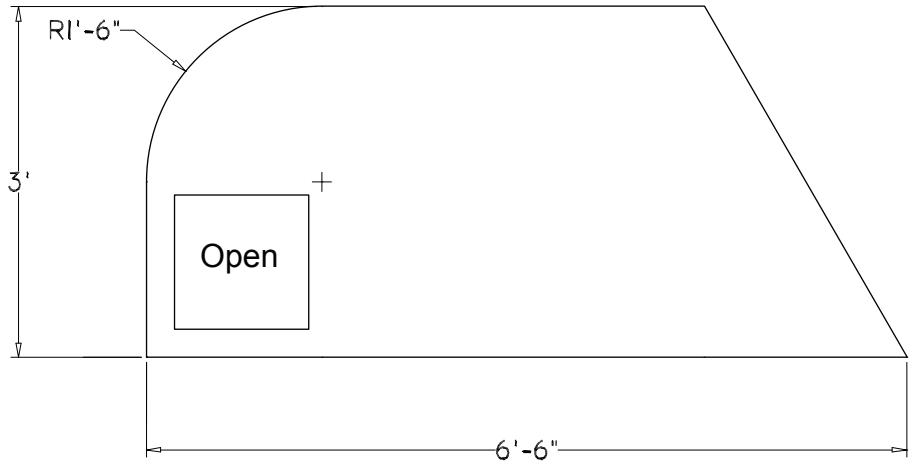
To calculate the time benefits of a jig, use the following formula. If **time per part without jig** x **number of parts** is more than **time to build jig** + **time per part with jig** x **number of parts**, then the operation would benefit from a jig. For example, building a band saw template jig (page 43) may take an hour, including making the guide and the template. Using the jig to cut the parts could save ten to fifteen minutes of layout time, careful cutting and sanding work per part compared to cutting a set of matching parts freehand. A run of only 4 parts could justify building and using the jig. The guide is reusable for future operations, and the template can be saved for quickly making replacement parts if any of the originals are lost or damaged (during transportation or load-in, for example).

In addition to using jigs to build scenery, they can be used to make parts for the shop or theatre that are not directly related to the production of scenery. A jig that produces appropriate door stops, just to make moving things around the building easier could be of use. (Hood 1.15.2009) Jigs that help an operator align or adjust a tool quickly and reliably between operations can save shop time and increase accuracy.

Analyzing a manufacturing process in this way may seem tedious at first, but will eventually become second nature. As the shop builds up a stock of jigs and gets in the habit of planning and working methodically, accuracy and efficienty will improve. The examples below will show possible ways to apply this method to real manufacturing processes.

Example - Building Matching Platform Lids

This section will walk step by step through designing the manufacturing process for the scenic piece in Figure 1. The drawing shows the top view of a platform lid. Our theoretical show requires one platform as shown, and one reversed and repeated. The platform lids have openings cut in them for access to fog machines that will be housed underneath. The lids will be cut from 4’ x 8’ sheets of 3/4” thick plywood.



Platform Lid
Cut 2 from 3/4” Plwood
Cut 1 as shown
Cut 1 R&R

Figure 1 - Platform Lid Process Example

►*What steps need to be taken to finish the part?*

○*the plywood must be ripped to width*

○*the angle must be cut in one end of the sheet*

○*the radius must be cut in one corner of the sheet*

○*the access openings must be cut out*

It makes sense to cut the plywood to width first, but the order of the other three steps is not important. I will choose to perform each operation on both lids before moving to the next step.

►*Do the operations require a jig or fixture for safety reasons?*

These tasks don't seem to require any safety devices that are not already standard components of the tools. The part only has through cuts (no dadoes) so the standard table saw blade guard should work. Cutting the angle or the radius would not require safety precautions beyond standard operating procedure on the jig saw, circular saw or router. Cutting the access openings can be done with the circular saw, jig saw or router with no extra safety devices.

►*Are the operations possible to perform freehand?*

Yes. The sheets could be ripped to width freehand with a circular saw or jig saw. The angle could be cut freehand with a circular saw or jig saw. The radius could be cut freehand with a jig saw. The access openings could be cut freehand with the jig saw or circular saw. However, the clean finish of a cut produced with a jig is preferable, and will allow production of parts to much tighter tolerances.

►*Do the parts need to match precisely with an existing part, or do sets of identical parts need to be made?*

The parts need to match visually, and they need to match the framing underneath, but they do not need to be identical or interchangeable. A variation of 1/16" from part to part will not adversely affect the finished product.

►*Can the tools in the shop perform the operation without augmentation?*

Yes. The finishes of all the cuts will be improved by a jig, but are within the capabilities of standard shop tools. The sheets can be ripped to width on the table saw with a standard fence. The circular saw can cut the angle, and the radius can be cut with either a router or a jigsaw. The access openings can be cut with the jig saw, circular saw or router.

►*Are the operations inefficient to perform by hand?*

The show only requires two parts. With a part run that small, the time taken to design and build a complex custom jig would be greater than the time saved by using the jig. For this process, jigs should be chosen that are either simple to make or already exist in the shop stock.

After considering these questions, the recommended manufacturing process would be:

►*rip both sheets of plywood to width on a table saw*

►*clamp or screw both sheets of plywood together face to face and cut the angle through both sheets at the same time using a circular saw with a rip fence (page 57)*

►*cut the radius in the corner of each sheet individually using the router or jig saw with a circle jig (page 52); either tool will produce an acceptable finish for this piece*

►*using a routing guide (page 54) route the access openings; the routing guide should be built to align with the corner of the workpiece*

Example - Manufacturing Interchangeable Caster Plates

Figure 2 shows a detail drawing for a caster plate. 100 plates need to be fabricated for a new stock turntable assembly. They are to be made from 3/16” thick by 6” wide hot rolled flat bar. The holes need to match the bolt pattern of the casters.

►*What steps need to be taken to finish the part?*

○*the flat bar must be cut to length*

○*the holes must be drilled or punched in the plates*

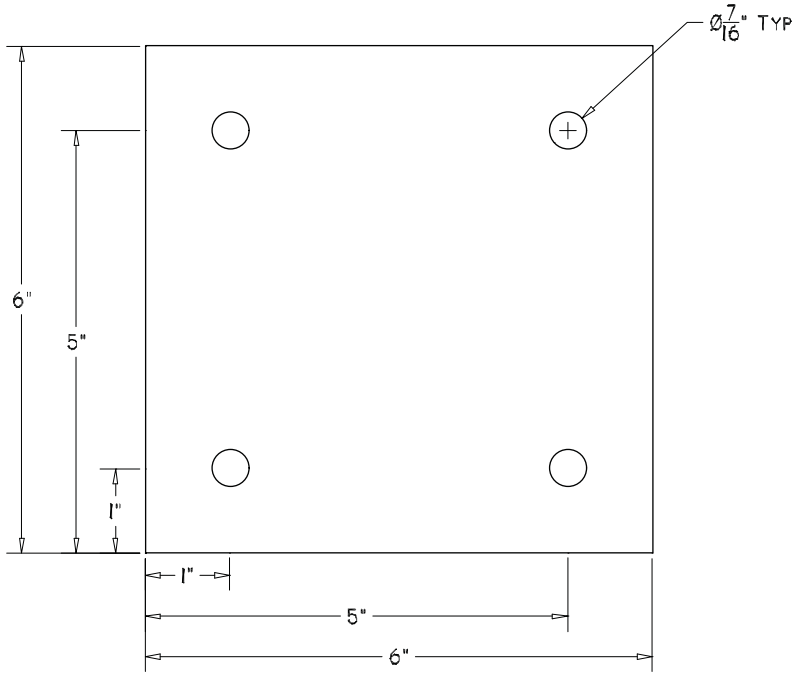
○*burrs need to be removed from corners and edges of the finished plates*

►*Does the operation require a jig or fixture for safety reasons?*

The part is small compared to the torque of a drill press, and steel parts can bind and twist out of control on the drill press if they are not clamped down. A jig that positions and clamps the part in place should be used.

►*Is the operation possible to perform freehand?*

The holes could be drilled with a hand drill instead of the drill press, but that would be tiring for the carpenter and less accurate. Measuring and marking each of the 100 parts would be time-consuming and introduce many opportunities for human error. Using a template to mark each piece will save time and improve the accuracy of marking each part, but will not ensure that the parts are correctly aligned with the tool each time. A jig



Caster Plate
Make 100 from 3/16” HRFB

Figure 2 - Caster Plate Process Example

that aligns the part blanks with the tool is preferable, because it will both save marking time and increase the accuracy and repeatability of the operation.

►*Do the parts need to match precisely with an existing part, or do sets of identical parts need to be made?*

At this point, we need to decide which measurements need to match exactly, and which have a greater tolerance. The plates should be interchangeable, and they all need to match the bolt pattern on the casters. Because the plates need to match the bolt pattern of the casters, the relationship between the holes is more important than the relationship between the holes and the edges of the plates. Because one corner of the plate will be used to align the plates with the platform framing, all measurements should be taken from that corner, and the same corner on each plate should be referenced.

►*Can the tools in the shop perform the operation without augmentation?*

A cold saw, abrasive saw, or hydraulic shear can make the crosscuts. The drill press can drill the holes without any additional functions being added. A hydraulic punch with an appropriately sized die could also punch the holes.

►*Are the operations inefficient to perform by hand?*

Yes. With a run of 100 parts, adding a jig to this operation has the potential to save a lot of time. A jig that positions the part blanks can cut down on a lot of measuring/marking time.

Given the requirements for this project, I developed the following process:

►*Cut the flat bar to length to make the part blanks. Use a stop block (page 40) to position the flat bar in either the cold saw, abrasive saw, or hydraulic shear. The hydraulic shear would be fastest, and would produce edges with the least burrs.*

►*Mark the same corner of each part blank as the edge that should be indicated in the jig. The parts may not be exactly square as they come off the saw or shear, so indicating the same corner of each piece for the entire run of parts will ensure that the hole patterns match, even if the edges are a little off.*

►*Measure and mark a 'Template' piece. Perform all operations on the Template first, and check subsequent pieces against it for accuracy.*

►*Line up the Template to make the hole in the lower left of the plate, and clamp it in place. With the template in place, clamp a 90° stop block (page 67) to the drill press or hydraulic punch table so the corner of the stop block lines up with the marked corner of the Template. Drill or punch the lower left hole in the Template, and all subsequent parts.*

○*depending on the diameter, rigidity and sharpness of the drill bit, the bit may 'walk' out of position as a hole is started. If this is a problem, use the template as a marking guage for center-punching the other parts.*

○*check every 5th or 10th part against the Template to make sure the stop block hasn't shifted*

►*Move the 90° stop block so the Template is lined up to make the upper left hole. The block should register with the same corner of the plate as before. Punch or drill the upper left hole in every part. Repeat for the lower right, and then upper right holes.*

►*Countersink both sides of each hole to remove any sharp edges or waste metal from the holes. Since the countersink depth is not critical, it may be fastest to do this with a hand-held drill, or a drill press without setting up a jig. Sand or grind the*

edges and corners of the plates.

How to use this Book

This book is not meant to be read once and put up on a shelf in a library. It is meant to be referenced at the drafting table or the workbench.

The **Introduction** presented an overview of jig capabilities, and a method for incorporating them into manufacturing processes in the shop. Next, **Jig and Fixture Construction** will provide information on designing, building and storing jigs. **Safety** will provide general information on shop safety practices and tool care and alignment.

The remainder of the text presents jigs sorted by tool: **Table Saw, Radial Arm Saw, Band Saw, Routers and Router Tables, Circular Saw, Belt-Disc Sander, and Tools Around the Shop**. Many of them may be used just as they are presented, but others will need to be modified to fit the tools in your shop. Still others will inspire modifications and adaptations for other purposes.

Appendix A and the **Bibliography** list sources for more information and further reading on the topic.

JIG AND FIXTURE CONSTRUCTION

Building Jigs and Fixtures

> "Good woodworking begins with good layout work. As you know, no matter how skillful you are with your woodworking tools, you can't find success in the shop unless you've also found success doing the preliminary work of laying out each new piece." (Pierce 9)

To gain the biggest advantage from a jig, it should be accurately built. Any inconsistency or defect in the jig will be propagated through every part the jig is used to make. Care should be taken to ensure that angles in any jig are what you want them to be. Guides that are not quite parallel or which bind in their slots can make a jig awkward and unusable. Guides that fit too loosely can lead to inaccurate cuts. Time spent building low-quality jigs is time wasted.

Choosing Materials

Materials should be chosen that are straight, flat and dimensionally stable. MDF and hardwood plywood are good choices. In a scene shop, lower quality softwood plywoods are more common. These can be acceptable for jig-making as long as care is taken to select parts of the sheet that are free from voids and defects. The solid pine common in scene shops is not usually very good for jig-making. Pine tends to be unstable, and depending on the grade can have knots and warps throughout the stock. Poplar is somewhat more suited to jig-making and is still affordable for single use jigs. Dense, straight-grained hardwoods like maple and oak are excellent choices for jigs that will remain accurate for years of use.

Plastics of all kinds can find use in a jig. Most plastics are dimensionally stable, and are not subject to the same warping effects that wood components face. Clear polycarbonates serve well as custom blade guards, windows and chip deflectors. Acrylics are more brittle and tend to shatter, so should not be used for parts that will be subject to rough use. Plastic parts can also be used as low-friction runners and guides. (Nagyszalanczy 20) Ultra High Molecular Weight Polyethylene (UHMW) is commonly found in scene shops, and is easily machined with common woodworking tools.

There are some jig surfaces that would benefit from higher friction, to help keep parts in place. There are many commercially available non-slip products that can be used on these surfaces: adhesive-backed sandpaper, or regular sandpaper can be affixed to jigs; double-stick tape can be used as a temporary fastener to hold parts to jigs, and non-slip pads can be put on tables to hold parts in place while they are being worked on. (Nagyszalanczy 22)

To make using the jig comforable, round over all edges that will be handled. Sanding your jigs will also help eliminate splinters that may catch unexpectedly during use. To keep your jigs running smoothly over your tools, a coat of wax will reduce friction and help prevent sticking and jamming during operation. A coat of sealer will keep out moisture, and make the jig less prone to dimensional changes due to humidity. (Tolpin 57)

A host of hardware options exist that can add features to shop-built jigs. Threaded inserts, tee-nuts, handles and wing-bolts all make adjustable attachments easy and reliable. For the height of sophisticated adjustable jigs, there are many extruded metal track options available that make adding a sliding stop block or adjustable pivot point possible. Adhesive-backed measuring tapes are available in english and metric varieties. Toggle clamps are a good addition to frequently used jigs to help hold work in place. (Nagyszalanczy 29) While this hardware can add functionality and adjustability

to a jig, it also adds cost and time to the construction of the jig. Jigs that are meant to be added to shop stock and used frequently will see the most benefit from commercial hardware. See Appendix A for a list of some sources for hardware of this kind.

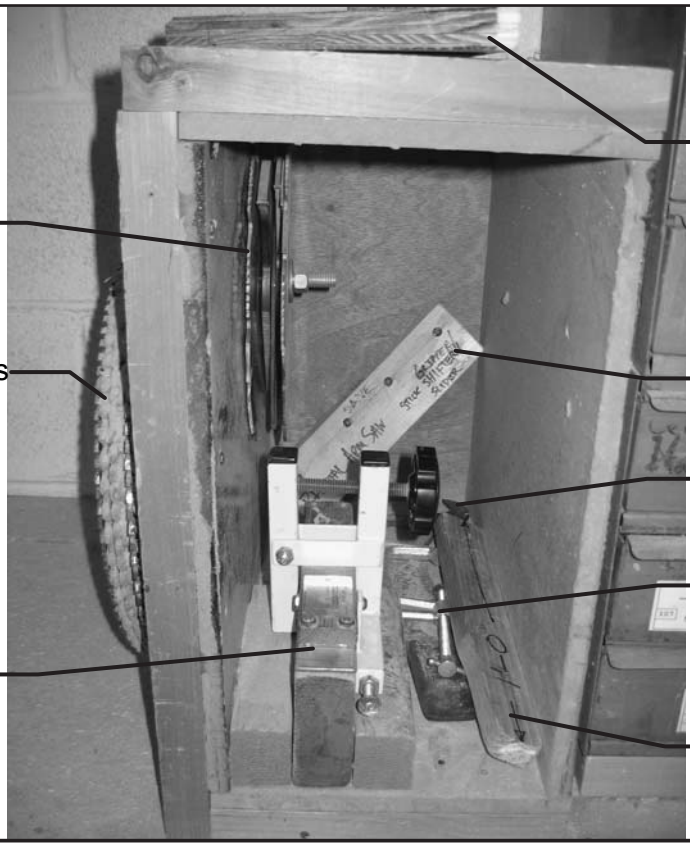
If you are using scrap material for jig construction, extra care must be taken to ensure that no hardware or fasteners remain in the stock. Leftover hardware and fasteners may be shot out of the piece at the operator, and will damage blades and cutters.

Dedicated or Adjustable?

A major decision when designing a jig is whether to make a jig dedicated to a single operation, be it a single angle, or a single depth of cut; or to make an adjustable jig that can be used for a wider range of applications.

A dedicated jig is usually easier to build and use, and can't be knocked out of alignment or improperly adjusted by a human operator. However, if storage space is tight, it may be impractical to keep a lot of single-purpose jigs around the shop.

Adjustable jigs require more care and time to construct, but are more flexible in their operation. They also require more time to operate, as they must be aligned or adjusted at the start of each job. (Nagyszalanczy 11) Unless a permanent positive stop is designed into an adjustable jig, it may not hold a consistent position; a part cut to 15º by Jack on Monday may not match a 15º cut made by Jill on Tuesday, if Jack and Jill made slight differences in their adjustment of the jig. It is my opiniong that the time and care required to make an accurate, long-lasting adjustable jig is too great for most theatrical applications. For most tasks, I favor dedicated jigs, and therefore you will find mostly dedicated jigs in this manual.



A Radial Arm Saw Workstation

Storage

Jigs will get the most use if they are kept on hand, and are easily accessible. Jigs used with a certain tool should be stored near that tool along with any tools and hardware required for blade changes or tool adjustments.

Quality Contol

The quality of a part is directly proportional to the quality of the jig used to make it. Any errors or flaws in the jig are transferred to every component made with that jig. Whether you decide to build jigs to permanently augment the tools in your shop or on an ‘as needed’ basis, take the time to build them well, and you will reap their benefits.

SAFETY

Safety

> "No matter how experienced you become as a machinist, never deviate from safe working practices in order to save time or money. Most wookworking machines will inflict serious injuries if they are misused." (Jackson 156)

Safety should be the number one priority of every shop. Scenery is not worth risking injury or death. A full discussion of shop safety could fill several volumes, and is beyond the scope of this book, but it is worth covering some safety basics before moving on to the jig descriptions.

Follow the tool manufacturer's recommendation for appropriate personal protective equipment (PPE). When choosing PPE to purchase for your shop, keep comfort in mind. Uncomfortable PPE is less likely to be used.

Below is a list of some shop safey guidelines from *The Complete Manual of Woodworking.* Also check federal and state OSHA guidelines for rules that apply to your shop. Federal OSHA regulations always apply, but some state OSHA regulations are more strict.

- ►*Use sound and sharp cutters or blades only. They are safer and produce better work.*
- ►*Use proper guards, as recommended by the machine's manufacturer.*
- ►*Disconnect a machine from the supply of electricity before changing cutters or blades.*
- ►*Do not make adjustments while cutters or blades are moving.*

A Sample of Personal Protective Equipment

►Check the work for nails, screws and loose knots before passing them through the blade or cutter. Knots or hardware can be shot out of the workpiece at the operator, and can damage blades and cutters.

►Don't operate a machine while wearing loose clothing or jewelry. Tie back long hair. Loose items may get caught in moving machine parts.

►Fit tools with some form of dust collection, or wear a face mask.

►Don't operate a machine under the influence of alcohol or drugs, or if you are feeling drowsy.

►Check that wrenches and adjusting keys are removed before switching on the machine.

►Feed the work against the direction of rotation of a blade or cutter.

►Support the work properly when passing it over or through a machine.

►Use a push stick to feed a workpiece rather than risk touching a blade or cutter by approaching it with your fingers.

►Never reach over a blade or cutter to remove waste or offcuts.

►Don't attempt to free a stalled blade or cutter before switching off the machine.

►Do not slow or stop a blade or cutter with a piece of wood. Let both come to rest naturally if the machine is not fitted with a proper brake.

►If you are interrupted when operating a machine, compete the process and switch off before looking up.

►Periodically check that all nuts, bolts and other fastenings are properly tightened.

►Keep the area around the machine clean and free from clutter. Cutting plastic-coated boards leaves especially "slippery" dust on the floor.

►Don't store materials or equipment above a machine in such a way that they could fall onto it.

►Check your machine settings and run through the procedure in your mind before switching on.

Some necessary shop operations, like cutting small parts or making non-through cuts on the table saw, may make the standard guards of your tool awkward or impossible to use. In those cases, the addition of the right jig will help keep the operator's hands away from the point of operation, and help guide the work safely through the machine. Jigs for specific tools and operations are organized by tool later in this book. This chapter details a few generally applicable safety accessories for the shop, which may find use in many operations.

Fences and Guards

Tool guards, which prevent operators from contacting the blade or cutter, and fences, which align workpieces with tools, must be properly adjusted and maintained in order to produce quality work safely. While some of the jigs presented stand alone to accomplish their task, many others rely on working in tandem with the fences and guards of the tool that are already in place.

A full discussion of fences and guarding is beyond the scope of this manual. The following pages will point out a few areas of particular interest to the jig-maker, but the ultimate responsibility for choosing, using and maintaining the fences and guards of the

tools in your shop falls on you, the reader.

Fences

“[The fence] is the most frequently used accessory on the saw and crucial to fast setups and consistently accurate cuts.” (Tolpin 53) If a tool and its fence are not properly aligned, no amount of jigging will improve the situation. A fence that is not aligned properly to the blade can lead to inaccurate and sloppy cuts, as well as stock feed and binding problems.

For **table saws**, the fence must be parallel to the blade, and the blade must be parallel to the accessory slots. The edge of the fence should be perpendicular to the surface of the table. The blade should be easily and reliably returned to a position perpendicular to the table surface. The table surface and any extensions should be flush and level. (Tolpin 32)

For **radial arm saws** and **power miter saws**, the fence and table surface must be perpendicular to the blade at the 0º position. It is also important that any positive stops the saw may have are correctly aligned, and accurately return the saw to the position indicated.

For **router tables**, fences can vary from job to job, and are the only fences that get much treatment later in the manual. The most basic router table fence is a simple board which can be clamped to the table that has a cutout for the bit. This simple fence will see you through most routing operations. (Hylton 210)

All work surfaces should be free from gross defects and obstructions that prevent either the jig or workpiece from sitting flat on the table or running smoothly across it.

Guards

Some of the operations and jigs presented in this text will interfere with some guards. For example, certain styles of table saw splitter guards make non-through-cutting operations impossible. While it is beyond the scope of this work to detail all guarding conditions, please consider guarding when adapting these jigs to work with the individual tools in your shop. Guards may exist that allow you to perform all the operations your shop requires without removing them. Remember, one of the goals of the jig is to improve safety.

For **table saws**, there are usually two components to the guard system: the **blade guard**, which prevents the operator’s hands from contacting the blade and keeps chips and debris from shooting out at the operator; and the **splitter**, which helps prevent the kerf from closing and binding on the blade. Blade guards may be integrated with the splitter, or may be mounted on a separate arm. General purpose splitters typically have anti-kickback pawls that prevent jammed workpieces from kicking back at the operator. A riving knife is a special type of splitter that does not have pawls and which sits slightly lower than the top of the blade which allows for non-through cutting.

For **circular saws**, **power miter saws**, and **radial arm saws**, there is usually a self-retracting blade cover that covers any part of the blade that is not in the workpiece. These should be kept in good repair, as a stuck guard may not retract or extend properly, and leave the spinning blade exposed. When cutting with a cicular saw, adjust the depth of cut so that the least amount of blade is exposed below the workpiece, as the guard will not cover that part of the blade during use. Radial arm saws are capable of many operations besides cross-cutting and mitering, which may require additional

guards; for example, ripping on the radial arm saw requires the use of anti-kickback pawls.

For **band saws**, the blade guard should always be adjusted so that the bare minimum of blade is exposed while cutting. Band saws also have various blade guides and guide wheels, which require precise alignment for consistent, accurate cuts.

For **routers** and **router tables**, guarding can be more challenging. Operations with these tools often require that the bit is almost completely exposed. Care should be taken to leave only as much of the router bit exposed as is absolutely necessary to perform the operation. On the router table, when the operation permits, fit a stop or guard over as much of the bit as possible to prevent contact with the operator.

Please refer to your tool manufacturer's instructions for properly adjusting and maintaining your tools, guards and fences.

Keep Your Hands Clear of the Blade

Most safety features are dedicated to keeping the operator from contacting the blade or cutter. In addition to following shop safety guidelines and using the tools' fences and guards, the next two pages present jigs that help to keep the operators hands clear of the point of operation.

Featherboards

A featherboard (or fingerboard) is a wooden or plastic block, with ‘fingers’ cut into one end, and is used to hold a workpiece against a fence or table as the workpiece is passed through a tool. They also help to prevent kickback. (Tolpin 50-53)

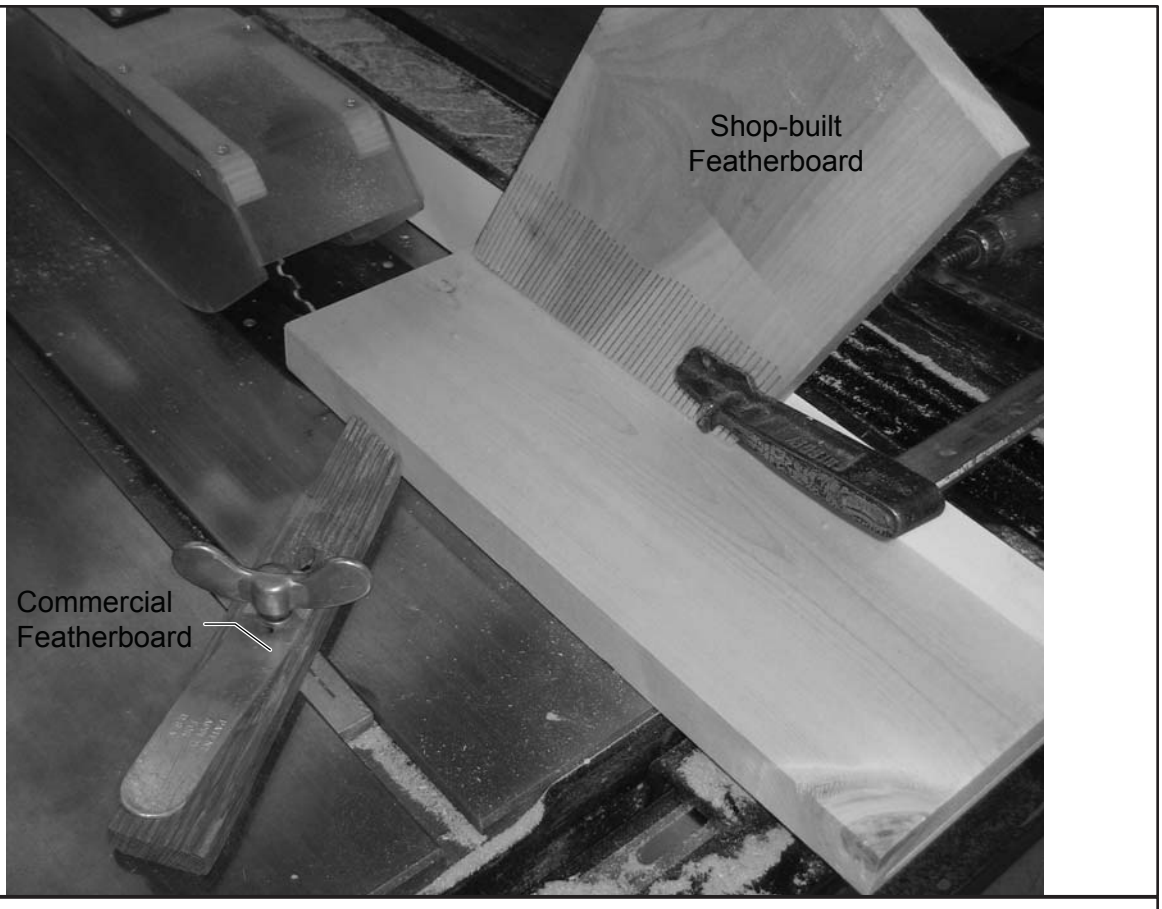
They can be easily built in the shop, and commercial versions are also available. The fingers of the featherboard should yield to light pressure and spring back into place when the pressure is released, but must be sturdy enough that they do not break off during normal operation.

The simplest method for attaching a shop-built featherboard to a tool is with a clamp, but hardware for fastening to a tool accessory slot is available at many woodworking retailers.

Commercial featherboards are commonly plastic, and attach to tools in a variety of ways. Versions are available that clamp to accessory slots, or attach to a steel surface with magnets.

Variations

Serving a similar function to featherboards are commercially available hold-down and anti-kickback wheels. Models are available that can permanently mount to a tool or clamp to the tool. Some wheels only rotate in one direction, which is good as an anti-kickback device, and some wheels will turn in both directions to act as a hold down for tools that require the workpiece be able to slide in two directions. Some wheeled saw accessories use the wheels to automatically feed stock into the saw.



Featherboards in Use

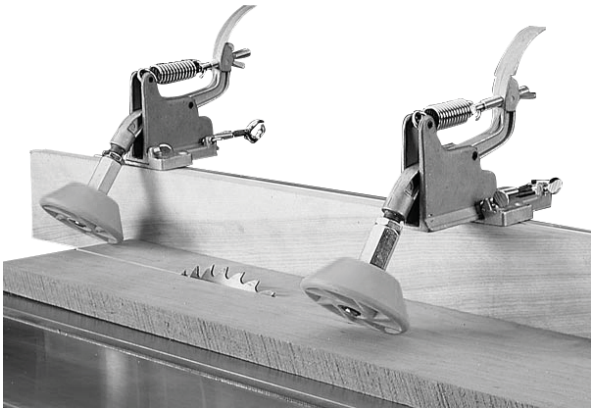


photo: www.woodcraft.com

Anti-kickback Wheels

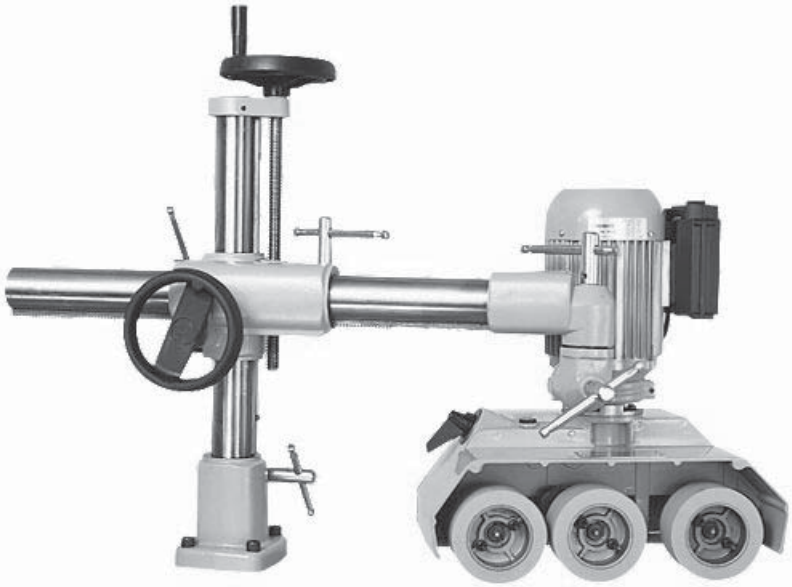


photo: www.rockler.com

Automatic Stock Feed Rollers

Anti-kickback Wheels and Automatic Stock Feed Roller

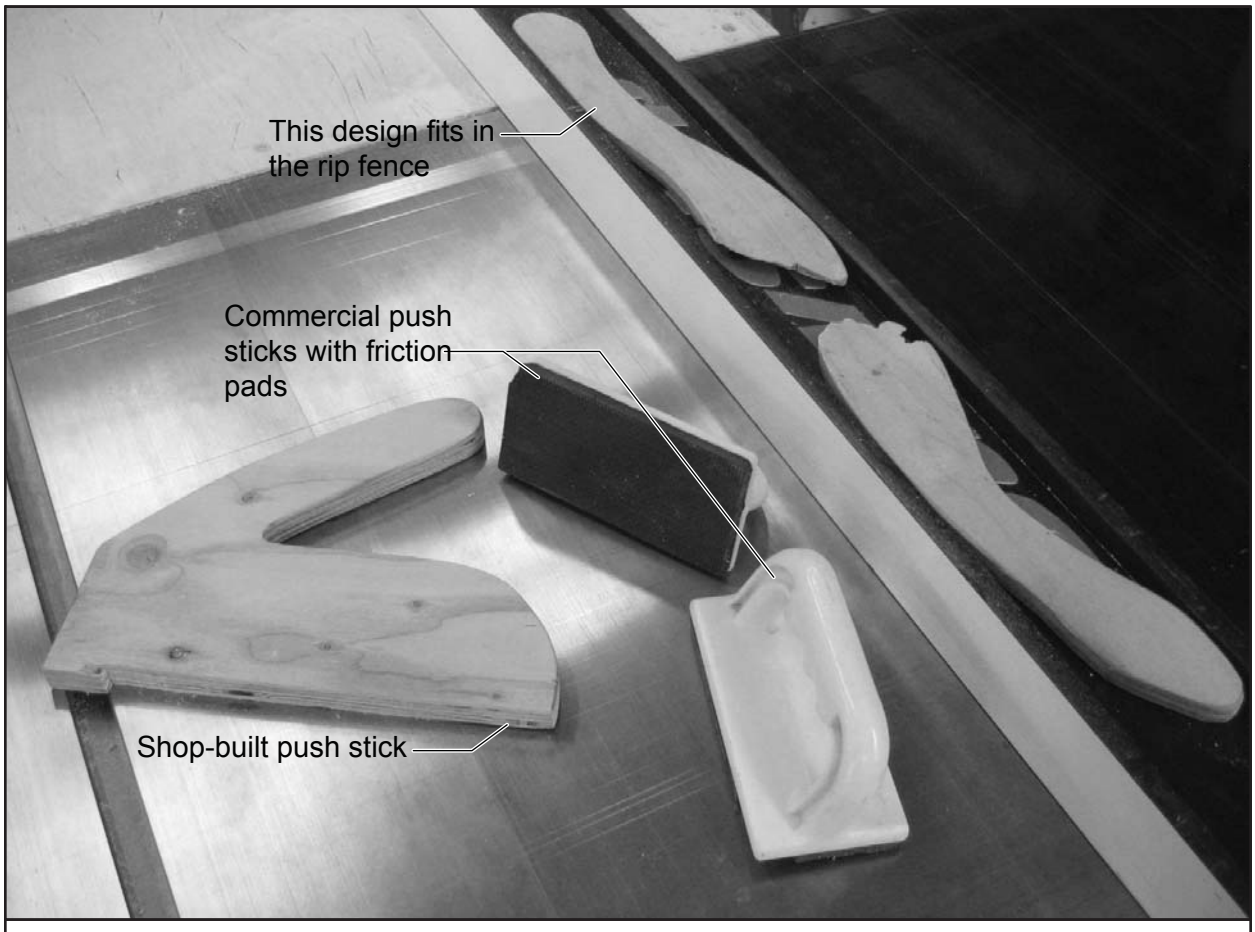
Push Sticks

Put simply, a push stick is a tool that lets you push a workpiece past a blade or cutter without getting your hands too close for comfort. Many varieties are available commercially, and they are easily made in the shop. Pictured below is an assortment of push sticks, both shop-made and purchased.

Push sticks are handled a lot, so handles should be sanded smooth and free of splinters. Sometimes it will be necessary to pass a part of the push stick through the blade, so it must be free of fasteners that might be shot at the operator.

Make push sticks in batches so that even if a few get destroyed from use, there is always a fresh one on hand. Keeping one clean 'template' push stick makes producing them in batches fast and easy.

Store them near the tool they will be used with. A push stick that fits in the table saw rip fence will always be on hand when needed. Push sticks get used the most when they are easily accessible.



Assorted Push Sticks

TABLE SAW

Table Saw

The table saw is a workhorse tool found in shops across the country, from garages to fine cabinetry shops. They come in portable contractor models and stationary cabinet models. The blade can raise and lower to set the depth of cut. The blade can tilt up to 45° and depending on the saw, the blade may tip left or right. Left-tilt saws are typically preferred, so that the beveled workpiece is less likely to jam between the blade, table and fence. The maximum cut that can be accomodated by a table saw is limited by blade diameter, and the maximum distance from the blade to the fence. Blade guards that mount to an arm may also limit the size of stock the saw can accomodate. Infeed and outfeed tables can help support large workpieces.

A good table saw will have a cast or ground table. Cast or ground tables can be manufactured very flat and inflexible. Cheaper, bent-metal tables must be very well braced to maintain a flat working surface. The rip fence is the most important accessory for the table saw for producing repeatable, accurate work. Saw manufacturers offer different fence options, and third party manufacturers offer after-market fence kits. Choose a rip fence that will accomodate the largest piece you wish to pass through the table saw. (Jackson 157)

A typical scene shop will have a 10”, cabinet-style table saw with a 3- or 5-horsepower motor. A fence with 50” clear to the right of the blade will cut typical 4’ x 8’ sheet goods with a little room to spare.

This go-to tool, with the right jigs, can perform most of the operations common to a scene shop, including ripping, cross-cutting and mitering. The reliable repeatability offered by even the simplest table saw jigs makes this the tool of choice for volume production.

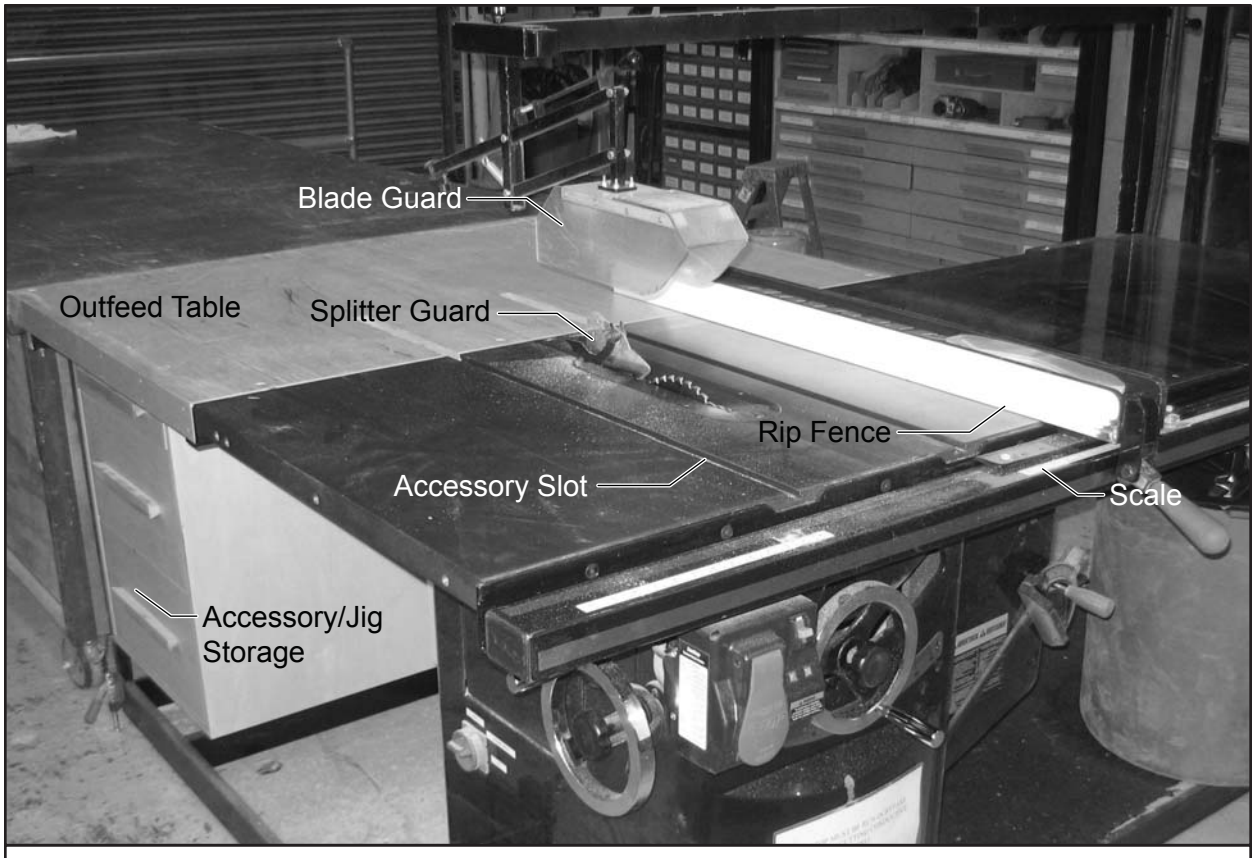


Table Saw

Zero Clearance Plate

This accessory is a must for making thin rips and small parts on the table saw. They are both commercially available and easily made in the shop. As the name implies, this plate has no extra clearance around the blade. The blade cuts its own clearance through the plate during the first use. Thin strips and small parts can not fall and jam between the blade and the plate. It can also help prevent unwanted tearout on the bottom of a workpiece, but this is rarely a concern in scene shops. A different plate will be needed for each angle of blade tilt. They can be made as needed, or plates for commonly used angles can be kept on hand. (Tolpin 18)

To make a zero-clearance plate

►*Plane a piece of hardwood or MDF to thickness. The plate should sit flush with the surface of the table.*

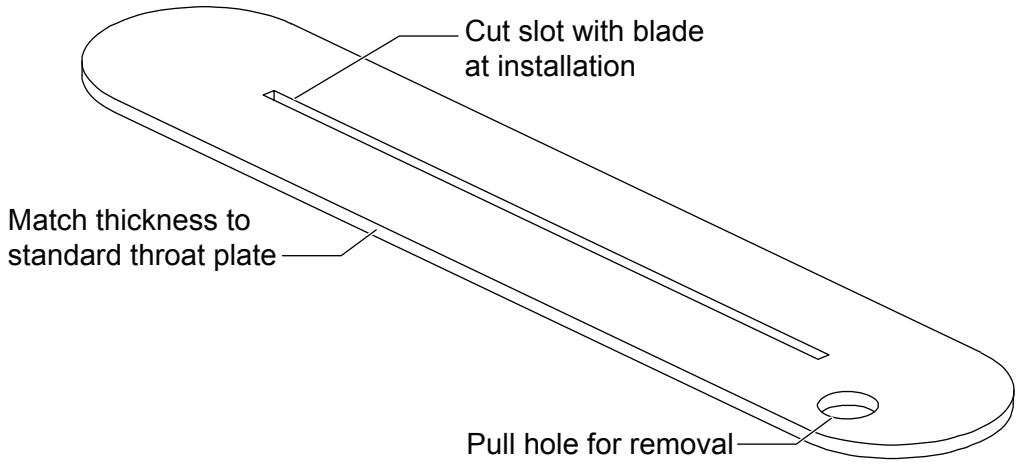
►*Trace the factory throat plate that came from the table saw and cut just to the waste side of the line on the band saw OR use the factory throat plate as a template and use a flush-trim router bit to cut an exact match*

►*If you cut the piece on the band saw, sand to the line to get a snug fit in the opening.*

►*With the blade all the way down, insert the new plate.*

►*Clamp the plate down with a piece of scrap wood. Make sure any metal parts of the clamps are clear of where the blade will come through the plate.*

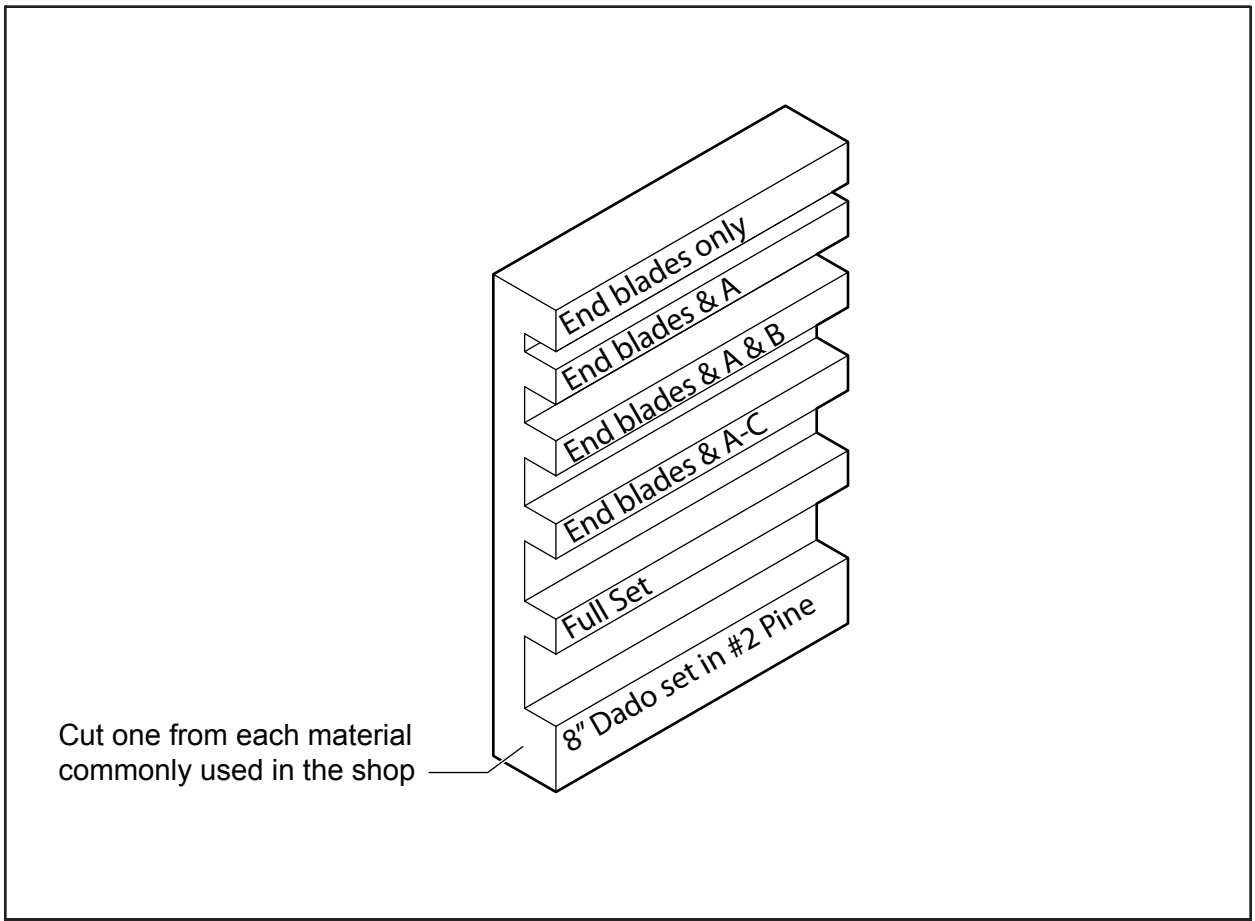
►*Start the saw and slowly raise the blade into the new plate. The blade will cut a slot in the plate, which is now ready to use.*



Zero-Clearance Plate

Dado Blade Width Guage

This shop-built guage can eliminate a lot of trial and error when setting up a cut with a dado set. Make a single cut in the guage with the dado set in each of its possible combinations, and label the guage with the blade combination that you used to make the cut. Store the guage near the dado set for quick reference when choosing which blade combination to use to achieve a desired cut. Consider making one guage of each material that is commonly used in your shop, as different woods may cut slightly differently. (DeCristoforo 75)



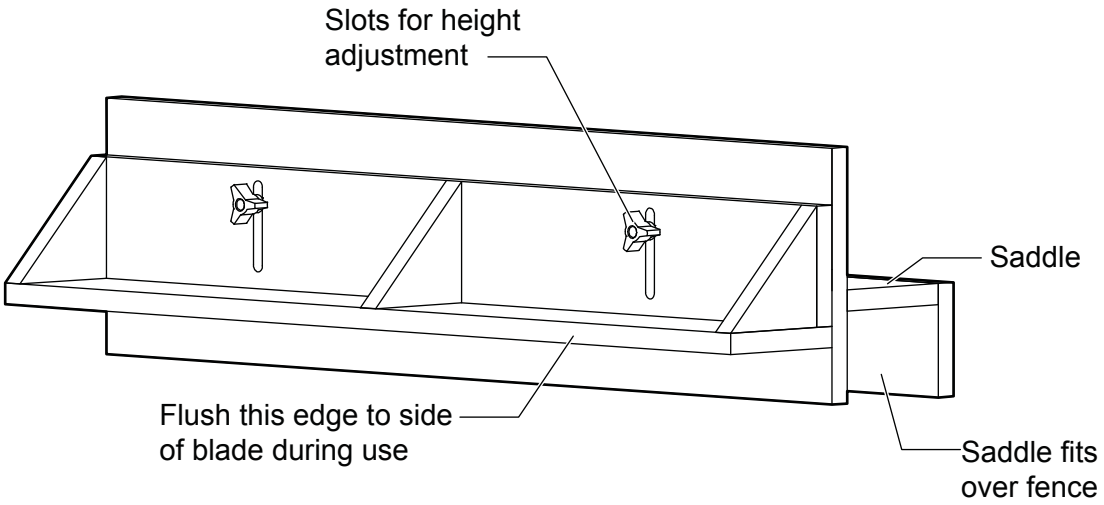
Dado Blade Width Guage

Template Jig

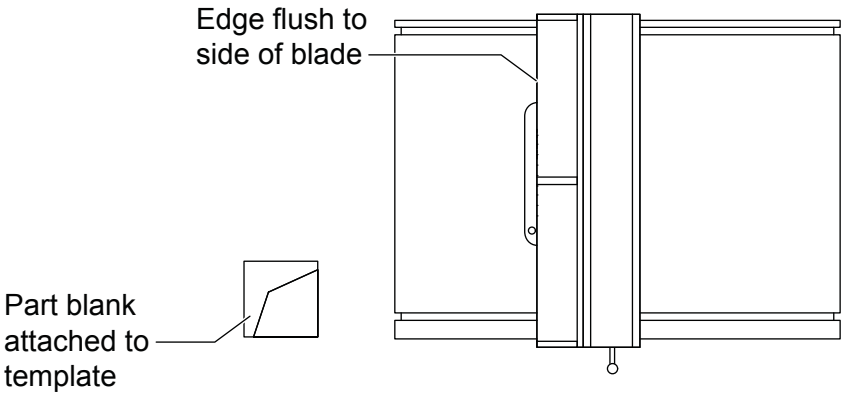
The template jig consists of two parts and is used to duplicate parts on the table saw. The major part is the auxiliary fence (seen below). In use, the edge of the fence and the side of the blade are flush. This fence sits above the blade, so the workpiece can pass underneath it. The second part is a template, which is attached to the top of the workpiece and rides against the edge of the fence, making cuts to duplicate the template.

The template can be screwed to the workpiece. If screw holes in the workpiece are unacceptable, the workpiece can be held to the template with double stick tape.

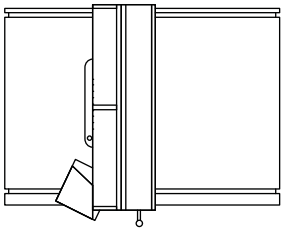
Gentle curves can also be cut using this technique. Mark the center of the blade in pencil on the auxiliary fence. Guide the workpiece past the blade, keeping the curved template against the auxiliary fence at the pencil mark. (Tolpin 140)



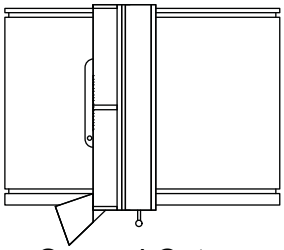
Template Jig Auxiliary Fence



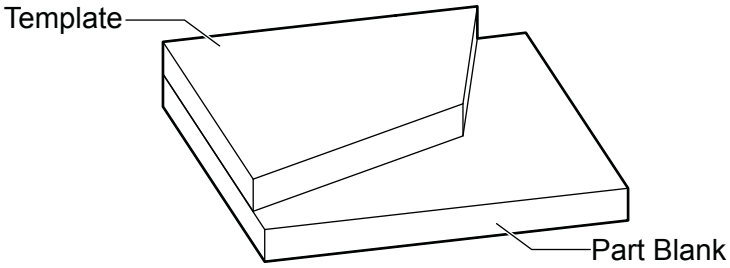
Jig Setup



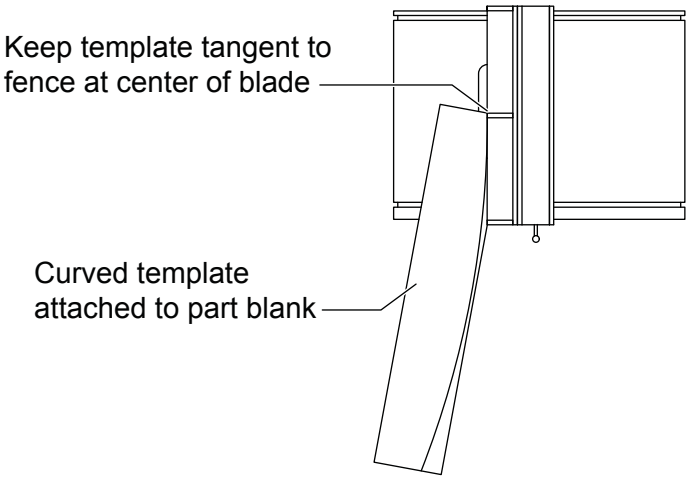
First Cut



Second Cut



Screw or Tape Blank to Template



Cutting a Curve

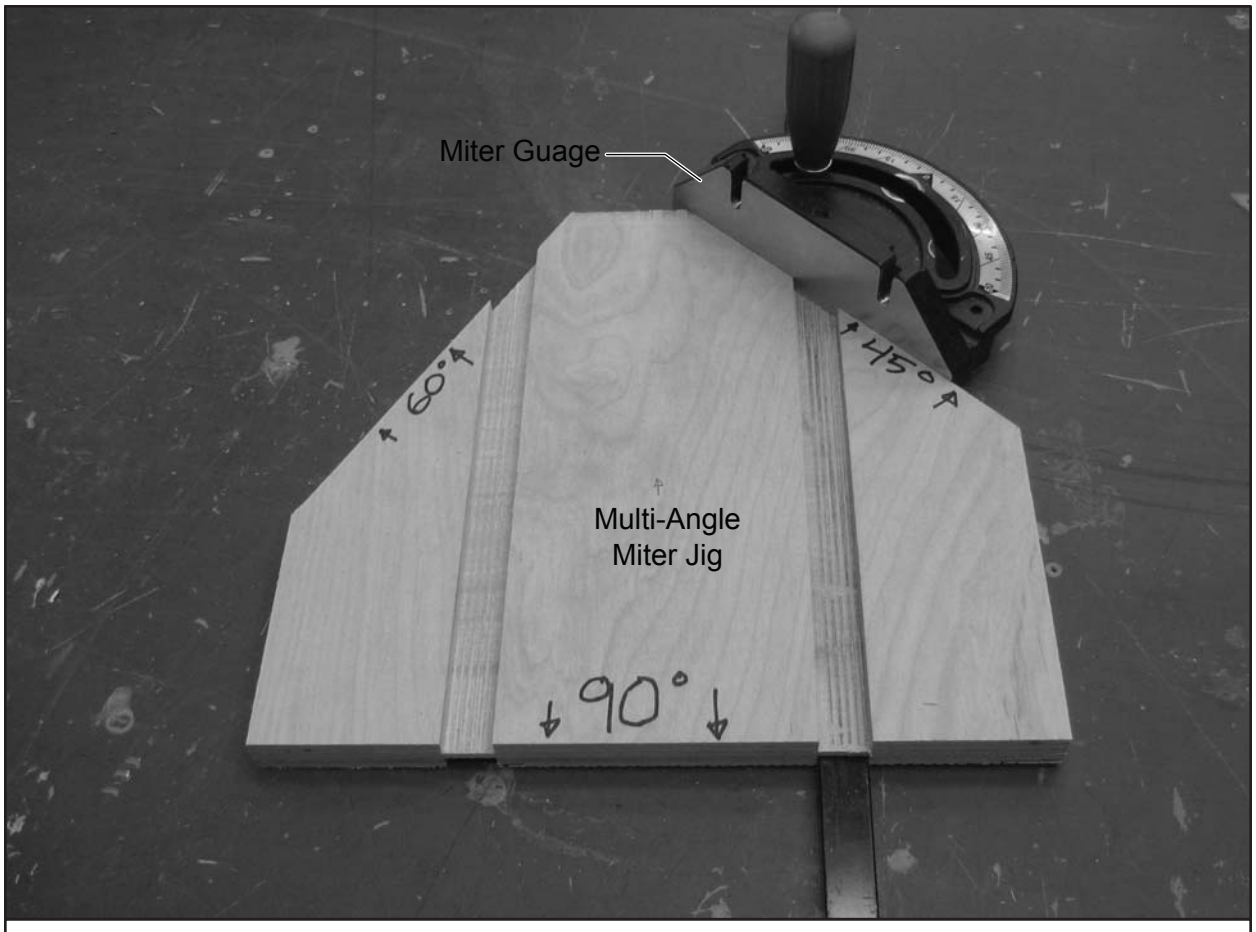
Template Jig in Use

Multi-Angle Miter Guage

This shop-built alignment tool will save time and improve accuracy when setting commonly used angles on your miter guage. Slide the miter guage into one of the slots on the jig, and then lock the miter guage at that angle. This method is more repeatable than trying to align a pointer to a mark. Store this near the table saw or miter guage for easy access. (Proulx 43)

To make a multi-angle miter guage

- ►*cut a rectangle in 3/4" Plywood or MDF*
- ►*on each face of the rectangle, cut three dados that will accept your miter guage*
- ►*cut commonly used angles in the guage*
  - ○*take care to cut the angles accurately, as they will be used to as references for the alignment of other tools*

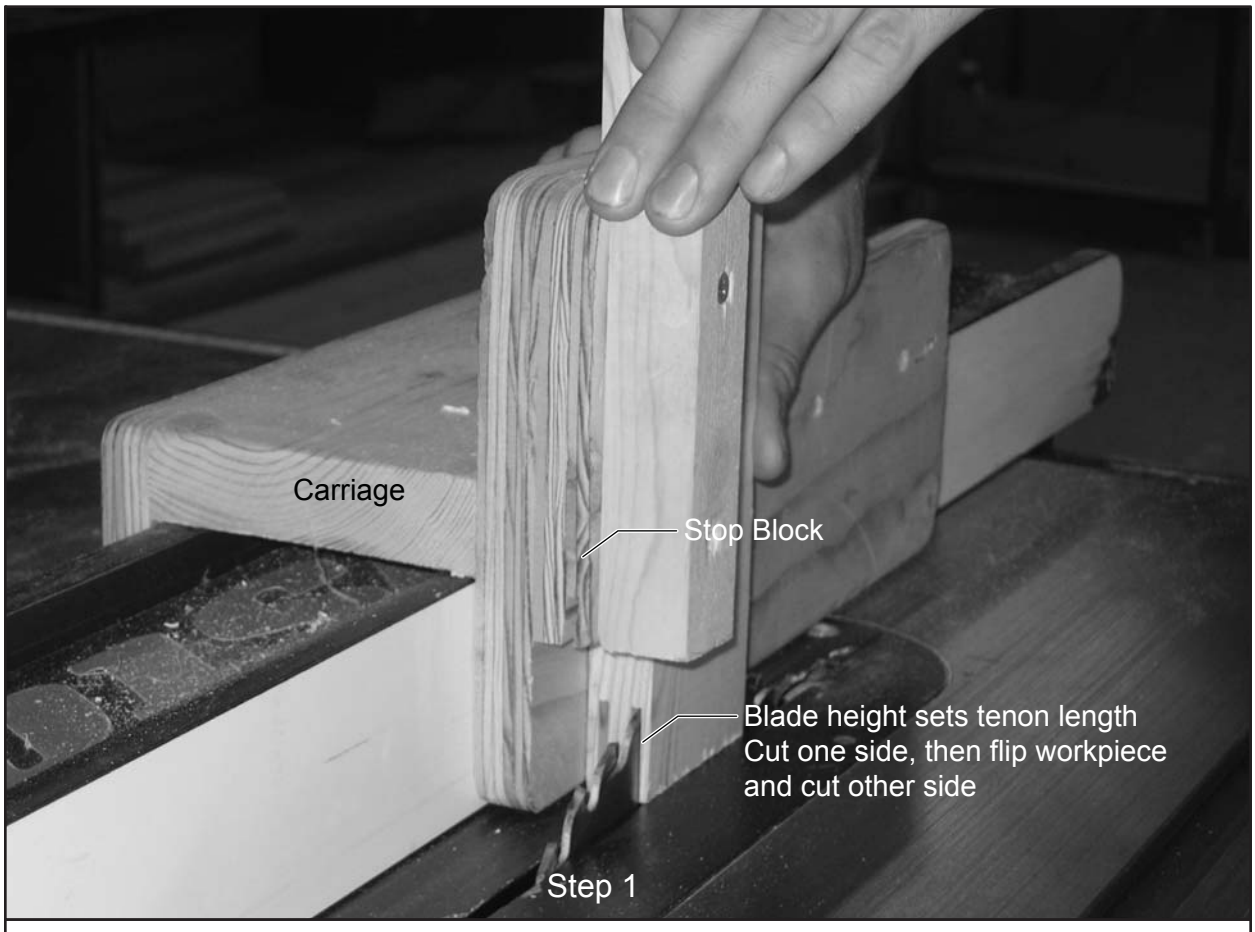


Multi-Angle Miter Jig

Tenon Jig

As the name suggests, the Tenon Jig is used to cut tenons on the table saw. Both commercial and shop-built designs exist. Commercial models tend to run in the saw's accessory slots, while the shop-built jig shown below works with the saw's fence.

The jig consists of a carriage that fits over the table saw rip fence, and a stop block that allows a workpiece to be held in the jig with either its face or its edge against the carriage. The jig shown below aligns the workpiece, which the operator holds in place by hand. Alternate constructions of the jig may include toggle clamps or other hold-downs to keep the workpiece in place.



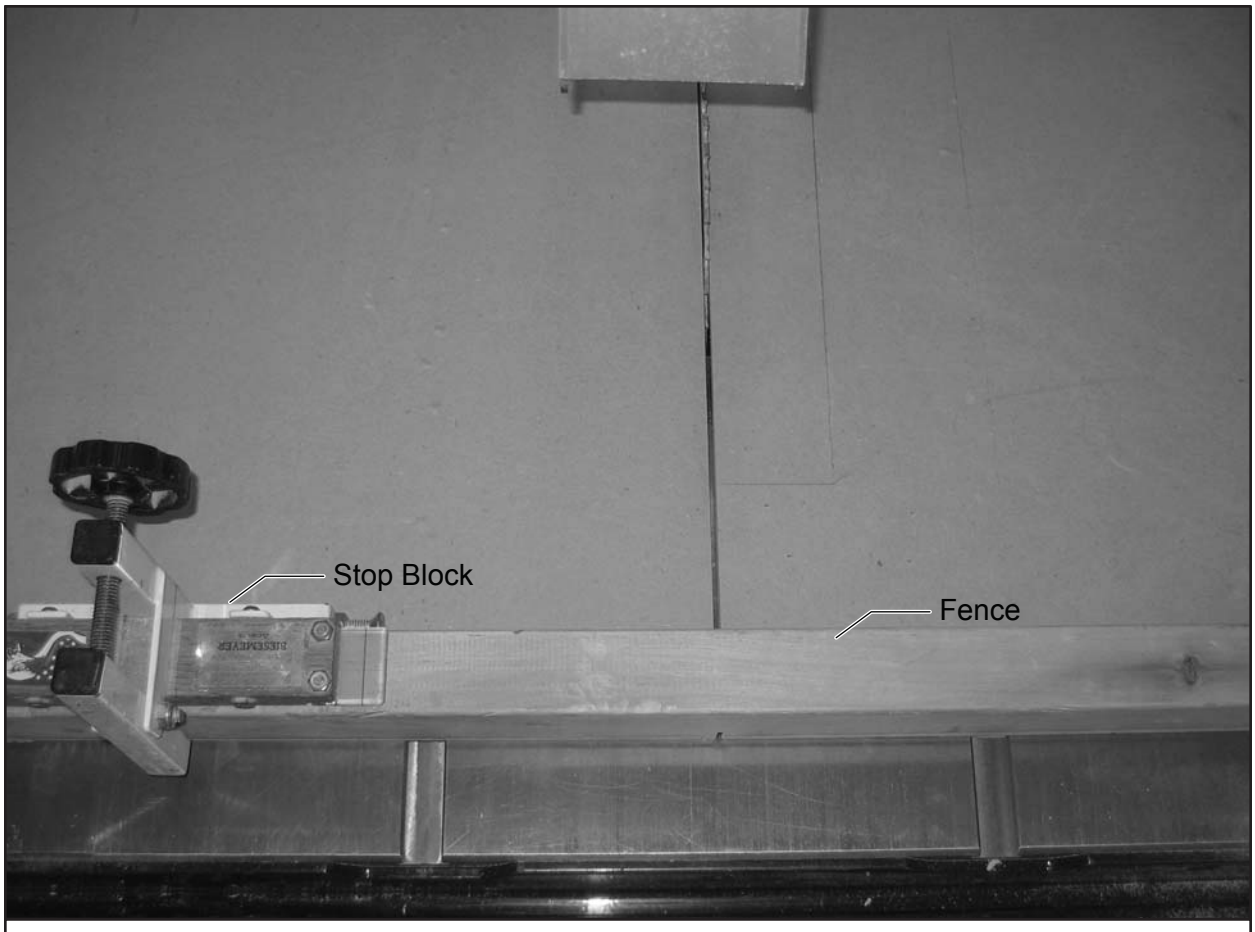
Using the Tenon Jig

Using the Tenon Jig

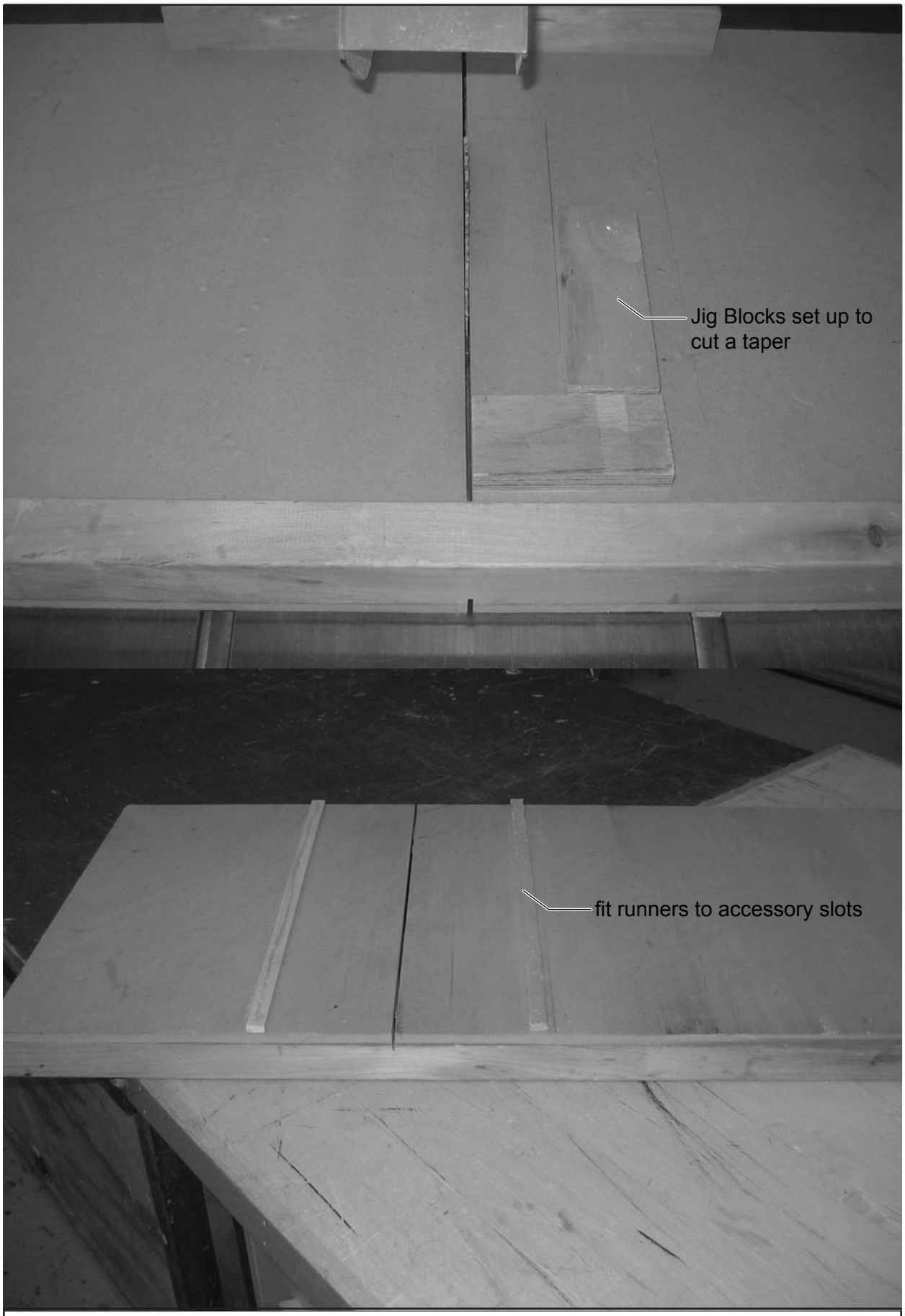
Cross-cut Sled

The cross-cut sled for the table saw is a more fully-featured replacement for the table saw miter guage. The sled is a moving work surface that carries workpieces past the blade of the table saw. Jig blocks (page 66), clamps and workpieces can all be attached to the sled to position pieces for work. Shown below is a sled set up to cut boards to length with a stop block. Stops can be positioned so that a workpiece is carried past the blade at an angle, allowing miters and wedges to be cut. Using two stops together, one to the right of the blade and one to the left, can be helpful for cutting half-laps.

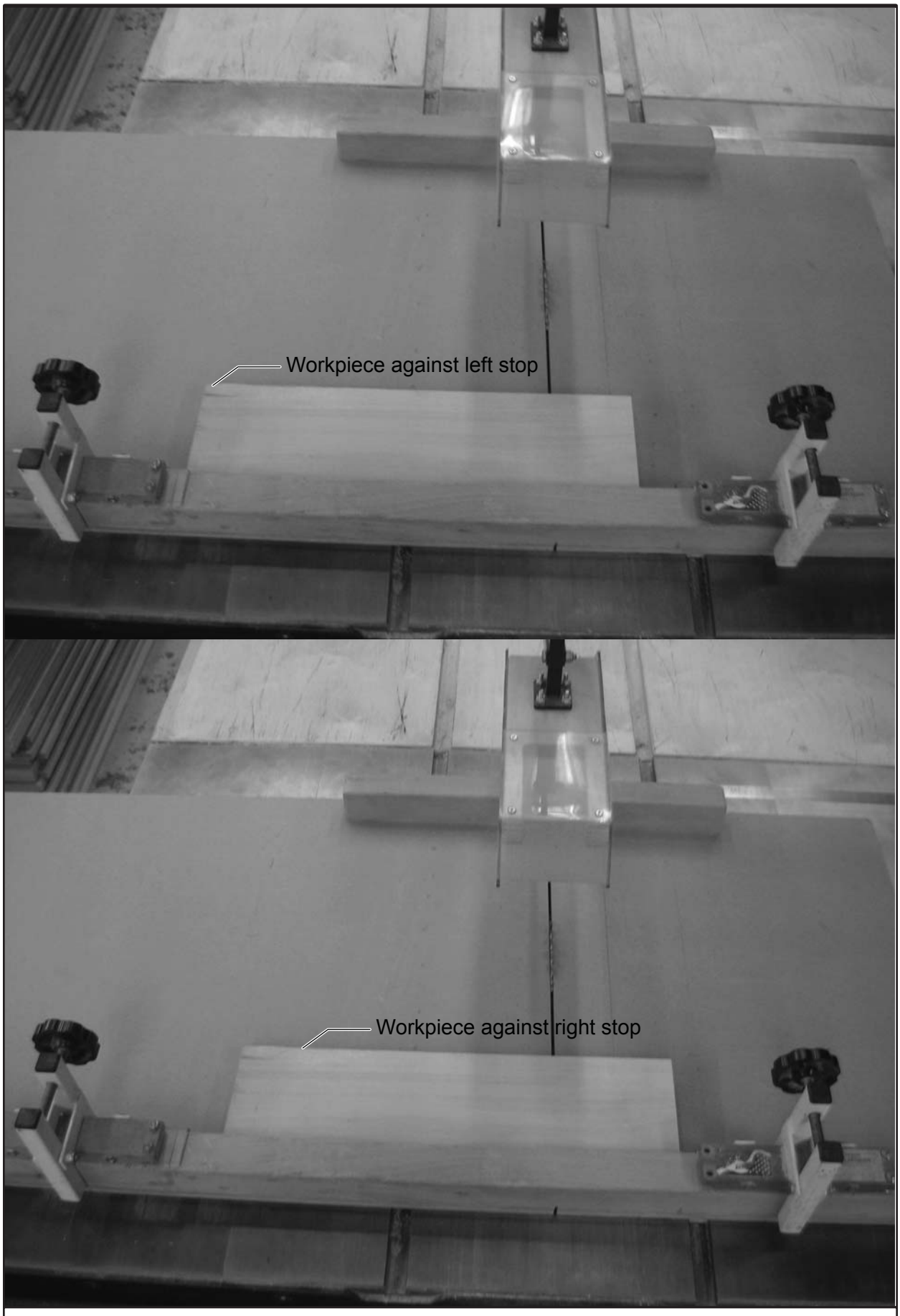
The sled is made from MDF or Plywood, with solid wood fences front and back.



Cross-cut Sled



Further Views of the Cross-cut Sled



Cross-cut Sled Set Up for Cutting Half-laps

RADIAL ARM SAW

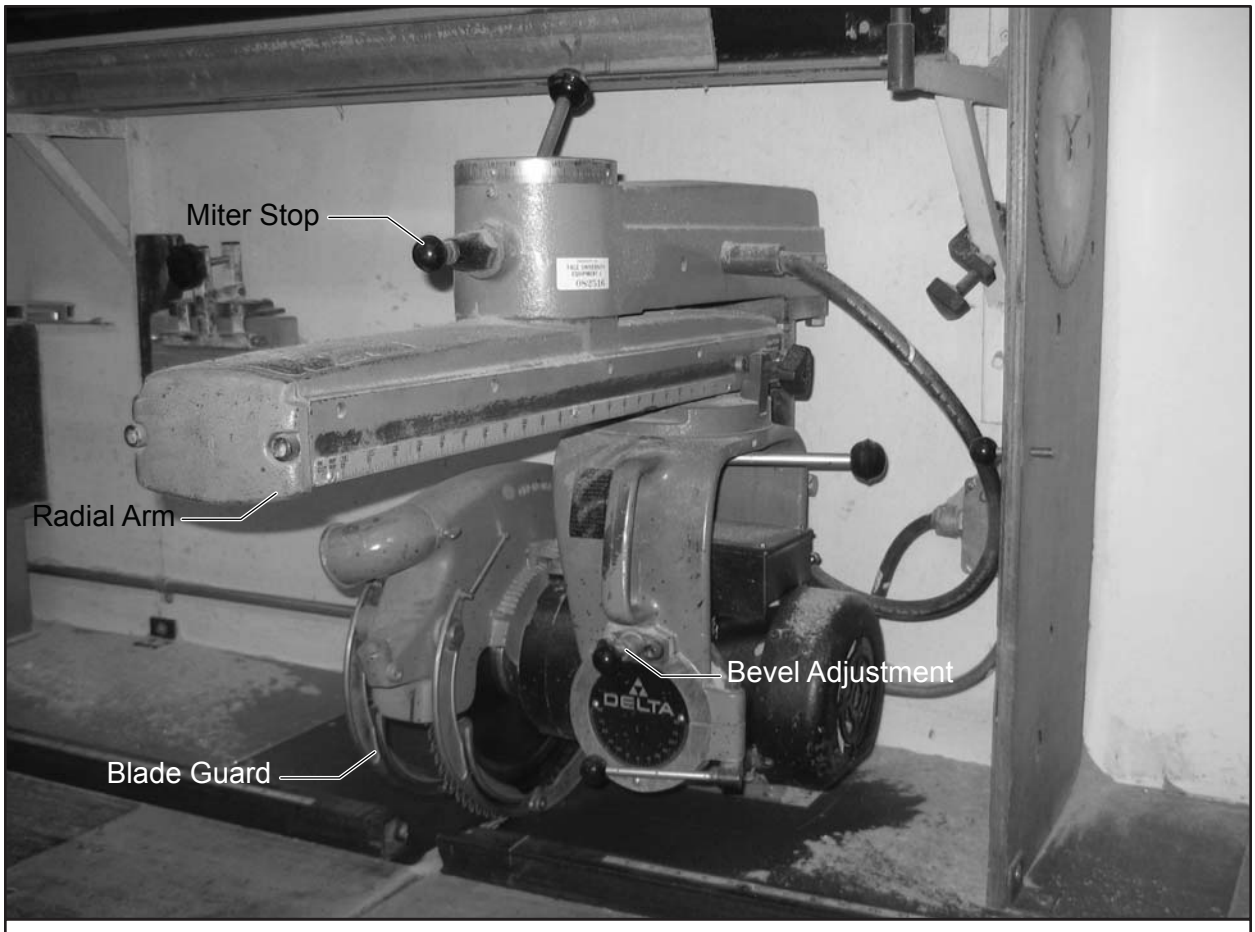
Radial Arm Saw

The radial arm saw is a versatile tool, but its primary use is cross-cutting. The arm can be rotated to allow miters to be cut. The motor can be tilted on its arbor for bevels. The height of the blade above the table can be adjusted, allowing for non-through cutting, like making half-lap joints. The blade arbor can be rotated 90° and locked in place for making rip cuts. The blade arbor should have a spring or counterweight return system, so that the blade is pulled away from the operator if the operator lets go of the tool. (Jackson 164)

A good radial arm saw will be sturdy and rugged, and all moving parts should move smoothly and easily. Adjustment points should have adjustable positive stops, so they can be calibrated periodically.

A typical scene shop may have a 12” or 14” arm saw with 18” to 24” of crosscut capacity. An ideal arm saw workstation would have 16’ of clear bench space on both sides of the blade, to accomodate a full stick of lumber on either side and allow for ripping lumber, but a space with 16’ clear on one side and 8’ clear on the other side will allow stick lumber to be crosscut at any point along its length.

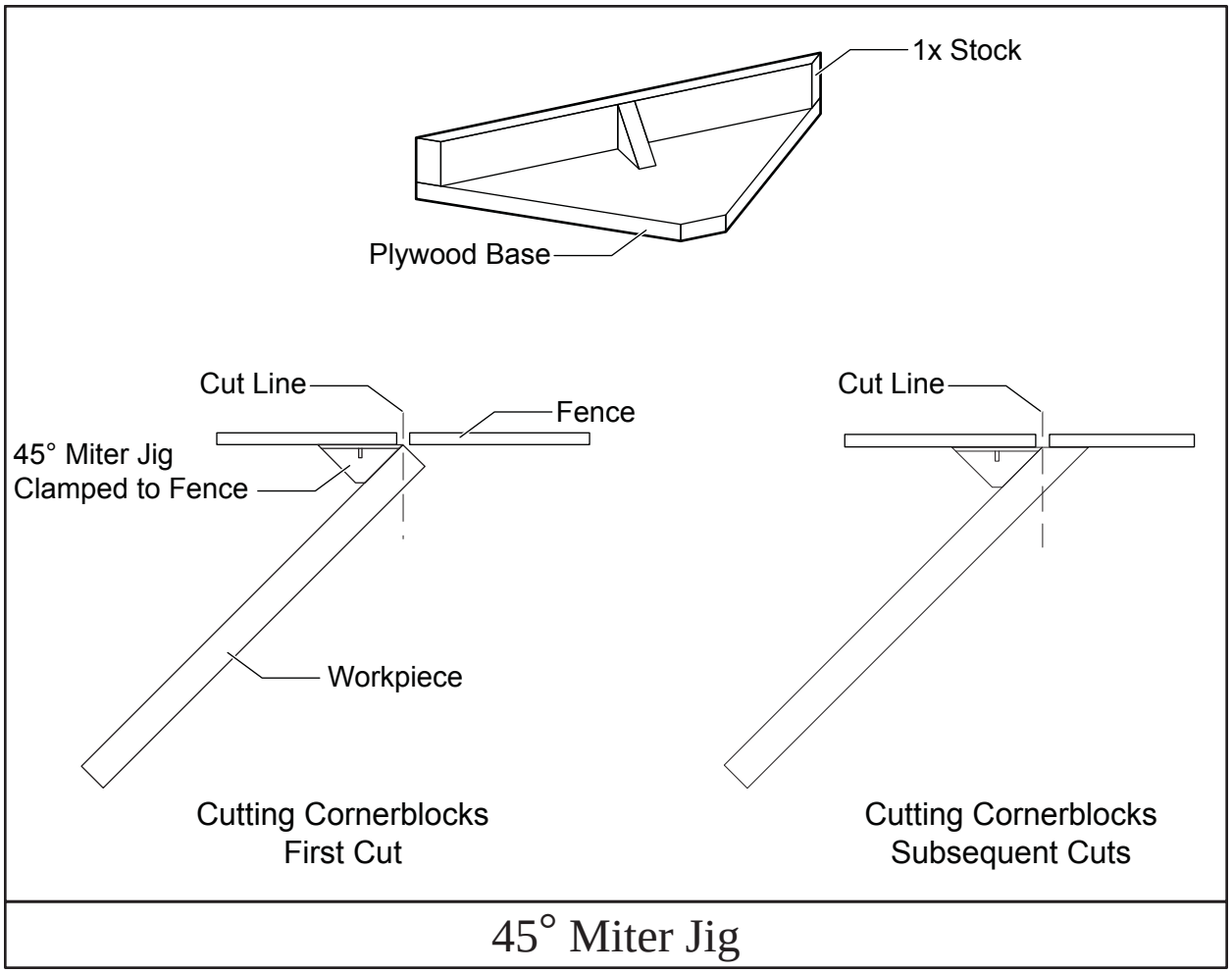
No other tool in the scene shop can match the speed of the radial arm saw for cross-cutting. Here are some jigs that help get the most out of this production machine.



Radial Arm Saw

45° Miter Jig

This jig is handy for cutting quantities of cornerblocks on the radial arm saw without setting the miter on the saw. The jig clamps to the radial arm saw's fence. The workpiece can be flipped to cut miters in different directions, or the jig can be moved to the opposite side of the blade. (Reinhart, 2009)

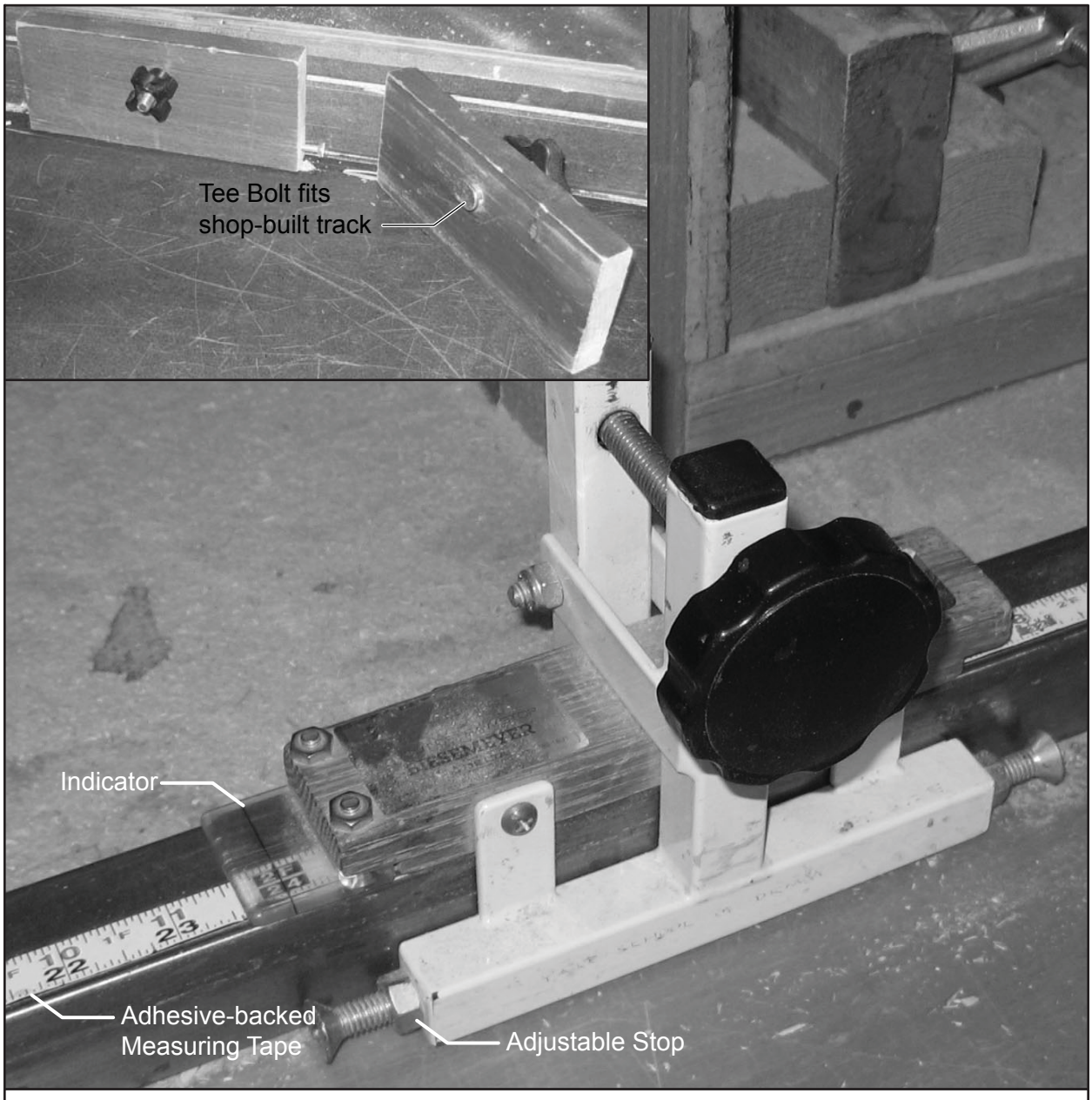


45° Miter Jig

Stop Block

A stop block is any block that is screwed, clamped, wedged, or otherwise fixed in place to assist in consistently placing a work piece in the correct position. These can be made out of scrap wood, but more sophisticated options are available that are adjustable, reusable and self-affixing. Dust accumulation around the stop block can prevent the workpiece from registering to the block correctly. Stop blocks should have an undercut, or other means to prevent dust build-up. When making large part runs, check every 5th or 10th piece to make sure the stop block has not shifted during operation.

The picture below shows a commercially available stop block by Biesemeyer. It clamps to the radial arm saw fence and can be used to repeatedly position workpieces for crosscuts, lap joints, etc. It features transparent plastic indicators that can be aligned with a measuring tape on the fence. The bearing surfaces are adjustable, so you can achieve very precise positioning.



Stop Blocks

BAND SAW

Band Saw

The band saw is a powerful and versatile tool. Band saws are available in both benchtop and stationary models. While it is capable of making rip- or cross-cuts, it is most often used for its ability to cut curves and sweeps. The saw table on most band saws will tilt for cutting miters and bevels.

Band saw blades are described by their length, width, teeth per inch, and the set of the teeth. Thinner blades allow tighter radii to be cut; thicker blades cut straight lines better.

The maximum size of cut is limited by the clear distance above the saw table and the clear distance between the blade and the vertical framing of the saw. The maximum cutting depth of a band saw is usually higher than on an arm saw or power miter saw, so the band saw is often used to cut miters in large crown moulding.

Choose the saw with the largest capacity that will fit in the shop and that the shop can afford.

Next are several jigs that add repeatable accuracy to this curve-cutting machine.

Band Saw

Band Saw Template Jig

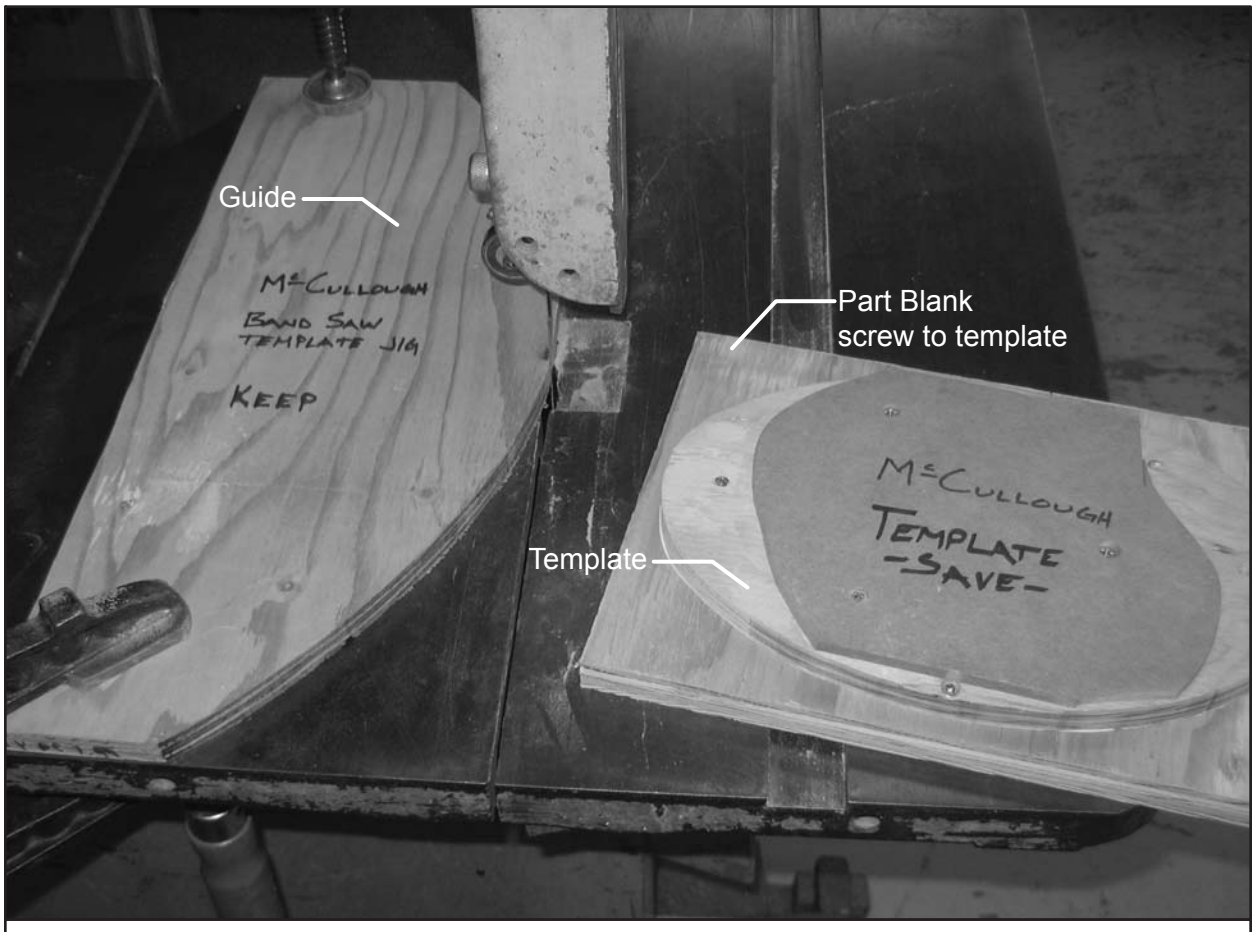
This jig is used to duplicate curved shapes on the band saw. As seen below, the jig consists of two parts: a **guide** which clamps to the saw table and the actual **template** to be duplicated. The guide is notched so the edge of the blade is flush to the outside of the guide. A part blank is affixed to the template. The template and blank are fed throught the blade against the guide to cut a part that matches the template exactly. (DeCristoforo 67)

The size and shape of the guide may need to be adjusted to cut concave shapes. Because the blade notch in the guide needs to fit very close to the blade, a different guide will need to be made for each width of blade you wish to use.

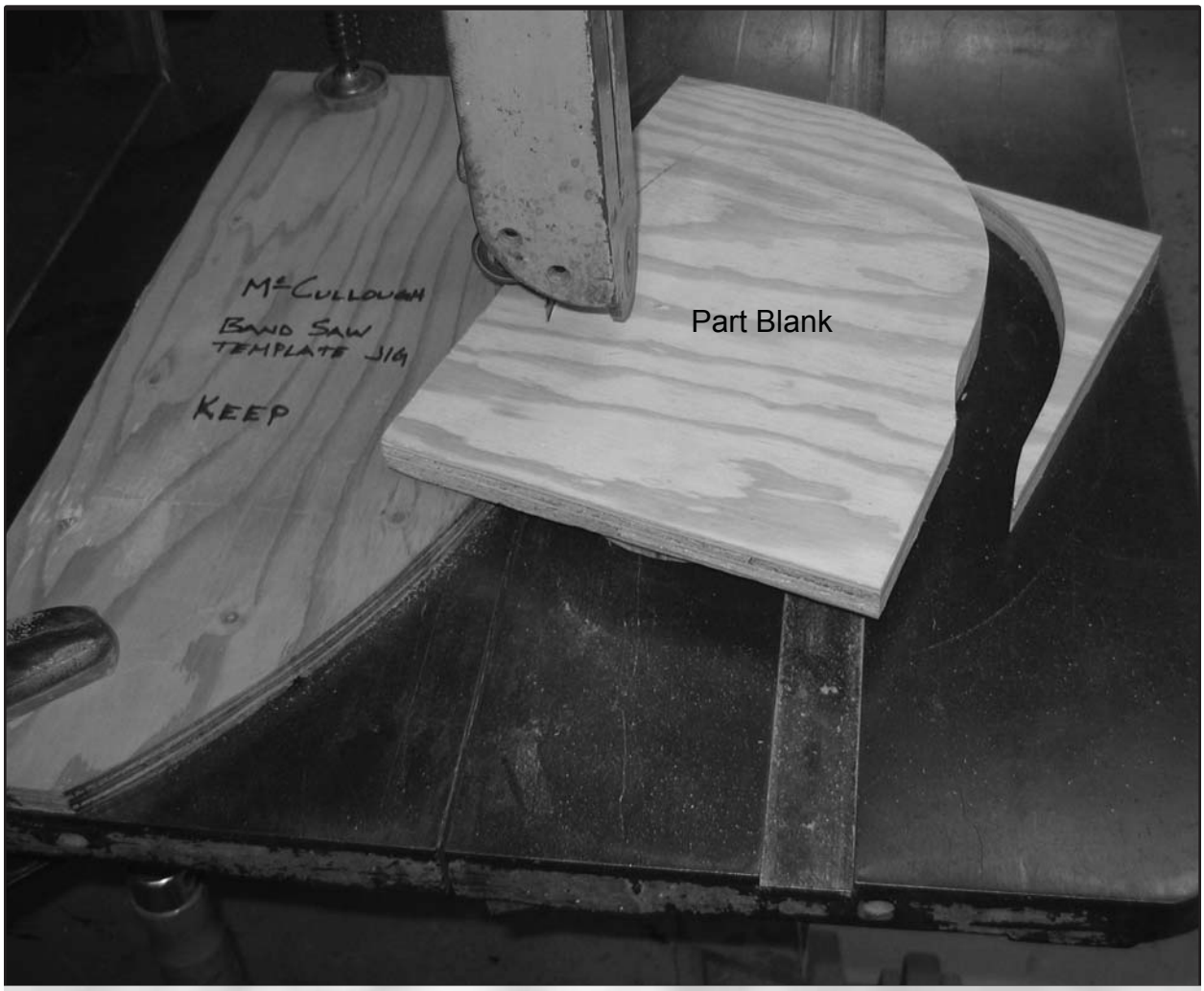
The guide must be thinner than the template, to allow for clearance between the part blank and the guide. See next page.

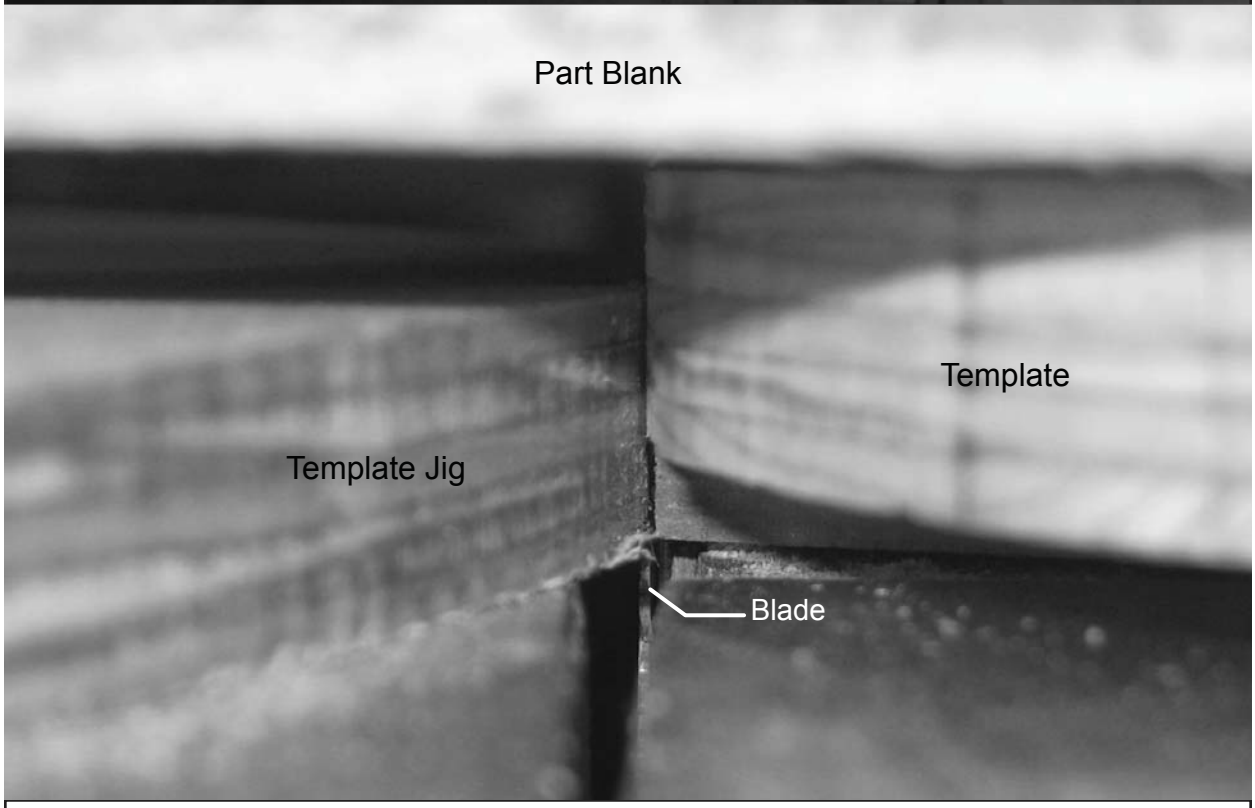
Using the Band Saw Template Jig

By keeping steady pressure with the template against the guide, the part blank is cut flush to the template. It is not necessary to make the cut in one pass. Good results can be had by making rough cuts to remove waste material, and only bringing the part into its final shape and dimension on a final pass. It takes practice to effectively use this jig, so try it out on a few practice blanks before cutting into your project material.



Band Saw Template Jig Setup





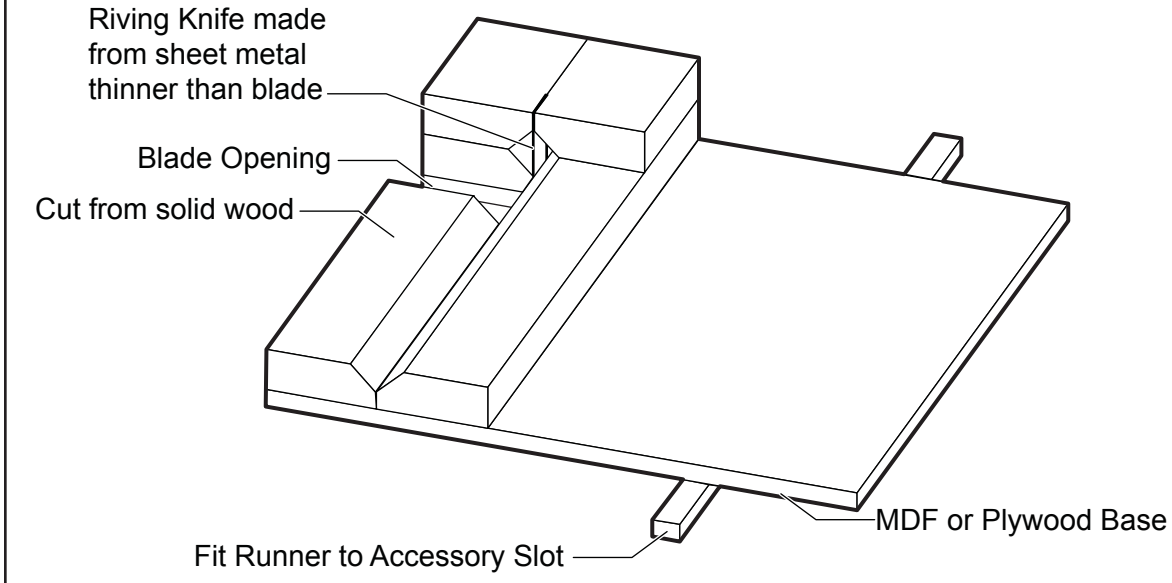
Band Saw Template Jig in Use

V-Block Splitter

This jig can be used for splitting dowels or ethafoam rod. The V-Block keeps the dowel feeding straight into the blade, and the splitter keeps the rod from rolling and twisting while you cut, allowing for clean, shop-built half-round moulding. This jig is positioned by a runner in the accessory slot, but the jig should be clamped to the table during use. (DeCristoforo 66)

Variations

If the jig is aligned so the blade is not at the center of the V-Block and the riving knife is removed, it is possible to use this jig to cut the corners off of square stock to make octagonal sections. (Pierce 56)



V-Block Splitter

V-Block Cross-cut Sled

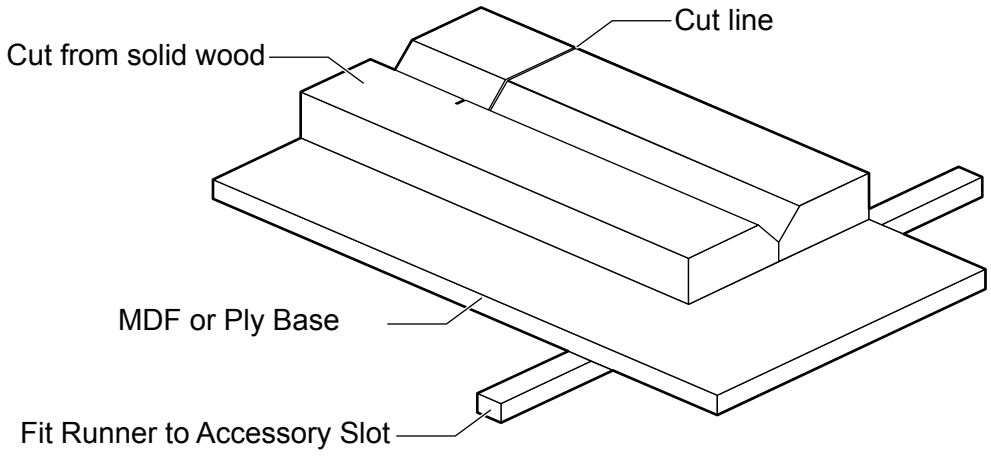
This jig can be used for cutting stock with a round section to length on the band saw. Screwing or clamping a stop block to the jig would allow identical parts to be manufactured. This jig is positioned by a runner in the accessory slot, and moves with the piece during operation. (DeCristoforo 66)

Cutting dowels to length this way is safer and results in cleaner cuts than using the power miter saw or radial arm saw, which have a tendency to leave a lot of tearout, and can shoot loose dowel segments across the shop, especially when cutting small parts.

Variations

The jig can be aligned so the V-Block is not perpendicular to the blade. This would allow for easy, repeatable miters to be cut in round stock.

If you cut only part of the way through a dowel and then spin the dowel in place, you can use the band saw to turn down the diameter of a section of the dowel.



V-Block Cross-cut Sled

Band Saw Circle Jig

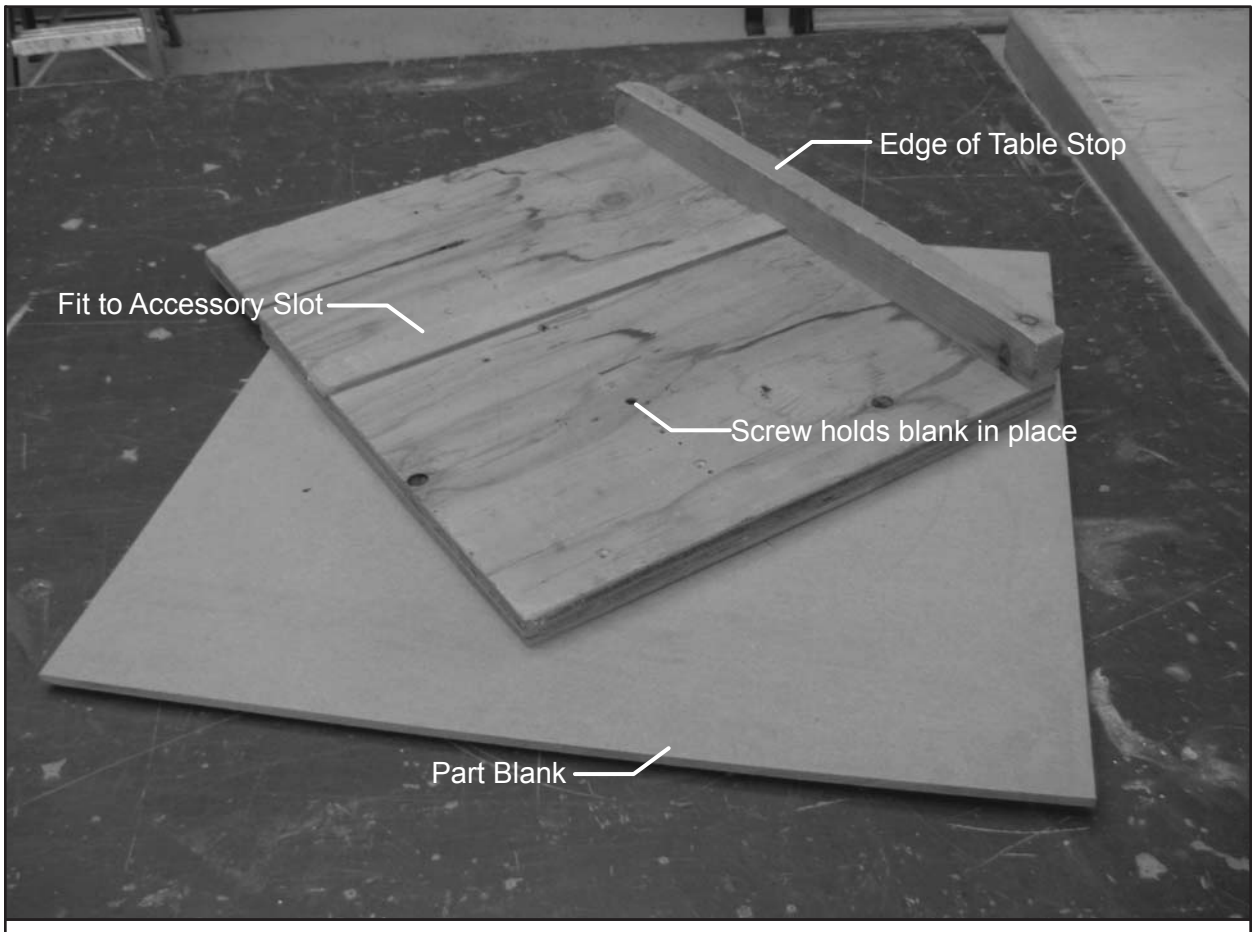
The band saw is tool of choice for cutting curves in the shop. This jig expands the repertoire to include cutting true circles. The part blank is screwed to the jig from underneath. The distance from the blade to the screw sets the radius of the finished circle. (Proulx 94)

This jig does leave a mark at the center of the finished piece. The blank should be placed with the finish side up, so the mark does not appear on the finished surface.

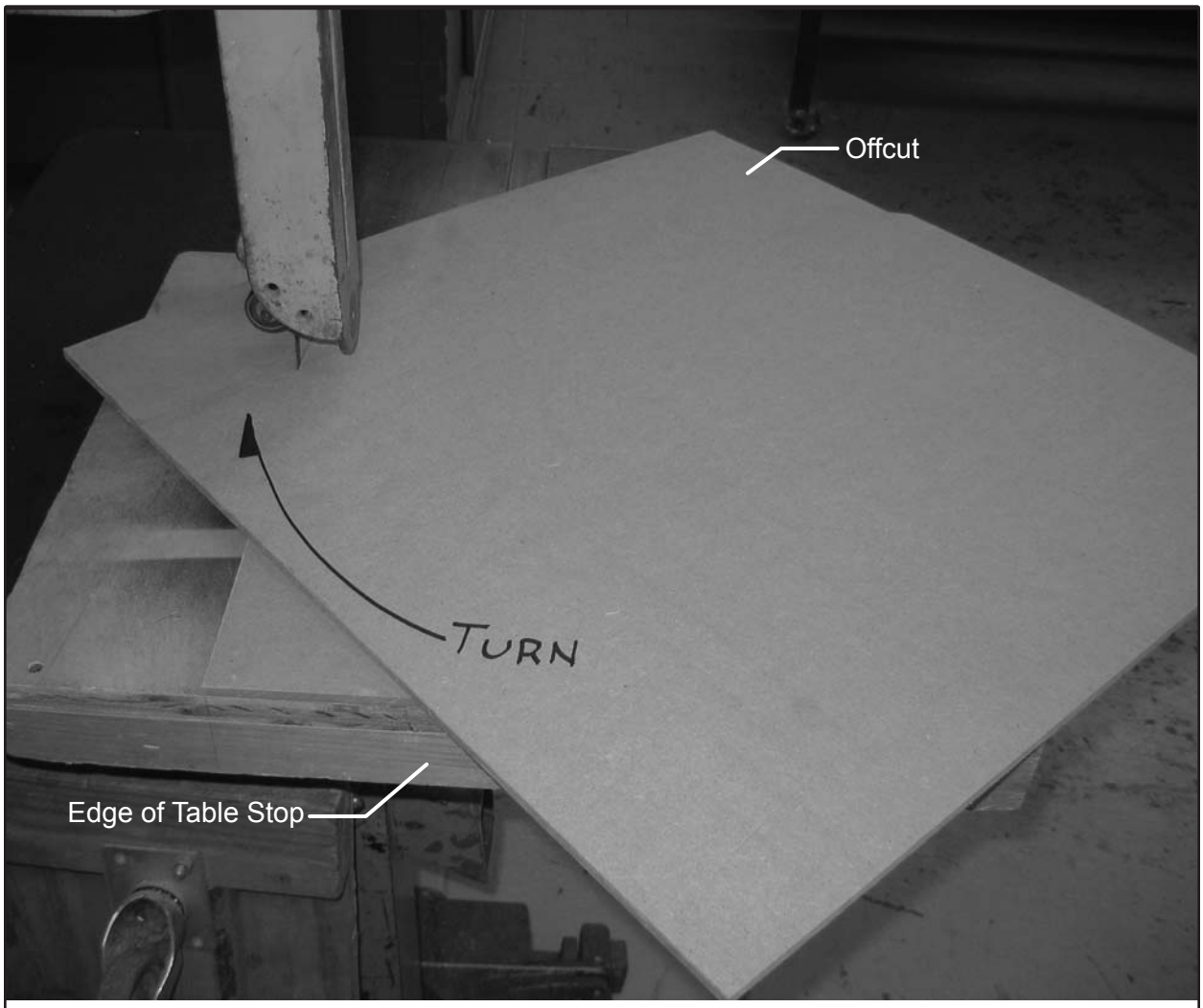
Using the Band Saw Circle Jig

To cut a circle using this jig, screw the center of the part blank to the jig. Start the saw and feed the jig and blank into the blade without turning the blank. When the jig is fully engaged with the table (the edge of table stop has hit the table edge), start rotating the blank clockwise (see next page). Continue rotating the blank until the circle is completely cut out. Turn off the saw and remove the waste material.

If the blank is larger than the jig, take care that none of the waste gets caught on the jig as you are making the cut.



Band Saw Circle Jig Setup - Upside Down



Cutting a circle on a shop-built circle jig

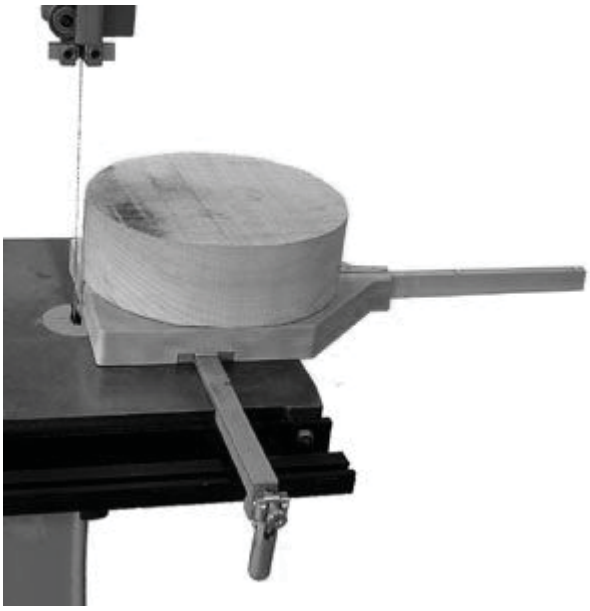


photo: www.highlandwoodworking.com

Commercial Circle Jig

Band Saw Circle Jigs in Use

ROUTERS AND ROUTER TABLES

Routers and Router Tables

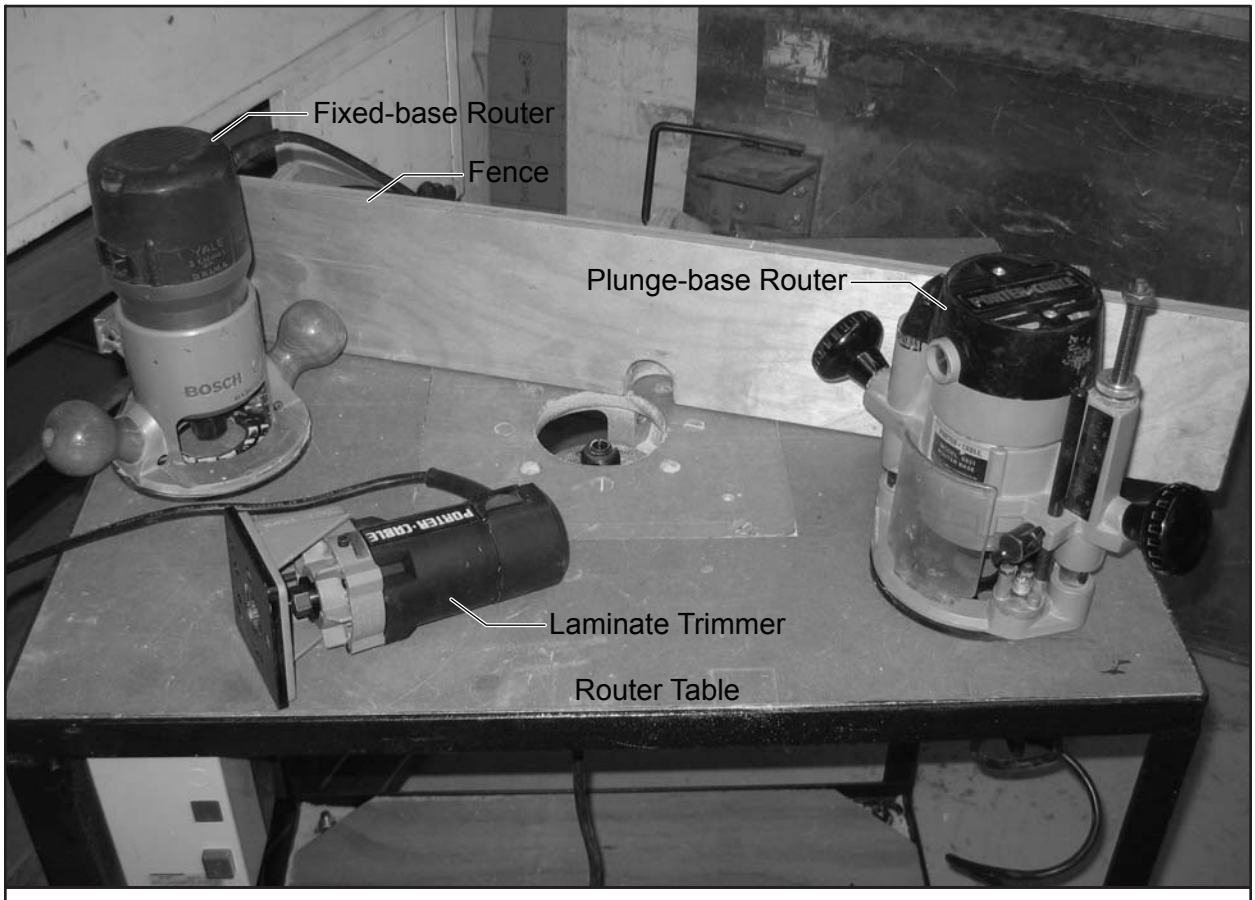
The router is a general purpose shaping, rabbeting and grooving tool consisting of a motor, a base and handles. They come in fixed- and plunge-base models. Fixed-base routers allow you to adjust the depth of cut, but the bit and router are fed into the work at the same time. The base of a plunge router is mounted on spring-loaded columns; the base can be set on the workpiece, then downward pressure introduces the bit to the workpiece.

Laminate trimmers are specialty routers from the kitchen countertop industry. Their small size allows them to be easily operated with one hand, and they can get into corners that a larger router can't reach. A router table is a table with a router motor mounted underneath.

The versatility of the router is due to the wide variety of bits available. Bits are available in high speed steel and carbide-tipped varieties. Carbide bits stay sharp longer, but are more expensive than steel bits. Bits usually have a shank size of 1/4" or 1/2". Most routers have interchangeable collets, so the same router can take bits of different shank sizes. Always feed work into a router against the direction of rotation of the bit. (Jackson 140)

A typical scene shop may have a laminate trimmer, a 1hp motor with both fixed and plunge bases, and perhaps a 3hp router for making heavy cuts, like routing deck tracks. A router table that one of the stock motors can attach to expands the versatility of the tool.

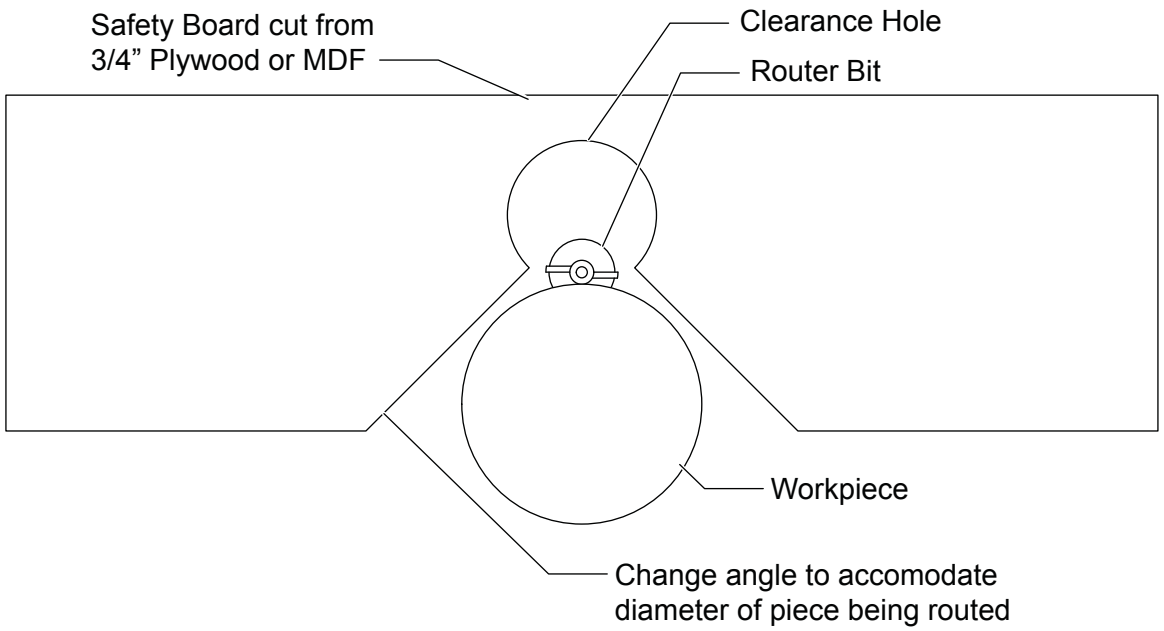
Here are some jigs that improve the safety and versatility of this already versatile tool.



Routers

Circle Edging Safety Board

Routing a detail in the edge of a circular part on the router table usually requires an exposed bit, and does not lend itself well to using a fence or guide. Using this guarding method, the part will have enough clearance to move freely by the bit, but if you lose control of the part, the guard will prevent it from sliding all the way past the bit, keeping your hands safely away from the point of operation. From a piece of 3/4” Plywood or MDF, cut a clearance hole for the router bit. Cut an angled access hole for the workpiece. The safety board clamps to the router table during use. The depth and angle of the cuts will depend on the size of the workpiece. (Proulx 15)



Circle Edging Safety Board

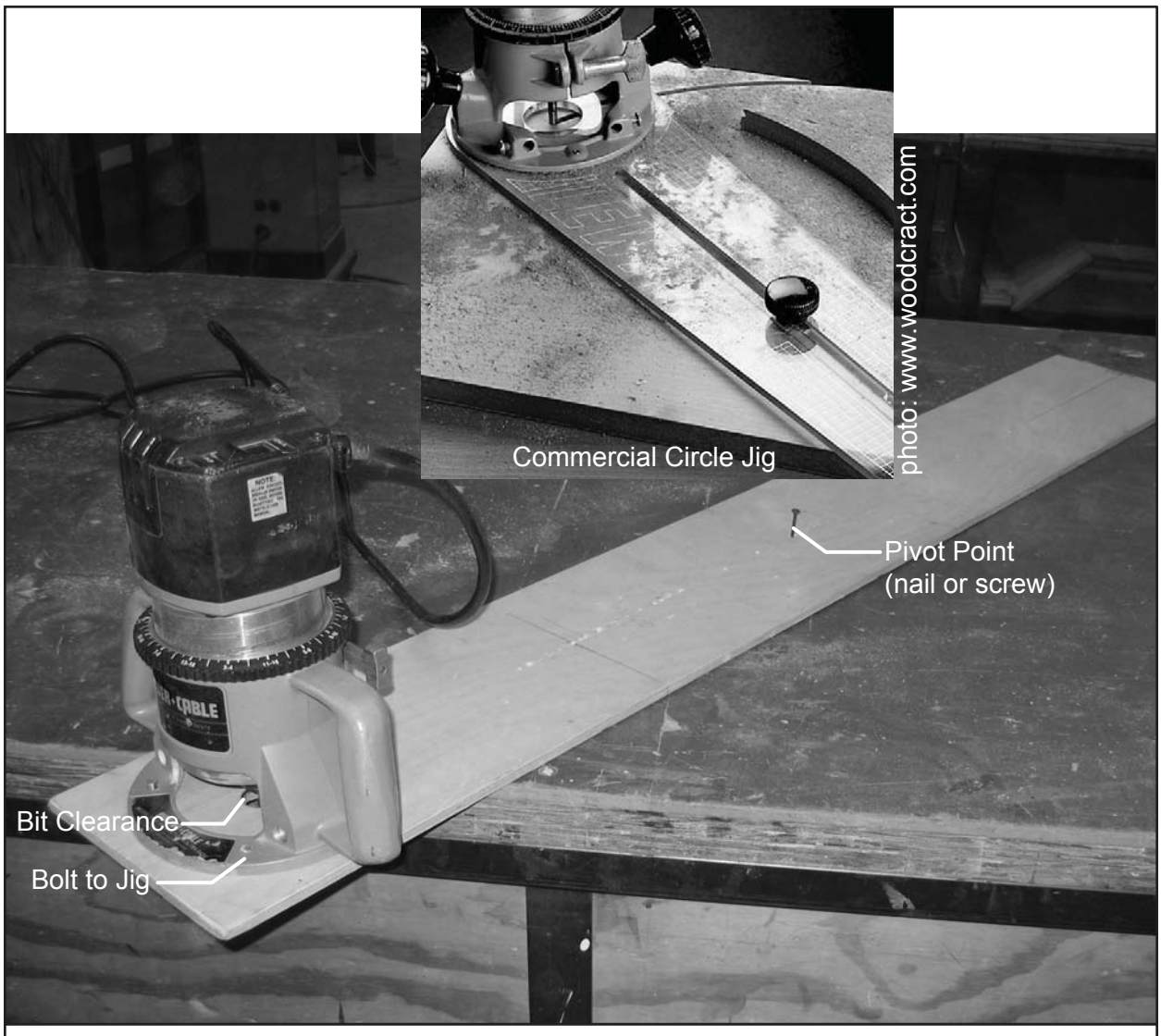
Circle Jig

This jig is used to cut circles and arcs with the router. The baseplate of the router is replaced with a length of plywood. The board bolts to the router using the same bolts that hold on the baseplate. Make sure to countersink the bolt holes on the jig so the bolt-heads do not snag on the workpiece. By placing a screw or nail at the appropriate distance from the edge of the bit, circles and arcs can be cut. (Yale Shop 2006)

This jig is simple enough to make that it can be discarded and replaced if if becomes too full of holes from repeated use. Because the bolt pattern on routers are not all the same, a separate jig is required for each model of router. Label the jigs clearly as to which router they are for.

Variations

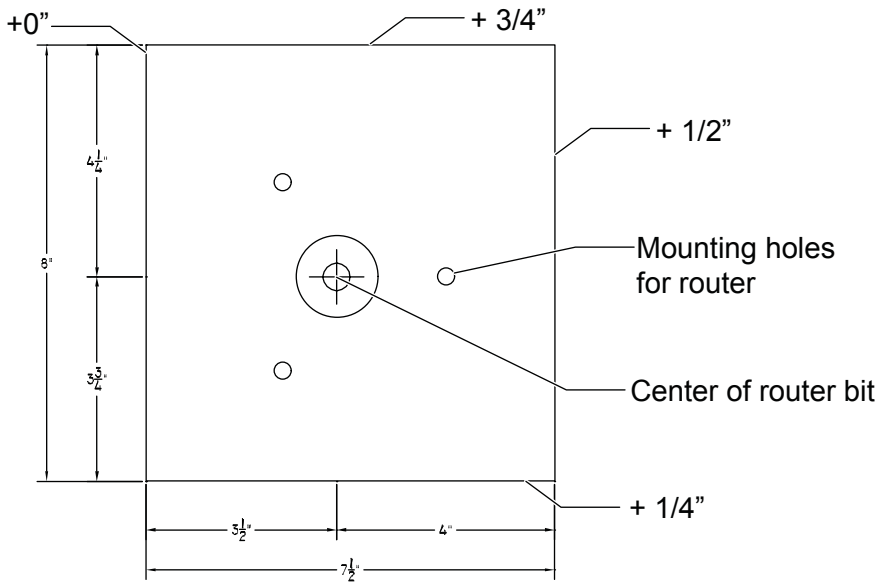
This type of jig also works with another popular curve-cutting tool: the jig saw. Using the same pivoting arm idea, bolt the jigsaw to the arm in place of the router (not shown). The jig saw will not make a plunge cut, so there needs to be another way to introduce the blade to the cutline. When building the jig, make sure that the blade is perpendicular to the radius you wish to cut.



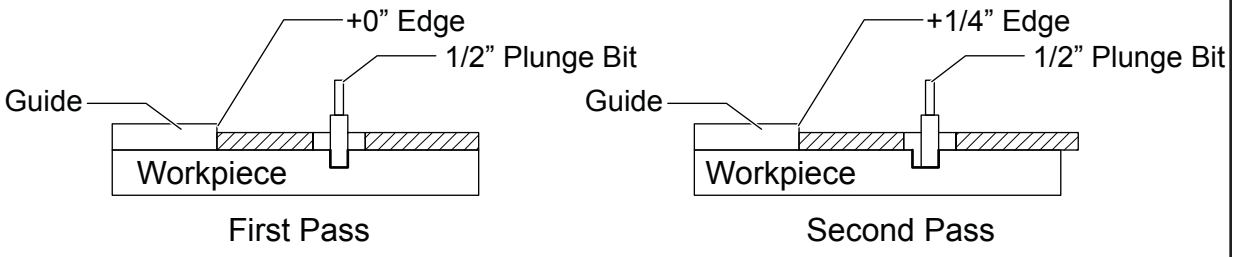
Circle Jig - Router

Fractionating Baseplate

The fractinating baseplate is a replacement baseplate for a router. The router is mounted so that the center of the bit is not on the center of the plate. With the bit off-center, each edge of the baseplate is a different distance from the bit. This can simplify the setup for routing dados that require multiple passes. For example, to route a 3/4” wide dado using a 1/2” diameter bit, first set a fence for the first pass. Run the first pass with the +0” side against the fence. For the second pass, run the router with the +1/4” side against the fence. This will create a clean, parallel-sided dado in two passes without moving the fence. Be sure to label the sides of the baseplate clearly. (Hylton 81)



Cut from MDF or Polycarbonate
Dimensions are given to center of router bit



Fractionating Baseplate in Use
Router not shown for Clarity
Hatched Region is Fractionating Baseplate

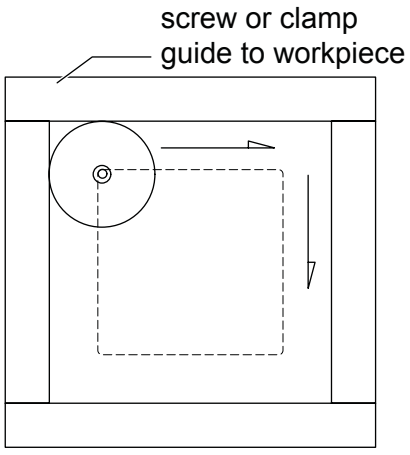
Fractionating Baseplate

Routing Guide

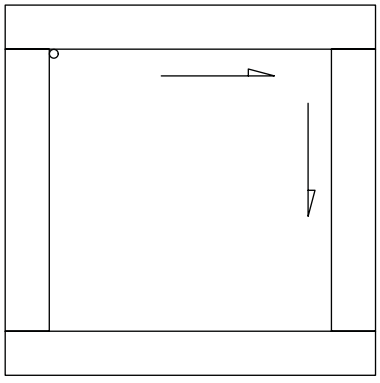
This simple jig is used to guide a router when cutting internal features on a workpiece, like mortises, dadoes or clean-outs. The jig is made of wooden battens screwed or clamped to the workpiece. For a re-usable frame, the battens can be joined at the corners, or a guide could be cut out of a piece of plywood or MDF. Corrugated fasteners, pocket screws, biscuits, half-laps or mortise and tenon joints could all work, depending on the required lifespan of the jig. For repeatability, build the frame so that an edge or corner of the frame can be aligned to an edge or corner of the workpiece. (Citation)

This jig can be made in any shape the design requires; the only limit is the diameter of the router bit. Smaller bits leave a smaller radius in the corners, and can fit in tight spots to route small features. Larger bits are usually more rugged and can take heavier cuts without breaking.

If making a jig to guide the router by its baseplate, mark clearly on the jig which router and bit it is designed to work with. If making a jig to guide a flush-trim bit, mark what diameter bit the jig is designed for.



Routing Guide
sized to guide the router's baseplate



Routing Guide
sized to guide a flush-trim bit

Routing Guides

CIRCULAR SAW

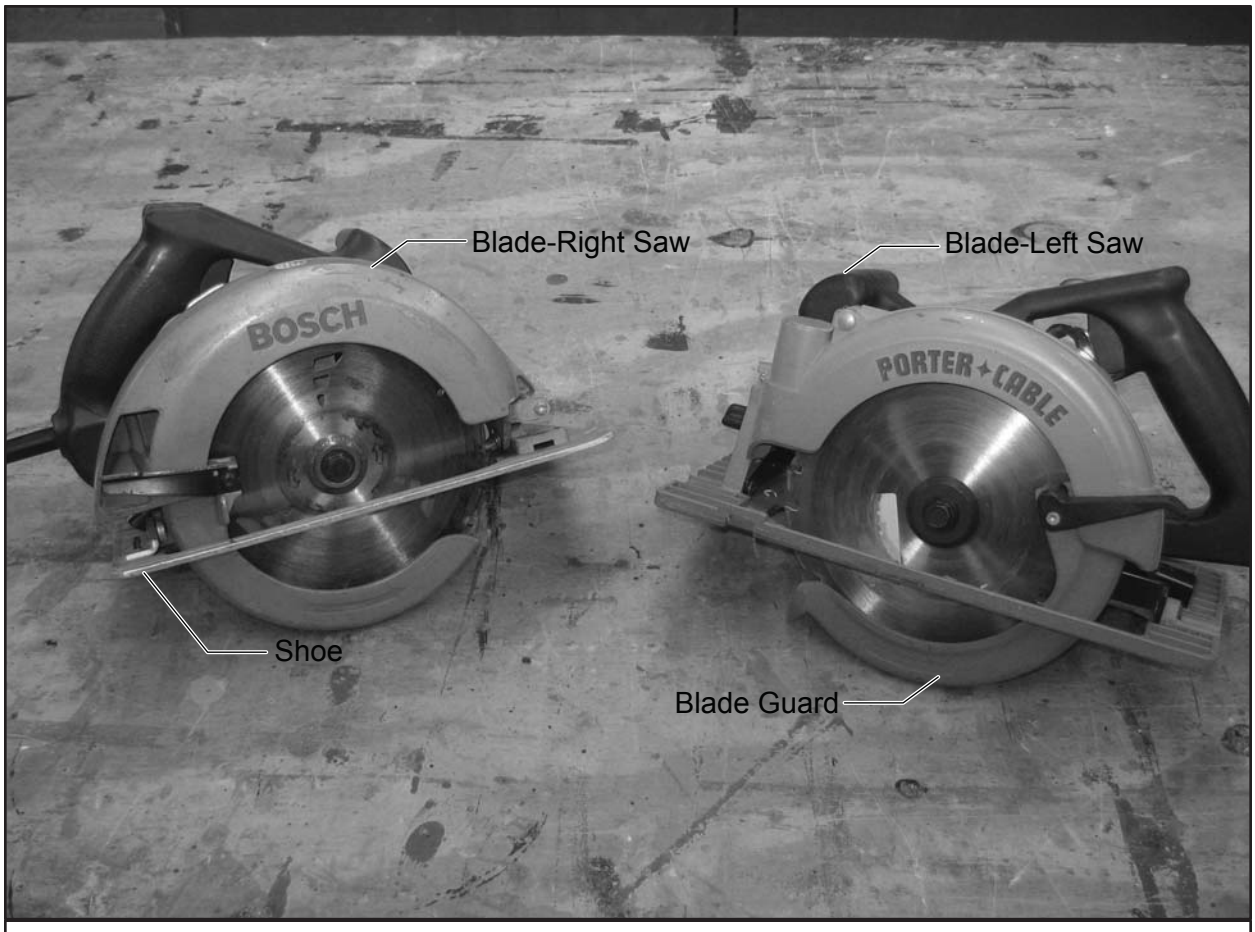
Circular Saw

The ubiqutous circular saw comes in many shapes and sizes. The motor can be either direct drive (as shown below) or worm-drive. Worm-drive saws tend to be heavier, but produce more torque. The blade can either be on the right or left of the motor, and come in different diameters, 7 1/4” being the most common. The maximum depth of cut is limited by the diameter of the blade. The shoe of circular saws can be adjusted to change the depth of cut, and tilted to cut bevels, usually of up to 45°.

The circular saw combines power and portability, whether in the shop or in the theatre. Recent advances in battery technology have made cordless models possible that are comparable to corded models in power and cutting capacity. (Jackson 132)

A typical scene shop probably has two or three corded circular saws. Stocking blades is simplified if all the saws take the same diameter blade. Having both blade-left and blade-right saws broadens the range of places you can fit a saw.

The circular saw rip fence presented next makes using this portable tool for straight and accurate cuts a snap.



Circular Saws

Rip Fence

This is a must for a wood shop, especially if there is no access to a panel saw. This jig is useful for cutting panel goods to length, or at angles. Because the distance from the edge of the shoe to the blade varies from model to model of circular saw, each model will necessitate its own rip fence. Likewise, each bevel angle will require a separate fence. A single 8' long fence will make almost any cut needed. An additional 5' long fence can make crosscuts and some angled cuts, and is easier to move around the shop. (Tolpin 127) The edge of the jig will wear with use, so replace it periodically.

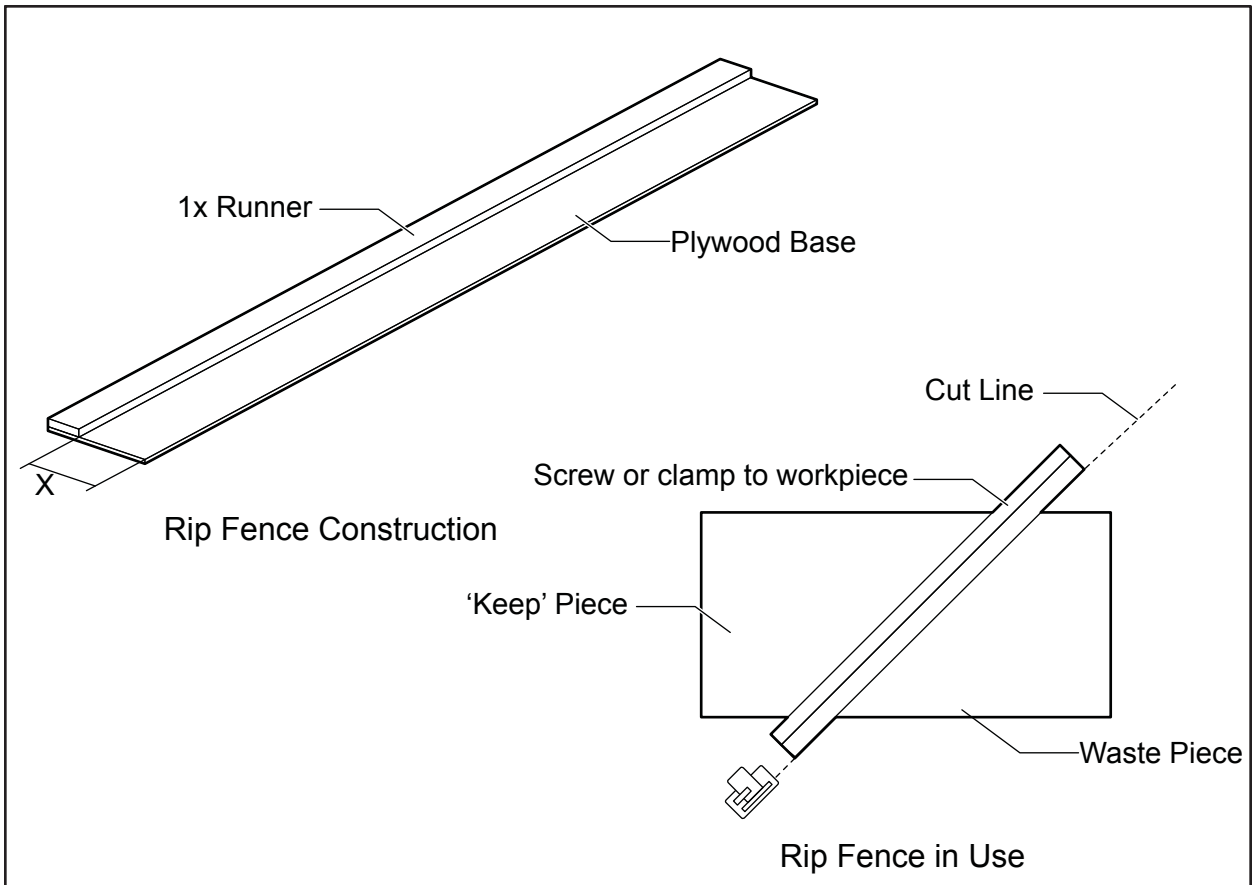
In use, the fence is either clamped or screwed to the 'keep' side of the piece along the line to be cut. If clamping the fence to the workpiece, make sure to check that the clamps do not interfere with the movement of the saw. The cut is made by running the shoe of the saw against the 1x stock, with the blade on the cut line. Take care that the blade does not stick out too far below the workpiece.

To make a Circular Saw Rip Fence

►*Glue a piece of 1x, or other stock, to a strip of 1/4" or 3/8" plywood (the base). The X dimension must be greater than the distance from the edge of the circular saw shoe to the blade.*

►*To cut the base to width, make a cut with the circular saw on the base, with the edge of the shoe riding against the 1x.*

►*Label each rip fence with the model of circular saw it is for.*



Circular Saw Rip Fence

BELT-DISC SANDER

Belt-disc Sander

The belt-disc sander is a stationary sanding station that includes both a sanding disc and a belt sander. The work rest of the disc sander can be tilted for accurately sanding mitered or beveled parts, and it has an accessory slot that can accept a miter guage. The belt sander can be tilted to allow sanding vertically or horizontally. The cover on the end of the belt sander can be removed so that concave shapes may be sanded against the idler wheel.

All sanding surfaces are specified by their grit. A higher grit number means a finer surface, and a lower number means a rougher surface. 60- or 80-grit paper is good for rough sanding work. 150- or 200-grit paper is fine enough for finish sanding on most scenery. For pieces that will be stained or polished, consider using 250- or 300-grit paper for the final sanding pass.

Sanding belts are specified by width and length. Sanding discs are specified by their diameter and can attach to the drive disc with adhesives or hook-and-loop fasteners.

If you will be sanding both metal and wood, it is a good idea to maintain separate sanding stations for each material; if metal is sanded on a machine normally used for wood, the hot metal dust could start a fire in the wood dust collected in the machine.

Next are two jigs that help move the belt-disc sander from the category of finishing tool to production tool.

Belt-Disc Sander

Dowel Pointing Guide

This permutation of the V-Block jig will hold a round object at a fixed angle to the disc of a belt/disc sander. (Nagyszalanczy 89) This makes for easy tapering of dowels and pins for doweled joints or for making cane bolts.

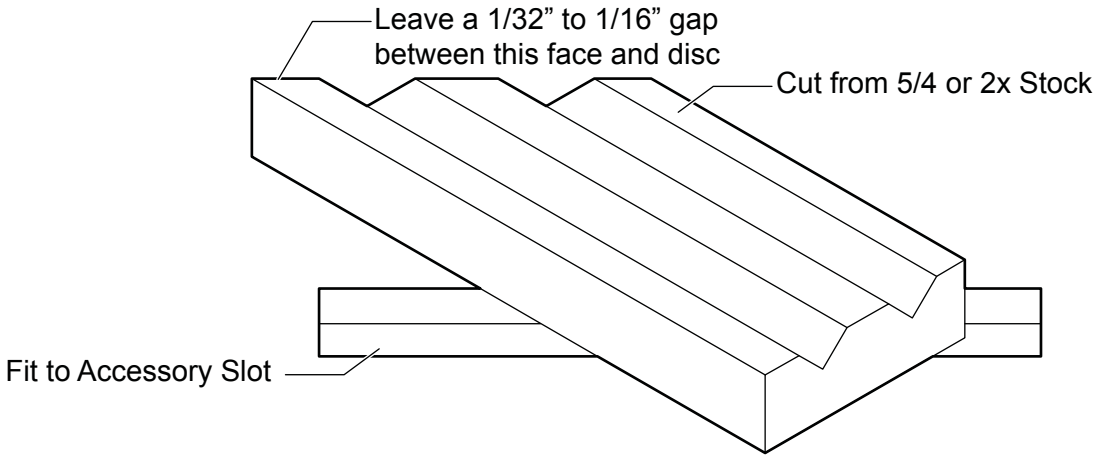
To make a Dowel Pointing Guide

►*Cut a v-groove in a piece of stock either with a v-groove router bit or on the table saw.*

►*Cut the desired angle in one end of the stock.*

►*The face of the guide should be spaced away from the sanding disc by 1/32”-1/16”.*

►*Attach a piece of stock cut to fit the accessory slot of your sander to the bottom of the guide to ensure repeatability of placement of the jig.*



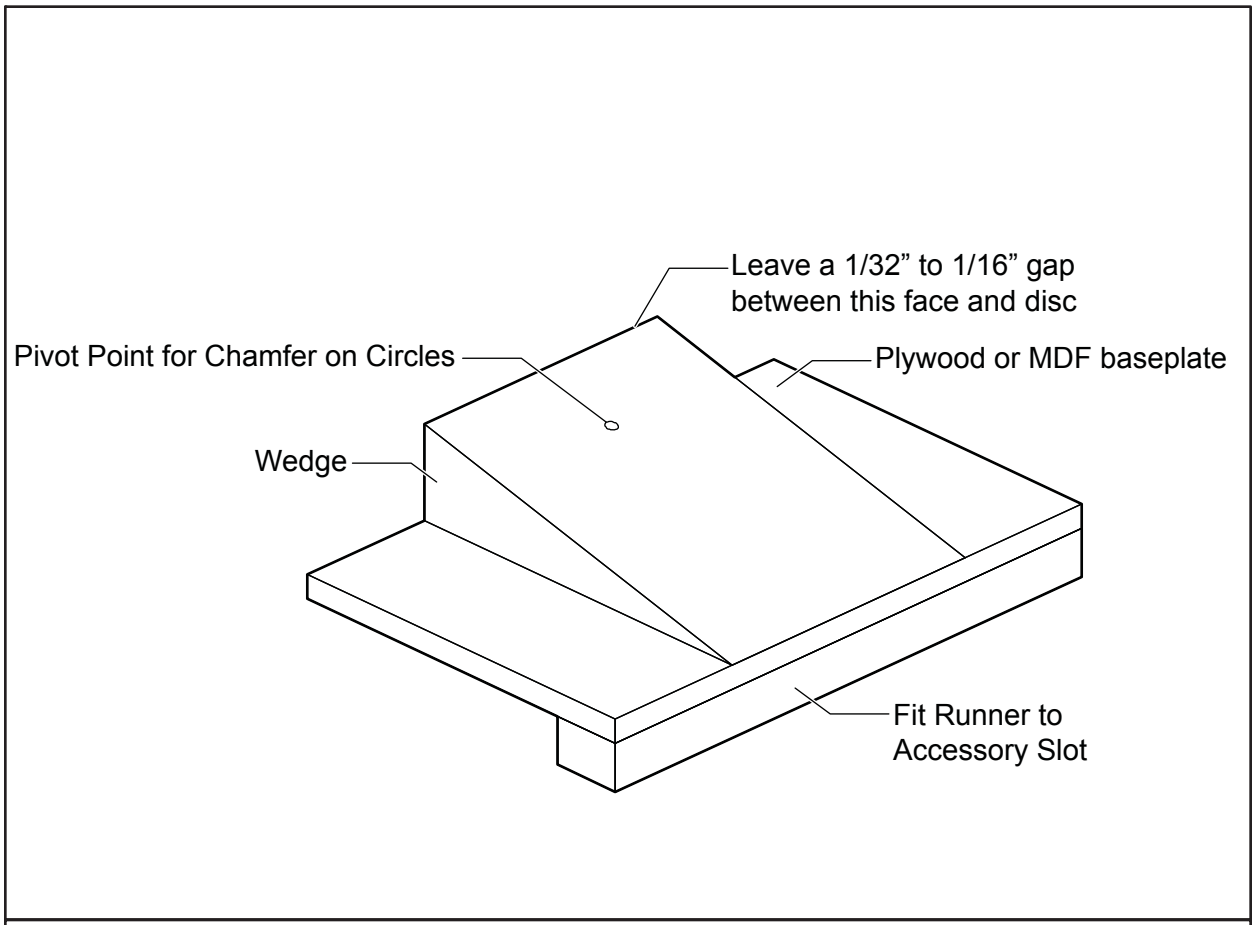
Dowel Pointint Guide

Chamfer Sanding Guide

This jig clamps to the table of a disc sander and allows you to sand repeatable chamfers without adjusting the table of your sander. By adding a finish nail or screw as a pivot point, circles can be chamfered evenly on the disc sander. A gap of approximately 1/16" should be left between the face of the guide and the sanding disc. Only use this jig when the rotation of the sanding disc will press the work towards the table. (Gardner, 2009)

To Make a Chamfer Sanding Guide

- ►*Cut a wedge for your desired angle of chamfer*
- ►*Cut a base plate from plywood or MDF*
- ►*Cut a guide from 1x stock to fit in the accessory slot of the sander table*
- ►*Glue the wedge to the base plate*
- ►*Align the guide with the sanding disc, and attach the runner to the bottom of the base plate.*



Chamfer Sanding Guide

JIGS AROUND THE SHOP

Jigs Around the Shop

This section presents a selection of jigs that are either useful with multiple tools or that stand alone to perform their function. They can help with general layout and alignment in many scene shop procedures.

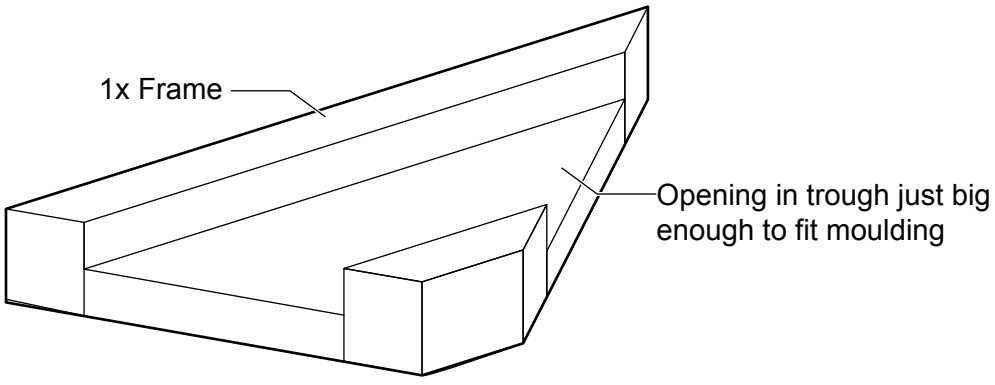
Pocket Miter Box

I first encountered this jig at the Pennsylvania Shakespeare Festival in the summer of 2007. It is a small miter box for use with a light handsaw. For custom fitting a lot of mitered pieces, using this jig at the workbench or on stage can be faster than making trips across the shop to the chop saw. It is small enough to use on a ladder for installing picture rail.

To make a Pocket Miter Box

►Make a wooden trough just bigger than the moulding you want to cut, as shown below

► Cut the desired angle in each end of the box. These can be the same angle, for cutting left or right hand miters, or they can be different angles.



Pocket Miter Box

Jig Blocks

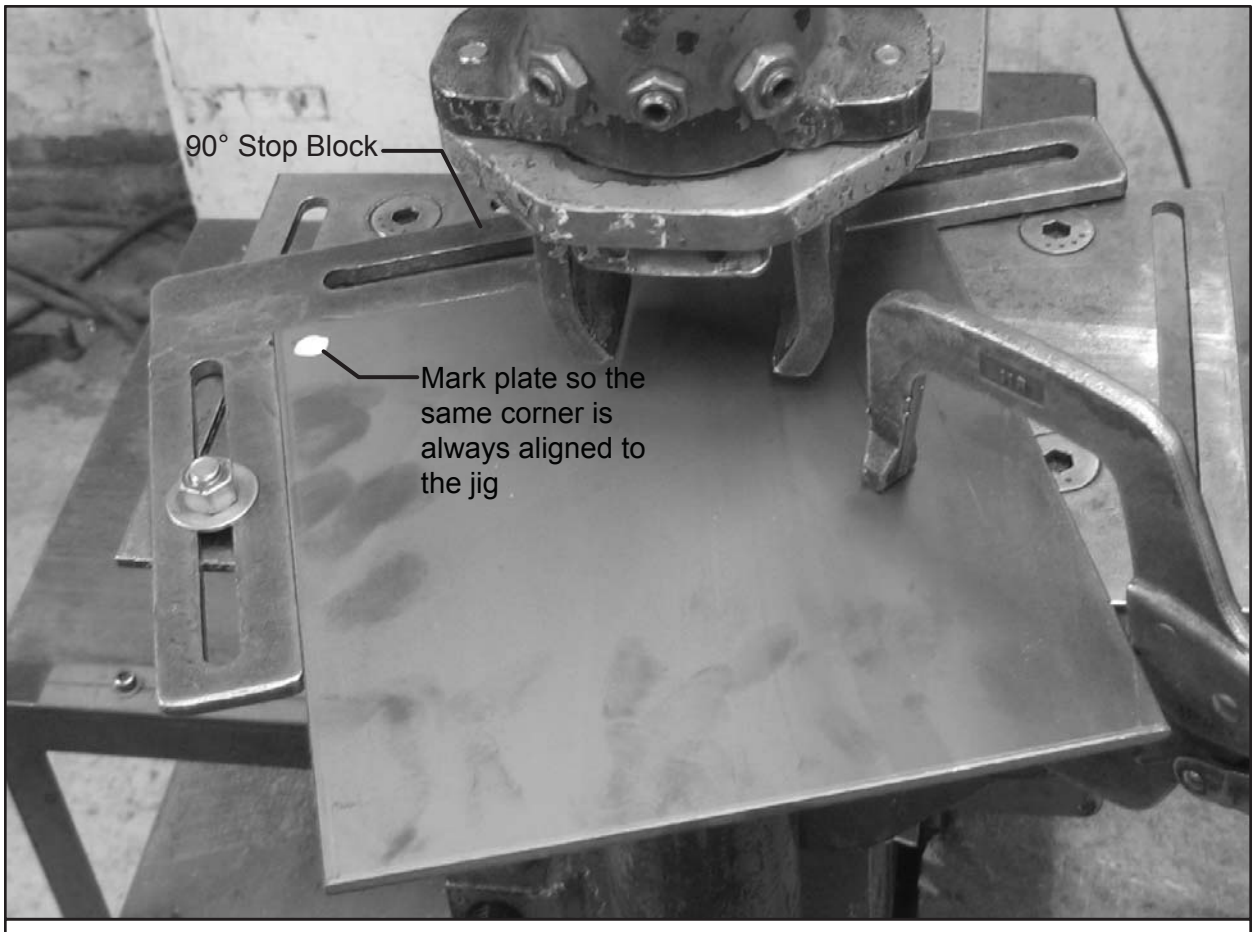
These simple blocks can be used to hold pieces in place during assembly or for aligning multiple identical assemblies. The blocks, which can be periodically cut from scrap lumber, can be stapled or nailed to a wooden worktable. Take care during setup not to knock the blocks out of place when fastening them to the table. When the project is finished, the blocks are knocked loose from the table and discarded. If the blocks are consistently cut to the same dimensions, they can serve as story sticks (page 69) for layout and alignment of parts. (Yale Scene Shop, 2006)

Jig Blocks in Use

90° Stop Block

The 90° Stop Block is useful on any tool in the shop with a bed but no fence. By aligning the workpiece in two directions, it assists in precise positioning for a variety of applications. It is shown below on a hydraulic press, but is also helpful for projects on the drill press. (Yale Shop 2006)

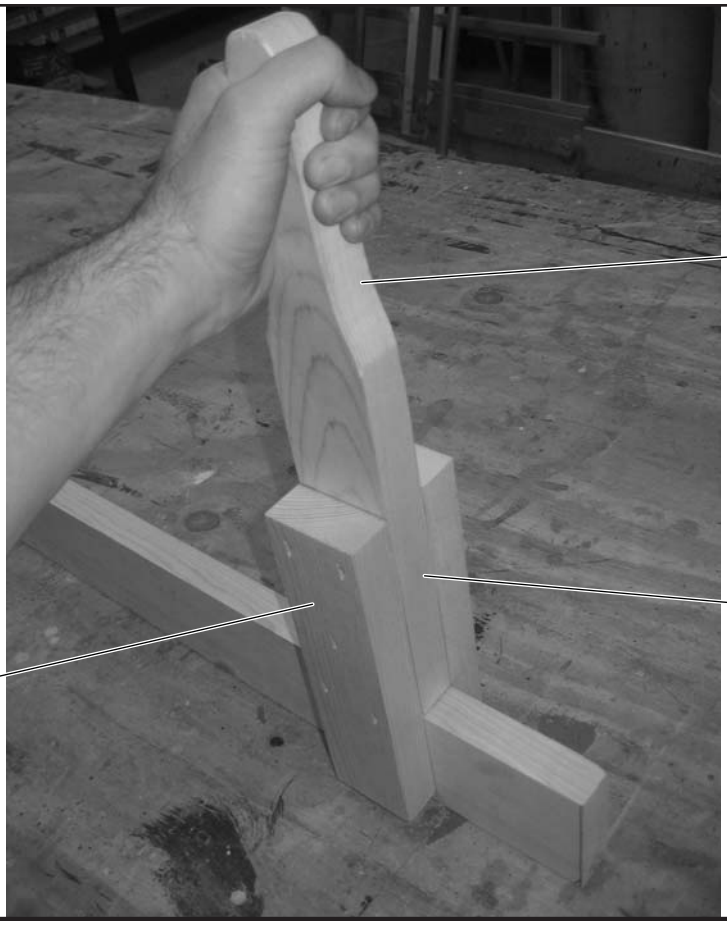
The image shows a mark on one corner of the plate on the press. This is so the same corner of the piece can be aligned to the jig when moving from step to step. If the same corner is always aligned to the jig, then the internal features of the part will be consistent with each other even if the edges of the part blanks are not perfectly matched.



90° Stop Block

Board Bender

This shop-built tool is used to add leverage for positioning twisted or warped lumber during assembly. The handle thickness determines the thickness of lumber that the jig is used with. For example, the jig shown below has a 5/4 pine handle for fitting over other 5/4 pine lumber. The thickness of the glue layer between the handle and the tines should provide enough clearance that the jig can fit on and off a piece of stock with minimal binding. (Amarakoon 2007)



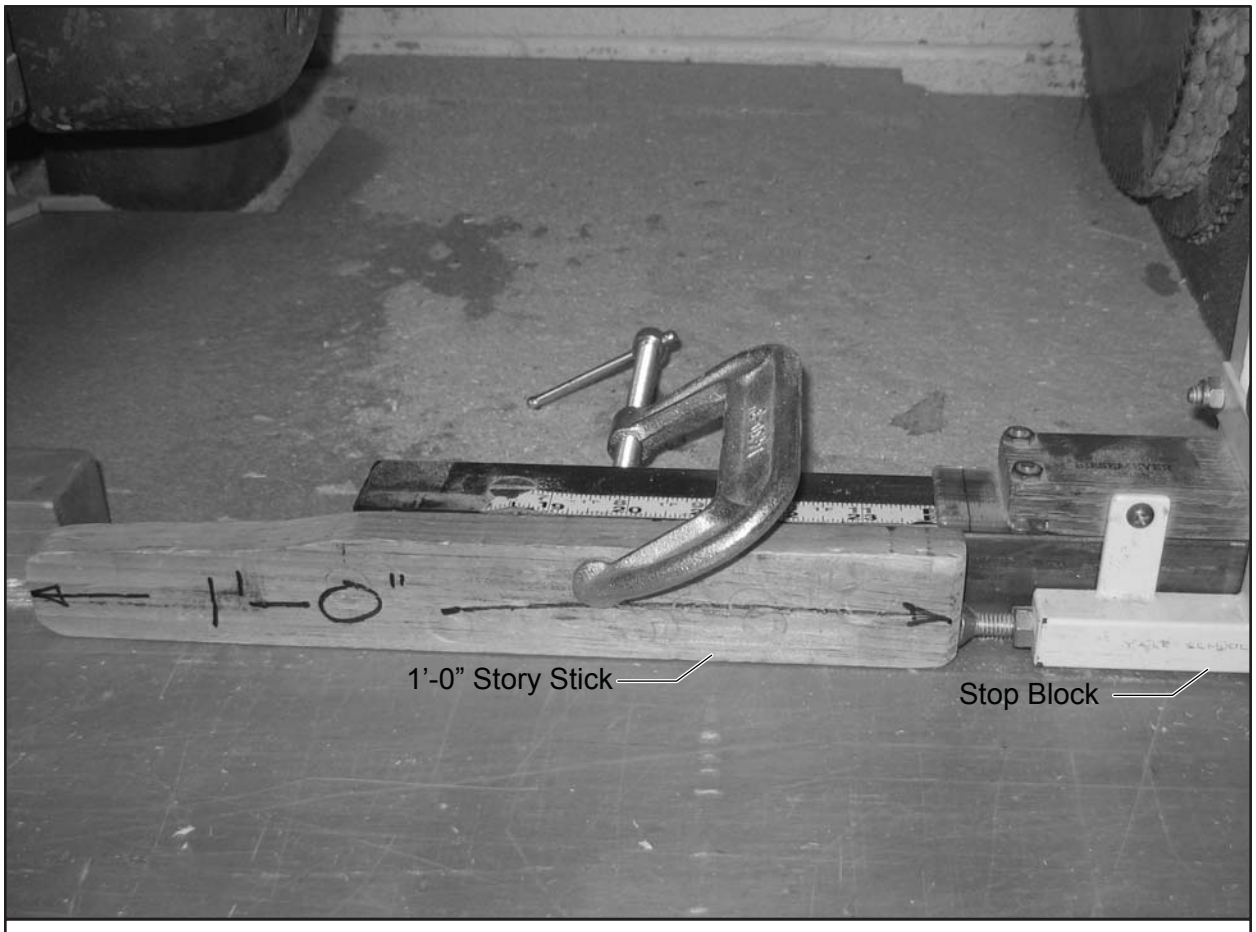
Board Bender

Story Stick

A story stick is a reference tool for quickly checking distances or laying out parts. Shown below is a 1’-0” long story stick used to offset the measurement set by the stop block.

Story sticks can be used for tool adjustment and alignment. For example, to check that the table saw fence’s scale is correct, place the story stick between the blade and the fence and check the scale reading. If the scale reads a different length than the story stick, adjust the pointer until the scale matches the story stick. (Pierce 21)

When cutting framing for 1x framed hollywood flats, a 1 1/2” story stick would let you set one stop block for the rails of the flat, then insert the story stick to cut the toggles without changing the position of the stop block.



Story Stick

THE NEXT STEP

The Next Step

Don’t ferret this book away when you are done reading it. This book is meant to be used. Keep it on your desk or in the shop where it can be easily referenced. Keep notes in the margins of modifications you make to the jigs presented, and sketch new jigs as you create them.

Most importantly, continue to think critically about the manufacturing processes you use in the shop, and find ways to improve and streamline them. When faced with repetitive tasks, or tasks that seem to require capabilities beyond those of your tools, consider adding a jig to the process. Remember that jigs can help in the shop by improving safety; performing operations that are difficult or impossible to perform freehand; machining parts with precision and repeatable accuracy; expanding the capabilities of tools and machines; and improving efficiency.

This text has presented a foundation for jig-making and incorporating jigs into a scene shop, but it is not meant to be the final word on jigs and their use. The bibliography lists many sources for additional research on the topic, and your own work in the shop will doubtless yield ideas for new jigs and new uses for old jigs.

APPENDIX A

DELTA Machinery | Porter Cable
tool manufacturers, also make fences, stops and accessories as Biesemeyer
www.deltaportercable.com

De-Sta-Co
manual and automatic workholding equipment
www.destaco.com

Highland Woodworking
tools, jigs, hardware and accessories
www.highlandwoodworking.com

Lee Valley Tools
hardware, tools, jigs, and jig accessories
www.leevalley.com

Micro Fence
high precision router accessories
www.microfence.com

Reid Supply Company
hardware, clamping, and material handling supplies
www.reidsupply.com

Rockler Woodworking and Hardware
hardware, accessories, jigs, tools, books, articles
www.rockler.com

Woodcraft
tools, supplies, books, hardware
www.woodcraft.com

Woodhaven
Fences and accessories for routers, router tables, and other stationary tools
www.woodhaven.com

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