

Marquetry Saw Manual

(May, 2020)



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I. Introduction

In the fall of 2019, the Rocky Mountain Marquetry guild experienced a shortage of the saws which we use to cut marquetry. A decision was made to redesign the saw based on some ideas from members, and the new saw design is now available for use. This manual describes that design and provides the information required to build the new design. The construction of this saw requires a machinist to fabricate a few metal parts. One of those parts, the adaptor plate, is the only part that is moderately difficult. The saw arms, both 16" and 24", require lamination of the top arm and the shoulder. This process can be demanding and requires material that is straight and free of voids. All other phases of saw construction are similar in difficulty to the earlier "Eifler" saw.

The new saw provides evolutionary benefits from previous versions.

- **Interchangeable saw arms** with throat dimensions of 16" and 24" respectively: The saw arms mount to an adaptor plate which registers the saw arm accurately and securely. A thumbscrew with washer firmly affixes the arm into a slot in the adaptor plate.
- **Uniform blade tension:** Custom laminated saw frames were developed so that the blade tension would be approximately 5 pounds for both arms. Previous designs provided this tension on short arms only. Previous long arms produced blade tension as low as 1 pound.
- **Precise geometry:** An arm assembly jig establishes the geometry of the arm assembly so that the blade is perpendicular to the saw top (front to rear). The ferrule geometry sets the blade precisely in the center of the arm cross-section, eliminating any torque on the arm.
- **Blade clamping:** A small groove in the blade clamping pad helps prevent the blade from rotating when being clamped.

The process for building the saw includes sections on the frame, the glide assembly, the laminated arm and then final assembly. There is a chapter in this manual for each section and each chapter will include a Bill of Material (BOM) for that section as well as drawings for the parts. Chapters II, III, and IV contain text, drawings, and bills of material required to build that specific assembly. Chapter V describes final assembly, in which all three sections are combined with additional hardware to build the completed saw. The saw is built in the order of these chapters. Chapter VI completes the manual with a total Bill of Material, listing all individual parts and the sourcing information to assist readers in procurement.



Frame assembly, Ch. II



Glide assembly, Ch. III



Arm assembly, Ch. IV

II. Frame Assembly (FA-1)



Frame assembly, right side up.



Frame assembly, bottom side up

Note that the screws fastening top to sides and sides to bottom are installed vertically upward. Screws through the cleats fasten sides to top. Screws through the bottom into the cleats attach the bottom.

Frame (FA-1): Bill of Material

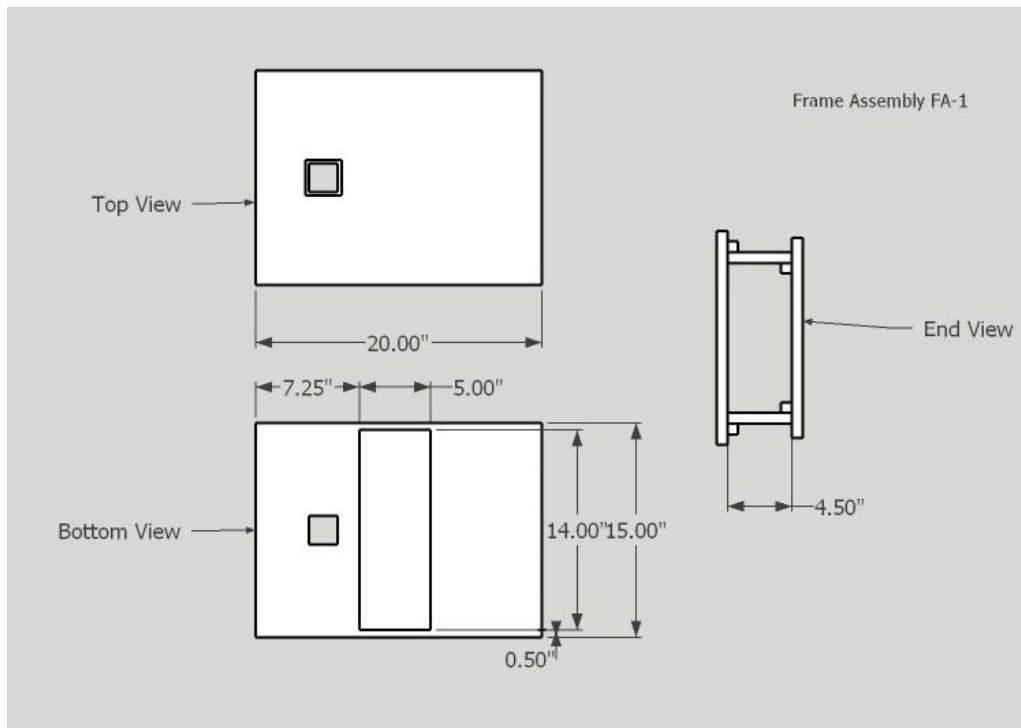
Part name	Part number	Quantity	
Top, frame	F-1	1	
Side, frame	F-2	2	
Bottom, frame	F-3	1	
Cleat, hardwood	F-5	4	(.75 x .75 x 5)
Screws	HW-1	8	

Process:

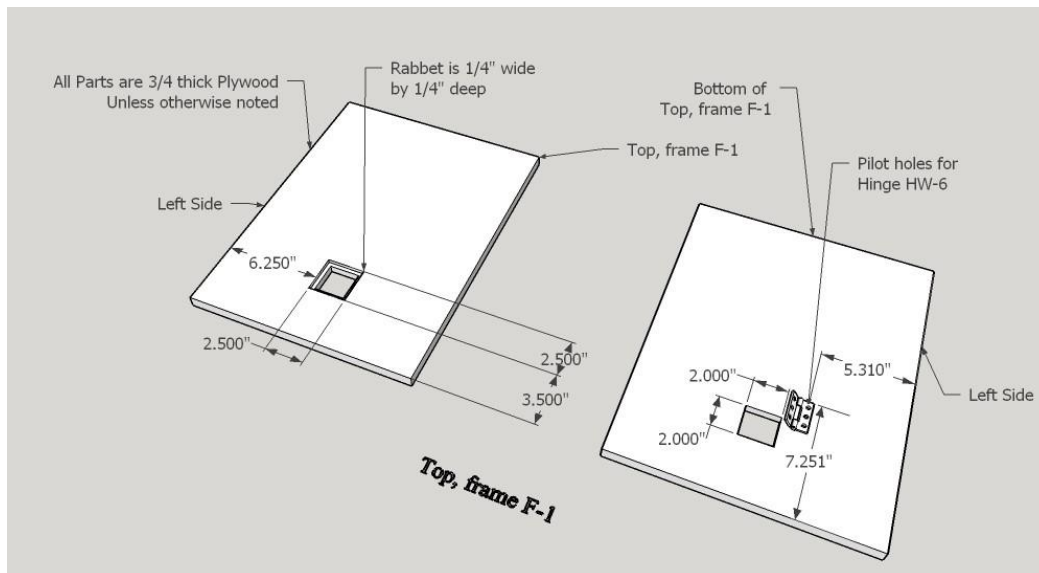
- Fabricate parts F-1, F-2, F-3, and F-5 from $\frac{3}{4}$ " cabinet grade plywood or a suitable hardwood such as cherry or maple. Refer to drawings within this chapter.
- Glue a hardwood strip on to the front edge of the bottom. (if the bottom is made of plywood) This provides a robust material for mounting the angle setting bracket. Final dimensions should match the drawing.
- Glue the four cleats onto the sides as shown. Drill two countersunk holes as shown in each cleat.
- Attach the sides to the bottom surface of the top. Space the sides 10.5" apart. Locate the front edge of the sides and bottom 7.25" from front edge.
- Attach the bottom to the cleats by inserting screws through the bottom facing upward.

(refer to subsequent drawings for detail.)

Frame Assembly (FA-1)

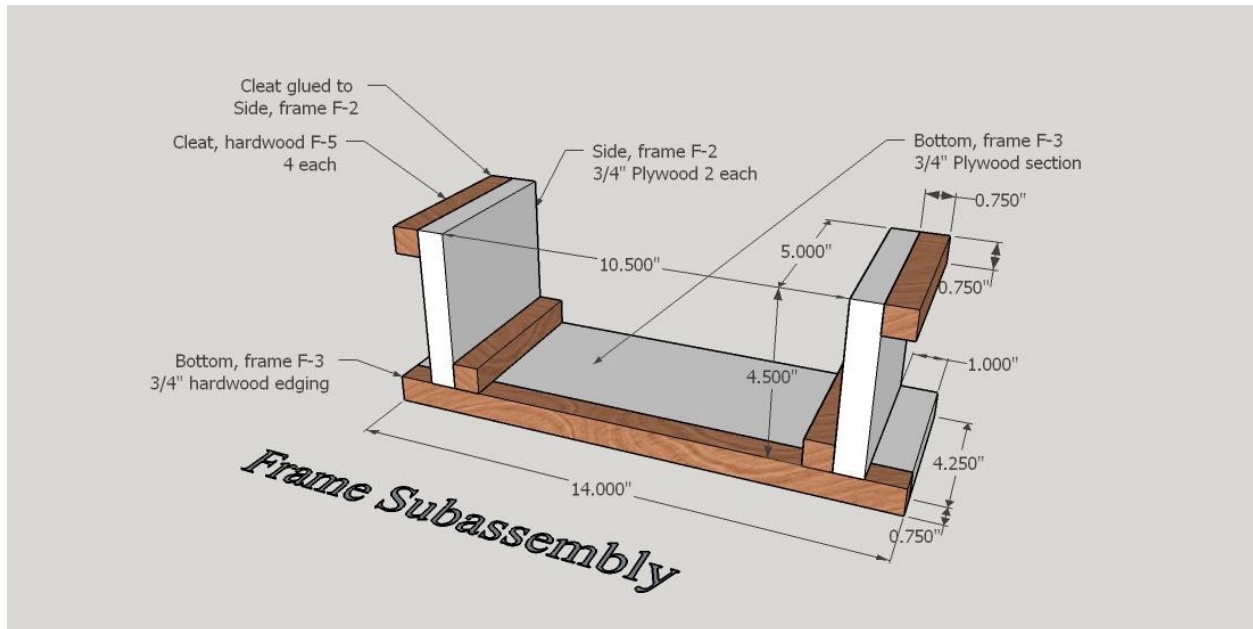


Top, frame (F-1)



Position hinge (HW-6) as shown 7.25" from front edge and with holes 5.31" from the right edge. Mark hole locations and drill pilot holes. This locates the glide assembly properly in both directions.

Frame sides, bottom, and cleats (F-2, F-3, and F-5)



This is a subassembly of frame components that support the frame top.



Closeup view of the frame assembly as viewed from bottom. Note the location of the hinge mounting holes for reference.

III. Glide Assembly (GA-1)

The glide assembly is a collection of parts, including a modified drawer glide, which guide the saw blade at a predetermined angle during the sawing operation.



Right Side. Note the nuts and washers that fasten the handle.

Glide Assembly (continued)



Left Side

Glide Assembly (continued)



View of the glide assembly from the rear.

Glide Assembly (GA-1)

Bill of material

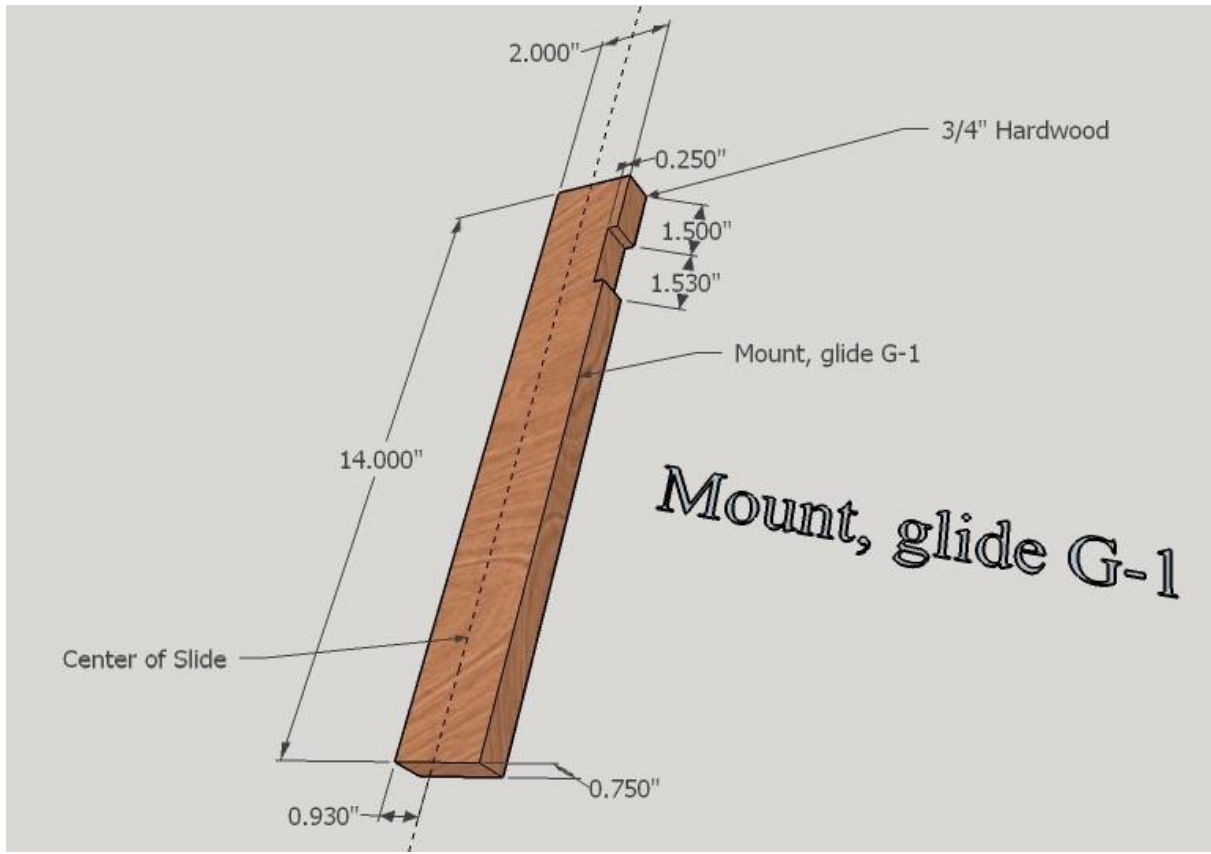
<u>Name</u>	<u>Part number</u>	<u>Quantity</u>	
Mount, glide	G-1	1	
Glide	HW-2	1	
Plate, adaptor	G-2	1	
Handle	G-3	1	
Screws, handle mounting	HW-12	2	
Washer, steel	HW-5	2	
Spring	HW-3	1	
Hinge, glide assembly mounting	HW-6	1	(screws provided w/ hinge)
Hinge, glide stop	HW-7	1	(screws provided w/ hinge)
Screw, adaptor plate mtg	HW-13	1	
Washer, steel	HW-5	3	
Eye screw	HW-14	2	
Nut, hex handle mount	HW-15	2	

Glide Assembly (process)

Process:

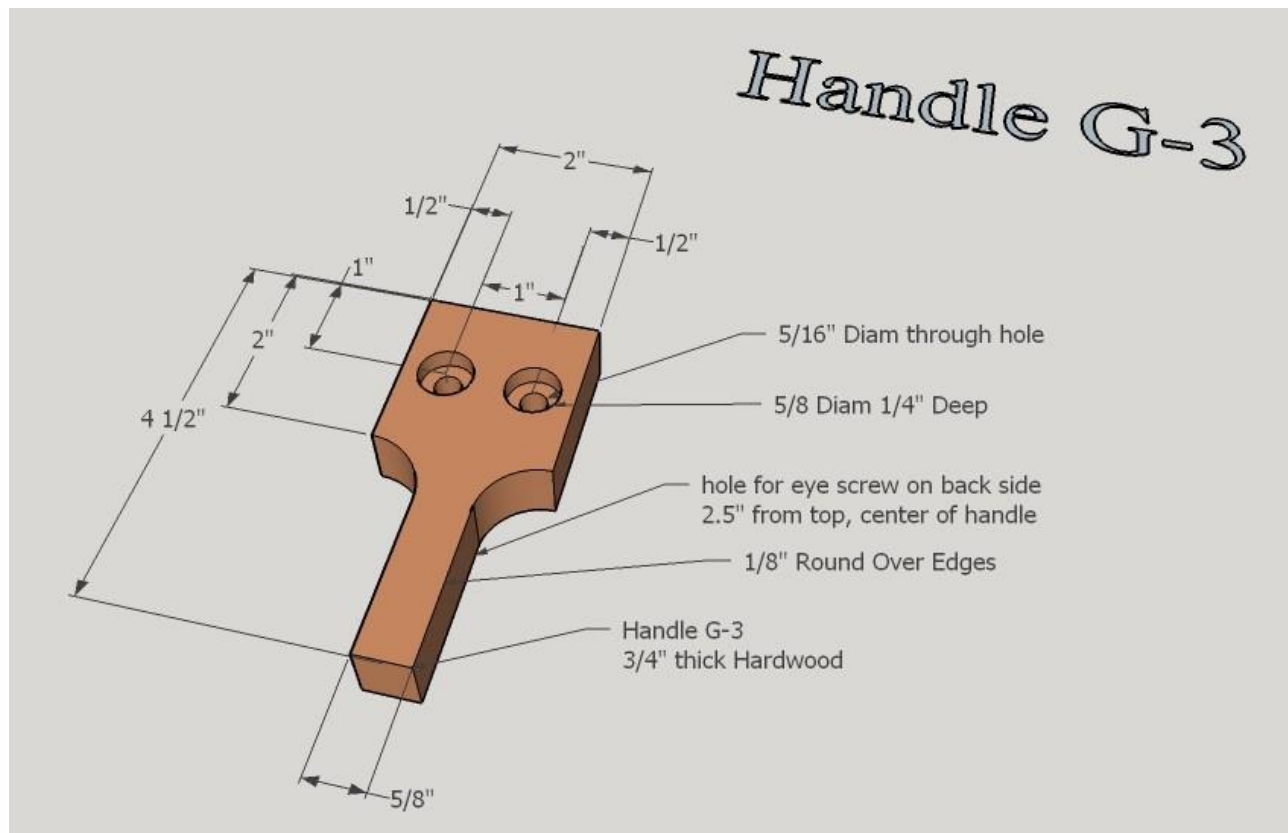
- Fabricate the mount and handle from a suitable hardwood such as cherry or maple. The mount is 2" wide to accommodate the 2" wide hinge, which was chosen to provide better stability. (See drawings)
- Fabricate the adaptor plate, ferrule components, and ferrule assemblies. (see drawings)
- Modify the purchased drawer glide according to instructions in this chapter. (see pictures)
- Attach the handle mounting machine screws (HW-12 and HW-5) inside out on the glide. (see pictures) Attach handle with washers (HW-5) and nuts (HW-15).
- Mount the adaptor plate to the top of the glide with screw (HW-13) and washer (HW-5). (see pictures)
- Mount the glide to the glide mount using screws supplied with glide. Position the glide center line 0.93" from front edge of the mount. (see pictures)
- Mount the hinge for the blade installation stop. (see pictures)
- Mount the eye screws. One goes on the handle as shown in pictures. The other goes on the glide mount, 2.5" down from the top end. The spring chosen for the first build was purchased locally and modified. A proper spring has been found and tested, and these dimensions are for the new spring, which is specified in the final BOM.

Glide Assembly Components



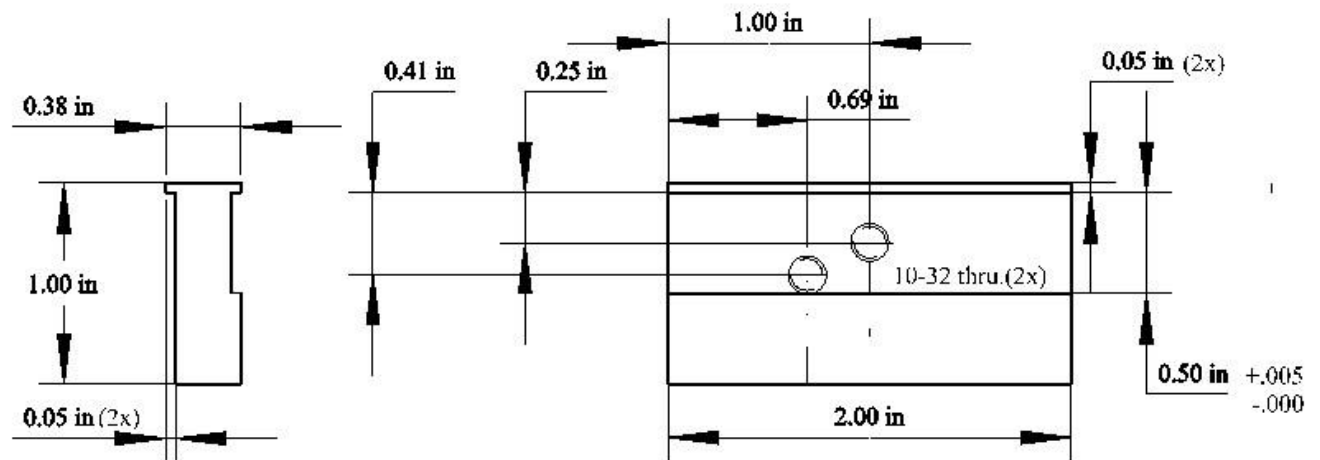
Glide Mount

Mark a pencil line 0.93" down the surface as shown. All glide mounting screws fall on this line.



Glide handle

Part # G3
Adapter Plate
Material: Aluminum



Tolerance: $\pm .010$ "

Adaptor plate

Glide modifications



10-32 holes are drilled and tapped into the middle of the glide. They are 8" and 9" respectively from the top end. The handle mounting screws (HW-12) with washers are inserted from the inside and tightened against the sheet metal.



Nuts and washers are used to fasten the handle. This arrangement helps to avoid stripping the threads in the sheet metal of the guide. (Be careful not to move the glide rails far enough to drop the bearing balls)

Glide modifications (cont)



Top end of glide: Bent tang on inner rail is straightened and sawn off.



Bottom end. Rubber bumper is removed and discarded.



Black plastic insert rivet is drilled out and then the plastic part is punched out.

Rivet hole is drilled out to 0.208".



Tang bent out before removal

Beware!!! Once you remove the tang, the glide can be pulled apart, causing the bearing balls to fall out.

Adaptor plate details



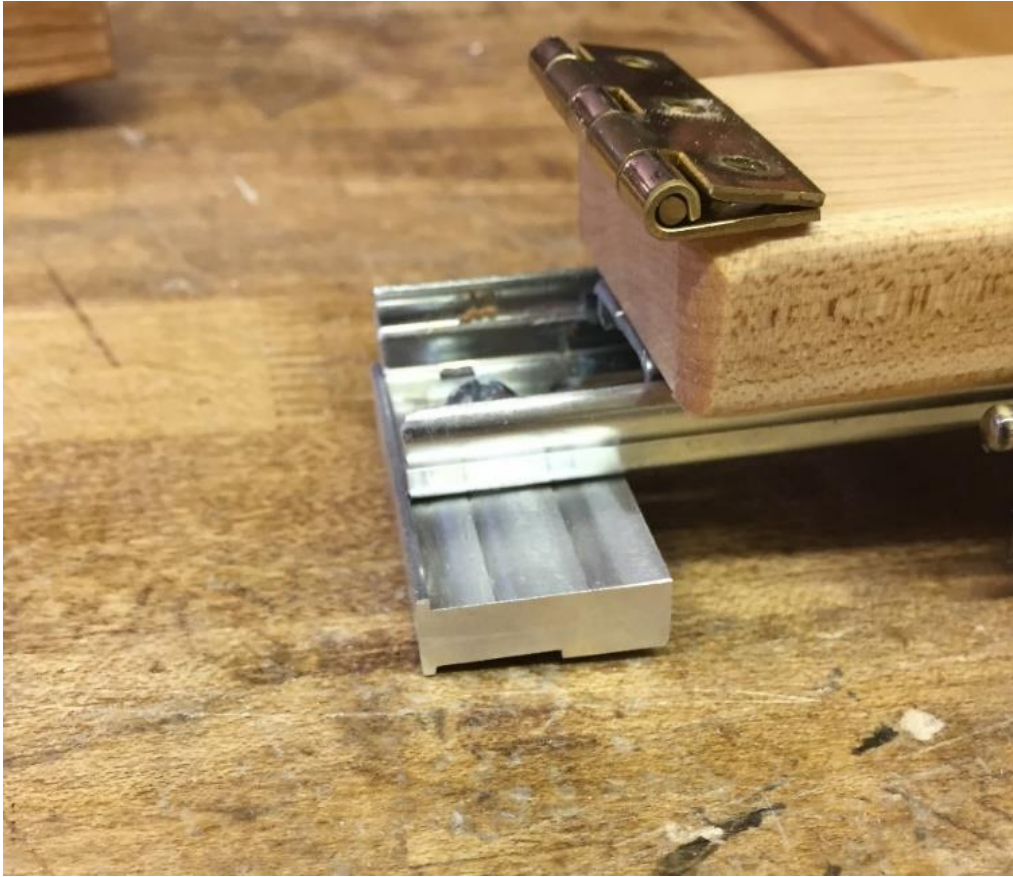
Close up of adaptor plate with saw arm attached. This shows the hinge in position to stop the adaptor plate from moving downward when a blade is being installed.

Adaptor plate details: (continued)



Closeup without saw arm attached

Note that the glide is NOT centered on the wooden mount. Refer to drawing of mount.



The adaptor plate is fastened to the glide with screw (HW-13) and washer (HW-5). The top of the glide should register against the lip on the back of the adaptor plate. Note the location of the glide mounting hinge

IV. Arm assemblies, 16" and 24"

Arm Assembly, 16":

Part number: ARM16



Complete 16" arm assembly.

16" arm assembly details

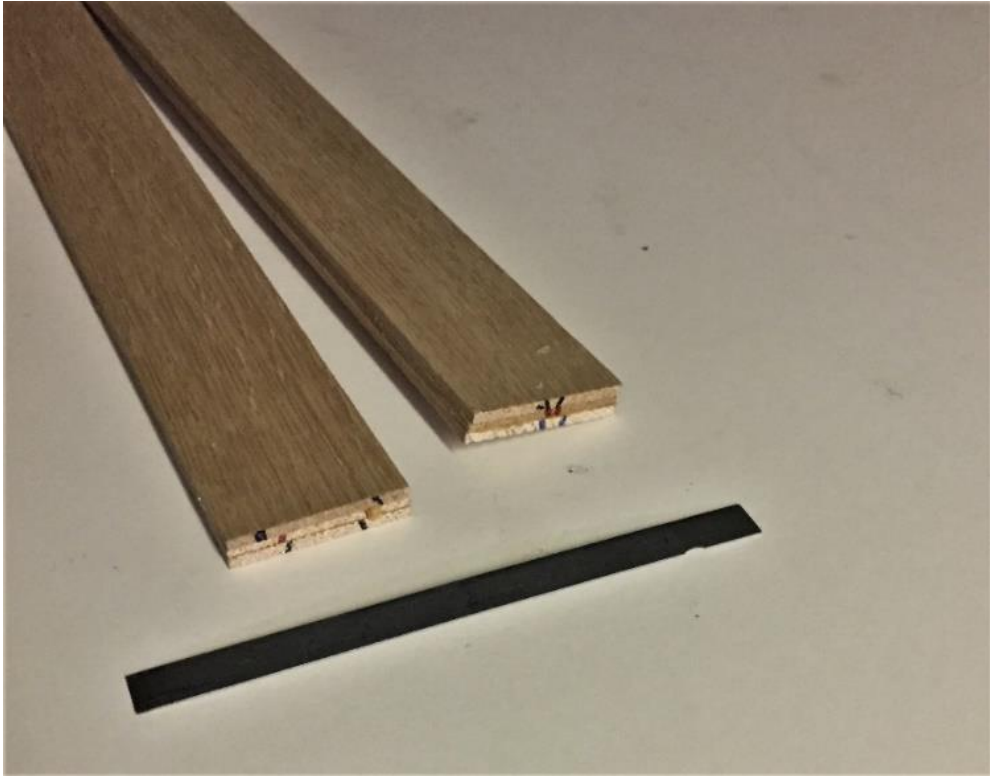


Closeup showing brass pins



Closeup of arm after glue up.

16" arm assembly details



Laminated strips: Each layer is 1/8" thick. These assemblies were .375" by 1.75" by approximately 36" long.

Arm assembly, 16" (ARM16)

Bill of Material

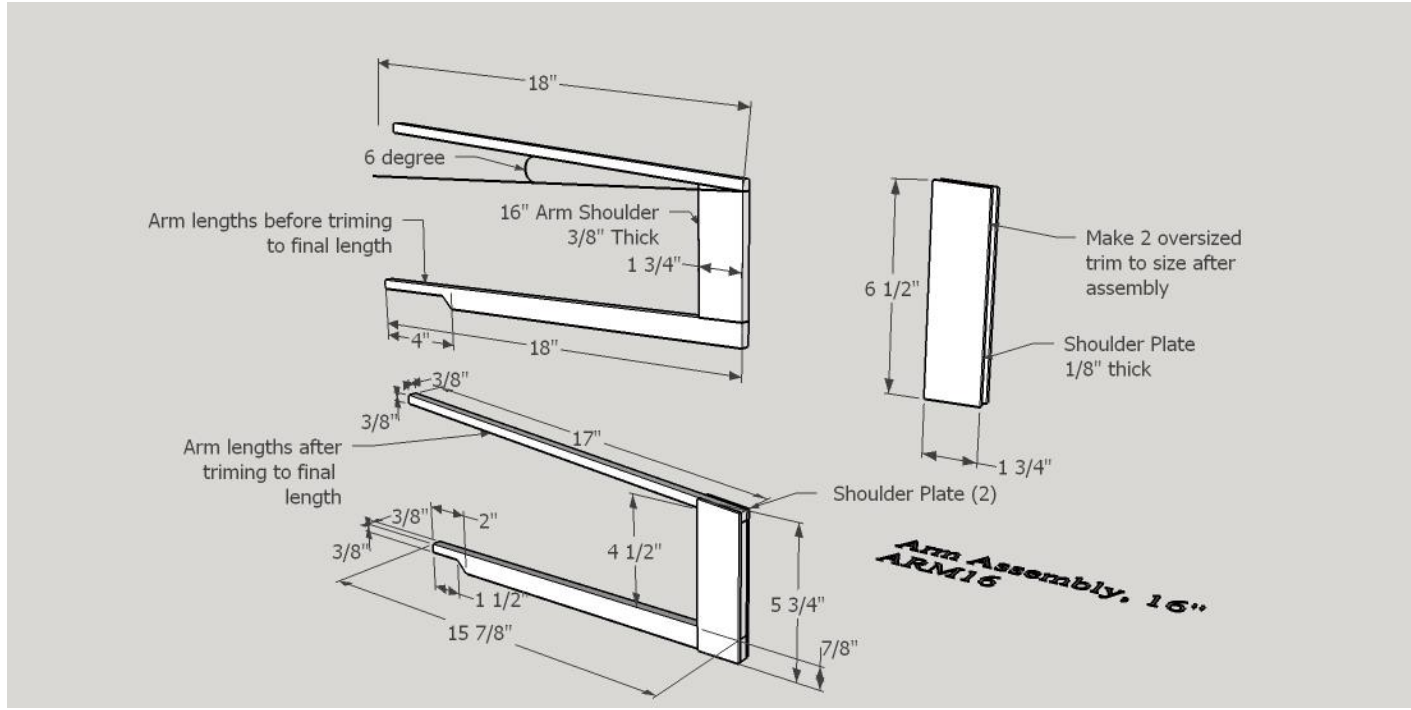
<u>Name</u>	<u>Part number</u>	<u>Quantity</u>
Thumbscrew	HW-4	2
Washer, steel	HW-5	4
Washer, plastic	HW-8	4
Arm, laminated 16"	A-1.16	1
Ferrule assembly, top	A-5	1
Ferrule assembly, bottom	A-6	1

Arm assembly, 16" (ARM16)

Process:

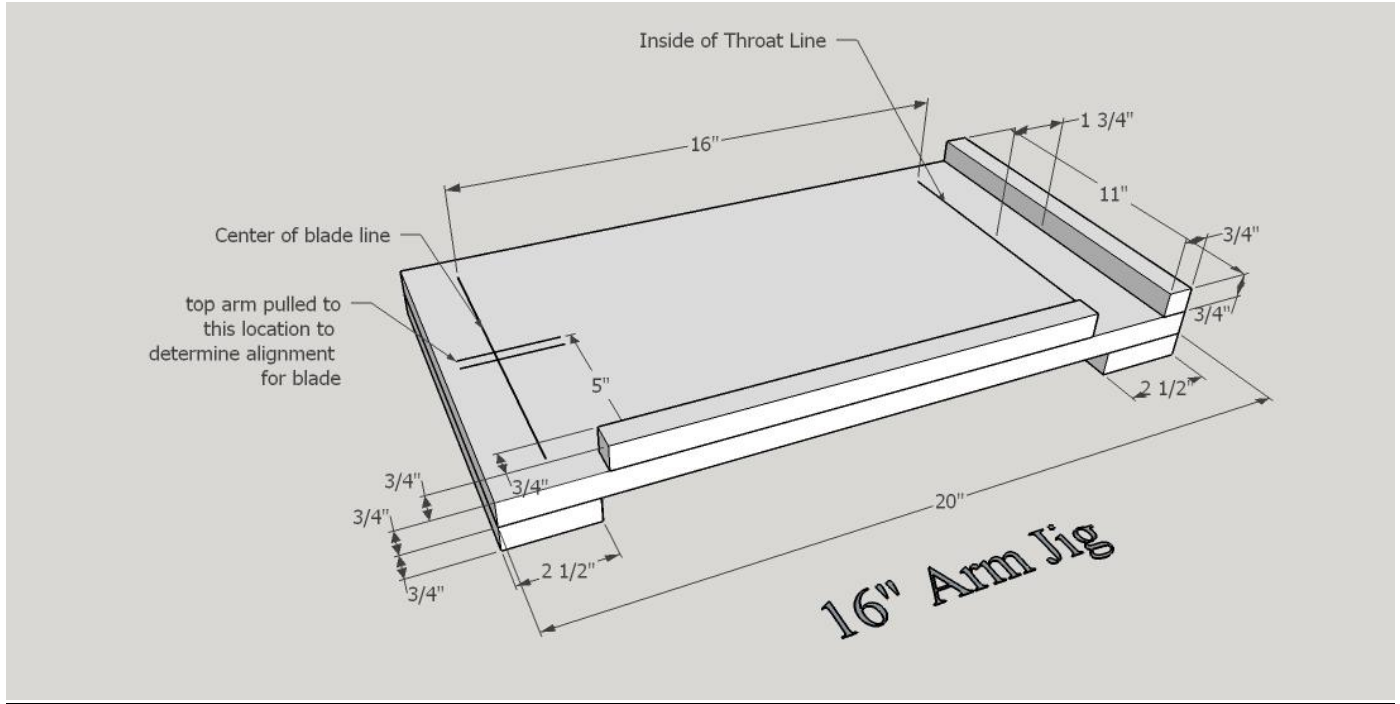
- Laminate 3 strips, each 1/8" thick and 1.75" wide, into one strip 3/8" by 1.75" by at least 36". Titebond I, Titebond II, Gorilla Glue, and plastic resin glue are all suitable adhesives. Titebond III is not recommended for lamination because its glue line is flexible and, therefore, susceptible to creep after curing.
- Cut the lamination to about 20" and then rip two strips. One is 3/8" by 3/8" for the top arm. The second is 3/8" by 7/8" for the bottom arm. The other section can be used to fabricate the shoulder. (see drawing)
- Fabricate two shoulder plates. (1/8" by 1.75" by 6")
- Glue up the arm using the assembly jig to accurately position the parts. Clamp carefully to avoid causing the components to slip. Drill and pin with 1/8" brass rod as shown in pictures.
- After glue sets firmly, place the arm back into the jig and mark the top and bottom arms for trimming to length. (see jig picture) Also trim the excess material from the shoulder plates.
- Fabricate the ferrule assemblies according to the drawings. The tapped holes for the thumbscrews are drilled and tapped after the insert is glued into the ferrule.
- Dry fit the ferrule assemblies onto the arms to ensure that they can be positioned accurately. The fit should be snug. The bottom ferrule is located so that the blade line on the jig goes through the center of the tapped hole in the ferrule. Mark the location on the bottom arm. The top ferrule is located in the same manner, except that the top arm is flexed down to the gauging marks on the jig during the fitting. Again, mark the location on the top arm.
- Remove the ferrule. Apply 5 min epoxy to the inside of the ferrule and to the outside of the arm so that both surfaces are coated after the ferrule is slid into place. Slide the ferrule onto the end of the arm until it reaches the mark. Check to ensure that the blade line on the jig goes through the center of the tapped hole on the ferrule. Carefully clear out any excess epoxy. Carefully set aside for the adhesive to cure.
- Assemble thumbscrew, 2 plastic washers, and 2 steel washers into each ferrule. The metal washers sandwich the plastic washers.

Arm, laminated 16" (A-1.16)



The top arm is a lamination of three pieces, each $\frac{1}{8}$ " thick. The reason for this is to avoid a weak section of grain that could run through the arm. Lamination of the bottom arm is optional, because it is much stronger. The arm assembly is glued and clamped in the assembly/test jig so that the geometry is controlled. The shoulder plates are necessary for strength.

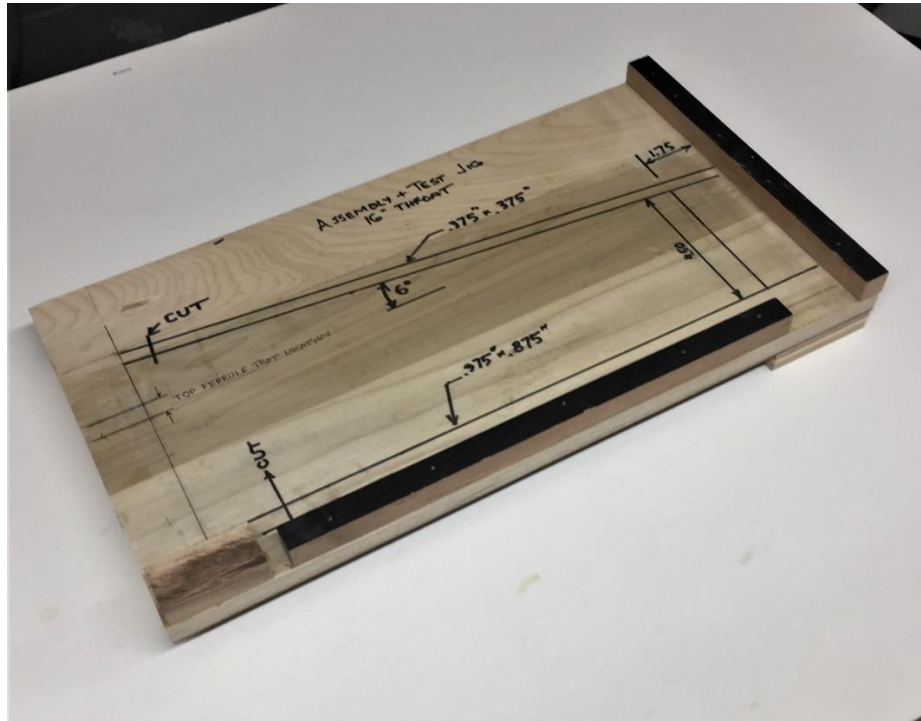
Assembly/test jig for 16" arm



This jig has multiple uses which include:

1. **Glue up of arm assembly.** The two registration fences are at 90 degrees to each other. The runners on the bottom are primarily for clamping stiffness.
2. **Trimming of top and bottom arms to length.** There are marks on the jig to locate these cuts. (see picture)
3. **Location of the ferrules.** The ferrules fit the arms tightly and are glued in place using 5 minute epoxy. The ferrules are first dry fitted to make sure they can be positioned accurately. All of these adjustments are made with the shoulder positioned against the two reference fences. The bottom ferrule is moved laterally until the center of the blade line is centered on the threaded hole in the ferrule. The positioning of the top ferrule is done while the top arm is flexed down into the alignment marks. (The ferrule moves laterally when the arm is flexed.)

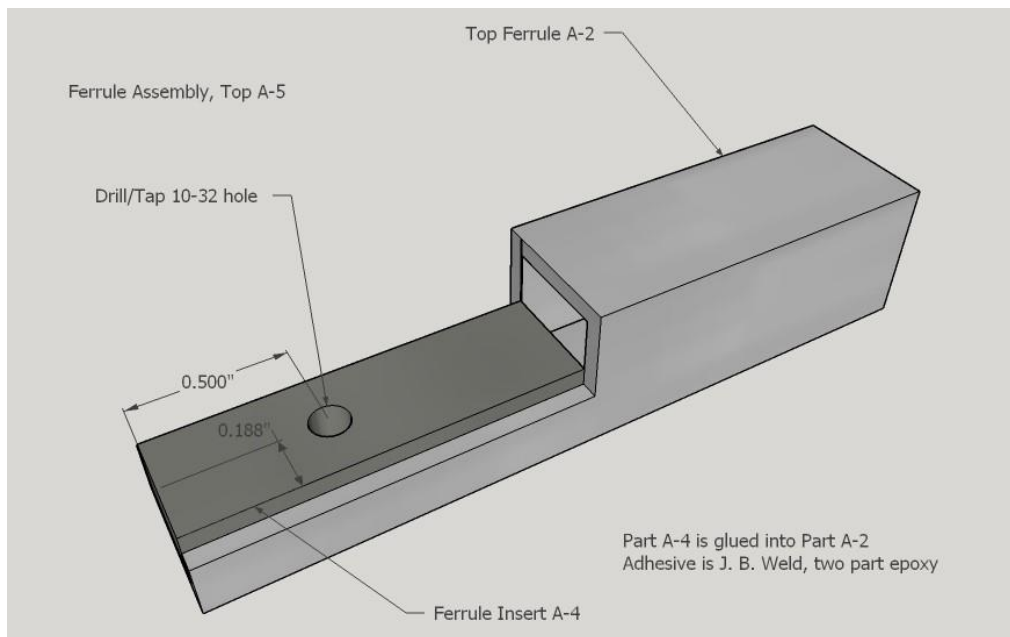
Assembly and test jig



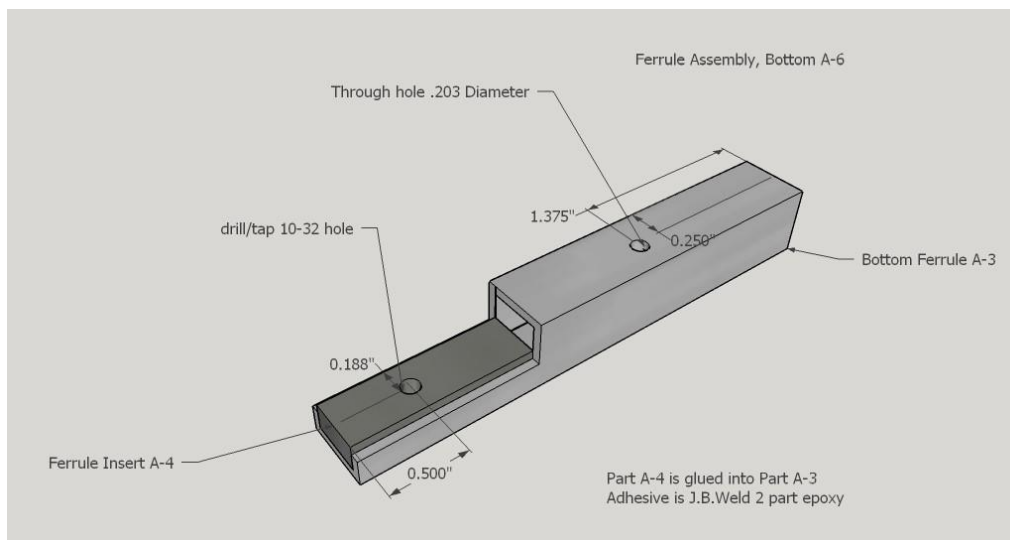
It can be seen that the right fence and bottom fence, black in this picture, are at 90 degrees to each other. The arm components are referenced to these fences during glue up of the assembly. There is a caul under each end of the jig so that the jig sits up above the workbench. This provides a solid clamping base during glue up. Another caul is placed over the top during glue up to help evenly distribute the clamping pressure.

- The clamping process starts by placing a shoulder plate against the right reference edge and overlapping the top and bottom arms. Apply glue to the shoulder plate.
- The bottom arm, arm shoulder, and top arm are placed in position against each other. Apply glue to the top surface of each.
- The second shoulder plate is applied on top, maintaining registration of the other pieces. A clamping caul is placed on top and light pressure is applied without moving the parts. Gradually add clamps until the joint is securely clamped.
- Allow an hour for initial curing and then remove the assembly from the jig. Clean the glue squeeze out from the jig. Set the assembly aside for a few hours to fully cure. After that, drill 1/8" diameter holes, two through each arm, and insert brass pins and epoxy into each hole. Trim flush after curing.

Ferrule Assembly, Top (A-5)



Ferrule Assembly, Bottom (A-6)

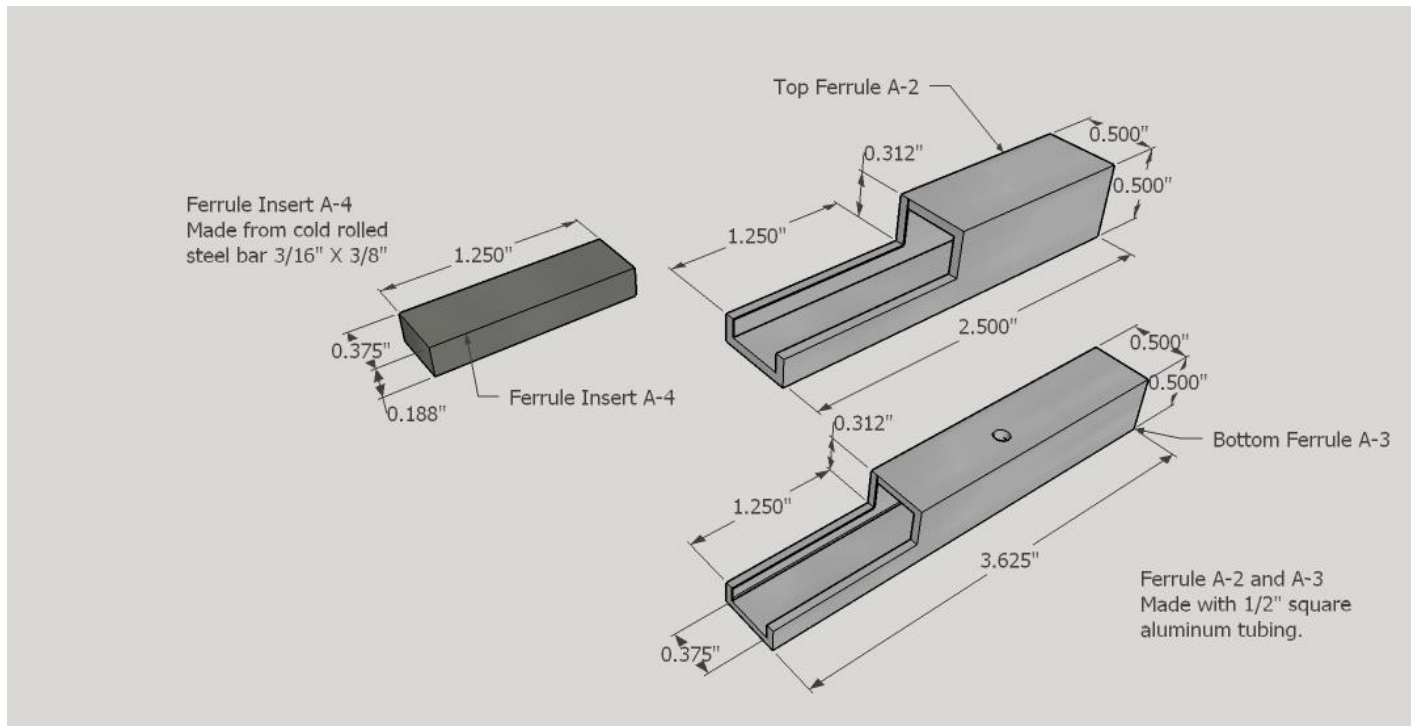


Glue surfaces for both assemblies should be roughened and cleaned prior to gluing. Clean with lacquer thinner.

Adhesive by JB Weld, a 2 part epoxy, was used because it provides better adhesion between metals.

10-32 hole is drilled and tapped after assembly.

Ferrule Components



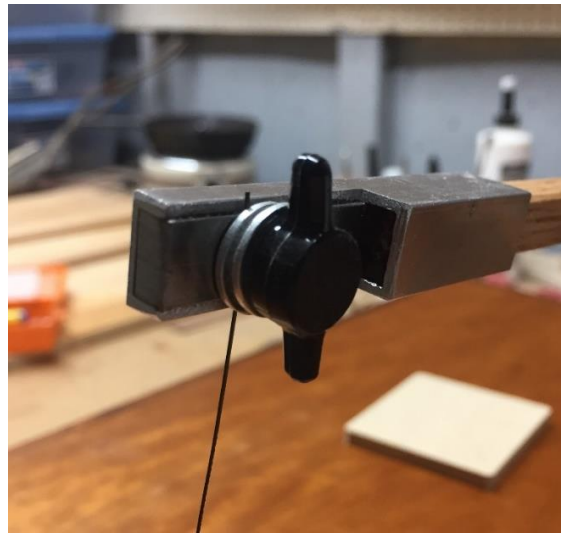
Aluminum tubing: Buymetal.com 1/2" square, 1/8" wall thickness
Look for a local source to save money. Shipping and processing were very high.

Steel bar: OnlineMetals.com 3/16" x 3/8" cold rolled steel

Ferrule Assemblies



Top ferrule with thumbscrew hardware



Thumbscrew and blade detail



Bottom ferrule with thumbscrew hardware

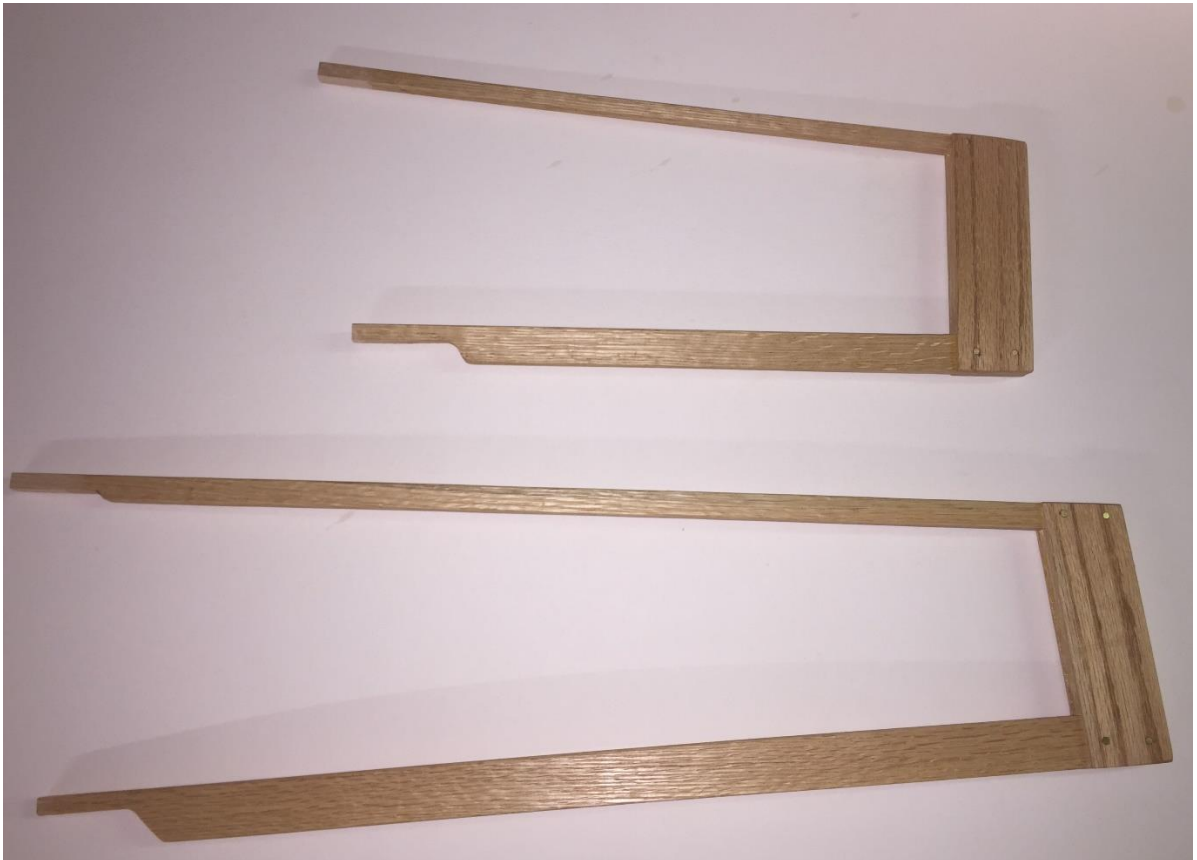


Groove to hold blade during clamping.
Grove is cut with edge of a triangular file.

IV. Arm assemblies, 16" and 24" (continued)

Arm Assembly, 24"

Part Number: ARM24



Both 16" and 24" arms shown prior to addition of ferrules. The laminations shown previously can be used for either arm.

Arm assembly, 24" (ARM24)

Bill of Material

<u>Name</u>	<u>Part number</u>	<u>Quantity</u>
Thumbscrew	HW-4	2
Washer, steel	HW-5	4
Washer, plastic	HW-8	4
Arm, laminated 24"	A-1.24	1
Ferrule assembly, top	A-5	1
Ferrule assembly, bottom	A-6	1

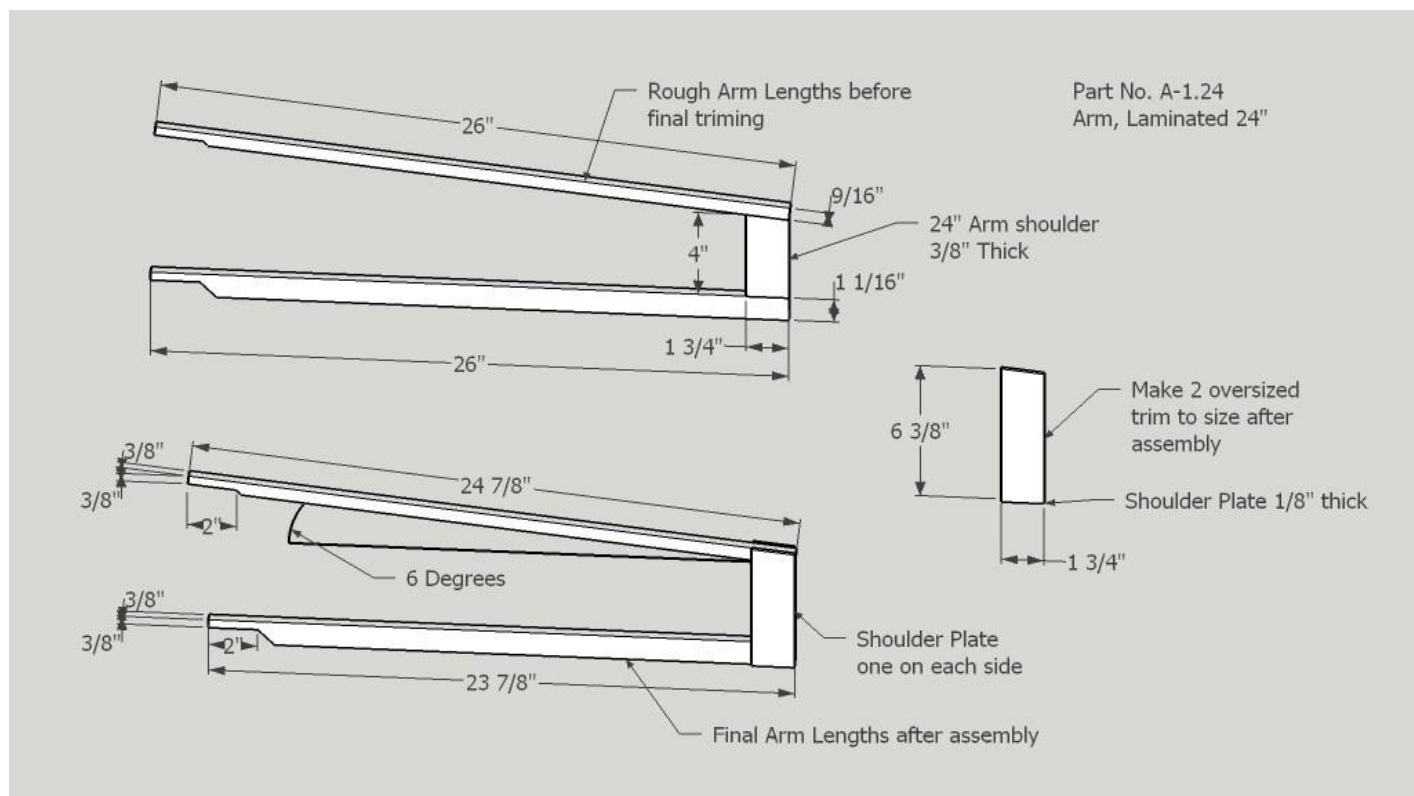
Process:

- Laminate 3 strips, each 1/8" thick and 1.75" wide, into a strip 3/8" by 1.75" by at least 36". Titebond I, Titebond II, Gorilla glue, and plastic resin glue are all suitable. Titebond III is not recommended for lamination because its glue line is flexible and, therefore, susceptible to creep after curing.
- Cut the lamination to about 26" and then rip two strips. One is 3/8" by 0.580" for the top arm. The second is 3/8" by 1.09" for the bottom arm. The other section can be used to fabricate the shoulder. (see drawing)
- Fabricate two shoulder plates out of 1/8" stock.
- Glue up the arm using the assembly jig to accurately position the parts. Clamp carefully to avoid causing the components to slip. Drill and pin with 1/8" brass rod as shown in pictures.
- After glue sets firmly, place the arm back into the jig and mark the top and bottom arms for trimming. (see jig picture) Also trim the excess material from the shoulder plates.
- Fabricate the ferrule assemblies according to the drawings. The tapped holes for the thumbscrews are drilled and tapped after the insert is glued into the ferrule.
- Dry fit the ferrule assemblies onto the arm to ensure that they can be oriented accurately. The bottom ferrule is located so that the blade line on the jig goes through the center of the tapped hole in the ferrule. Mark the location on the bottom arm. The top ferrule is located in the same manner, except that the top arm is flexed down to the gauging marks on the jig. Again, mark the location on the top arm.
- Remove the ferrule. Apply 5 min epoxy to the inside of the ferrule and to the outside of the arm so that both surfaces are coated after the ferrule is slid into place. Slide the ferrule on the end of the arm until it reached the mark. Check to ensure that the blade

line on the jig goes through the center of the tapped hole on the ferrule. Carefully clear out any excess epoxy.

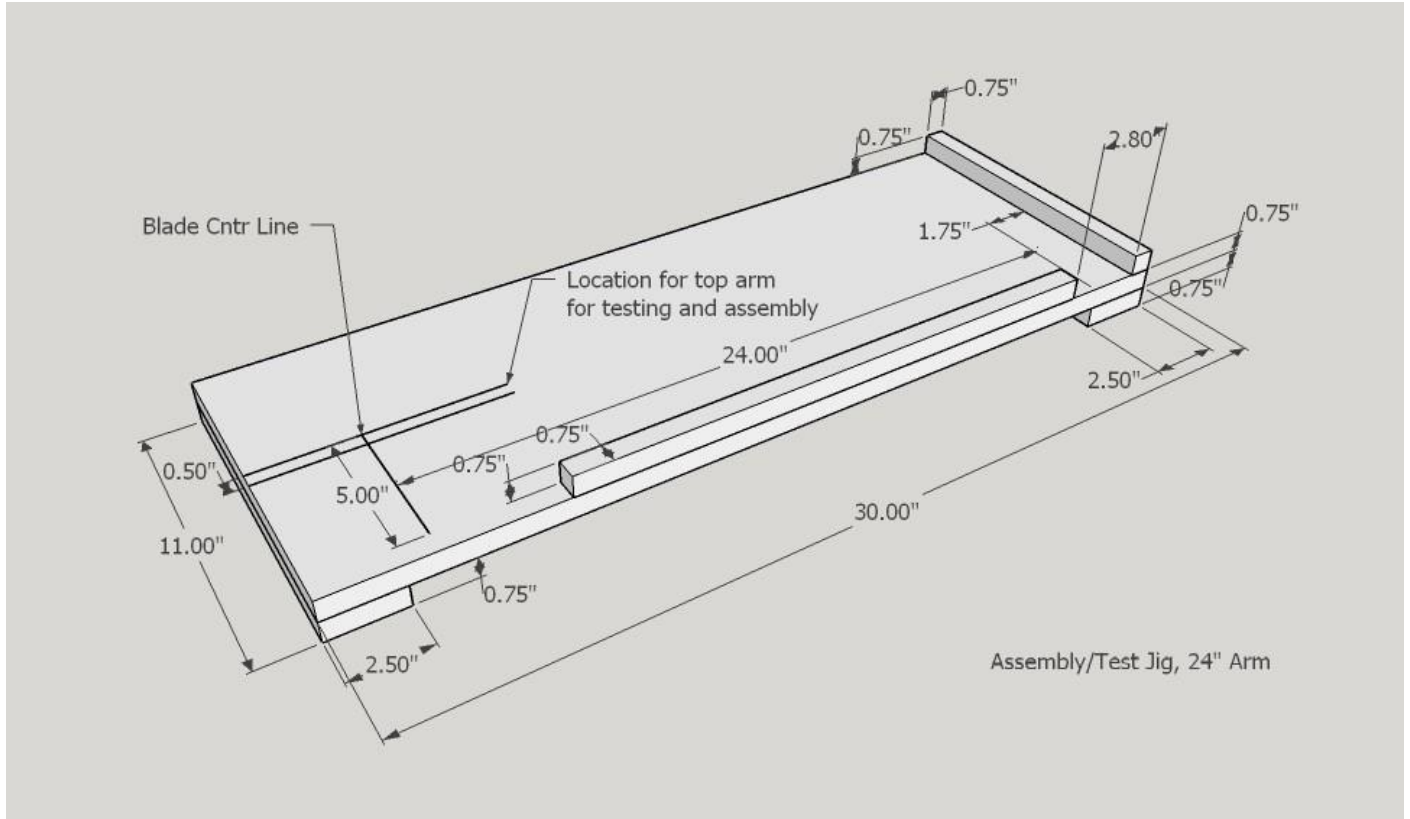
- Assemble thumbscrew, 2 plastic washers, and 2 steel washers into each ferrule. The metal washers sandwich the plastic washers.

Arm, laminated 24", A-1.24



The top arm is a lamination of three pieces, each 1/8" thick. The reason for this is to avoid a weak section of grain that could run through the arm. Lamination of the bottom arm is optional, because it is much stronger. The arm assembly is glued and clamped in the assembly/test jig so that the geometry is controlled. The shoulder plates are necessary for strength.

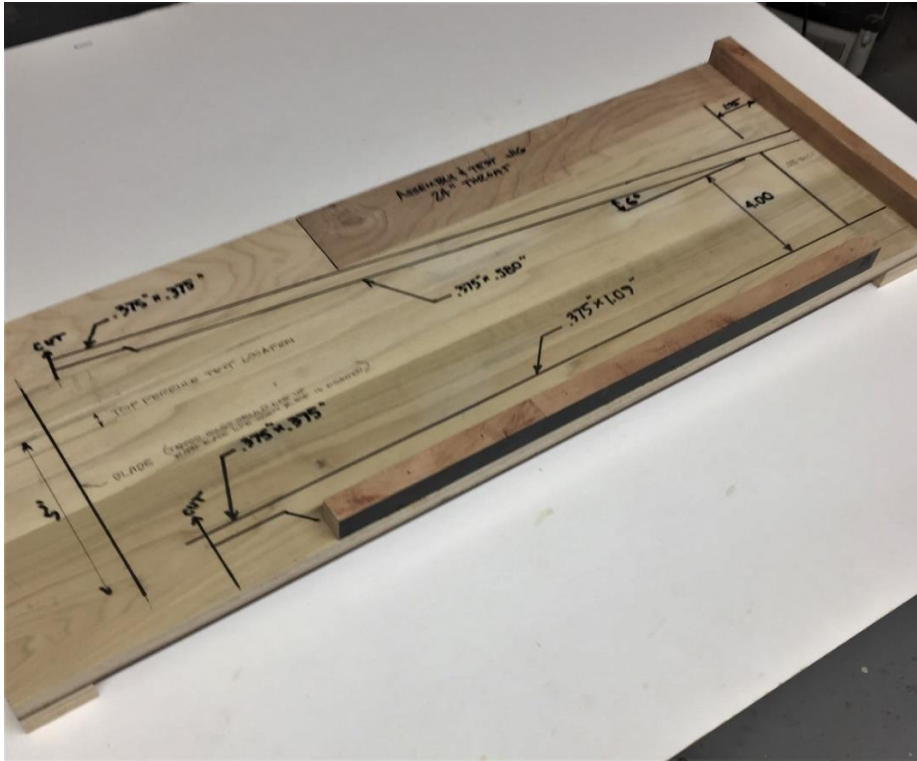
24" Saw Frame Assembly Jig



This jig has multiple uses which include:

- **Glue up of arm assembly.** The two registration fences are at 90 degrees to each other. The runners on the bottom are primarily for clamping stiffness.
- **Trimming of top and bottom arms to length.** There are marks on the jig to locate these cuts. (see picture)
- **Location of the ferrules.** The ferrules fit the arms tightly and are glued in place using 5 minute epoxy. The ferrules are first dry fitted to make sure they can be positioned accurately. All of these adjustments are made with the shoulder positioned against the two registration fences. The bottom ferrule is moved laterally until the center of the blade line is centered on the threaded hole in the ferrule. The positioning of the top ferrule is done while the top arm is flexed down into the alignment marks. (The ferrule moves laterally when flexed.)

Assembly and test jig



It can be seen that the right fence and bottom fence are at 90 degrees to each other. The arm components are referenced to these fences during glue up of the assembly. There is a caul under each end of the jig so that the jig sits up above the workbench. This provides a solid clamping base during glue up. Another caul is placed over the top during glue up to help evenly distribute the clamping pressure.

- The clamping process starts by placing a shoulder plate against the right reference edge and overlapping the top and bottom arms. Apply glue to the shoulder plate.
- The bottom arm, arm shoulder, and top arm are placed in position against each other. Apply glue to the top surface of each.
- The second shoulder plate is applied on top, maintaining registration of the other pieces. A clamping caul is placed on top and light pressure is applied without moving the parts. Gradually add clamps until the joint is securely clamped.
- Allow an hour for initial curing and then remove the assembly from the jig. Clean the glue squeeze out from the jig. Set the assembly aside for a few hours to fully cure. After that, drill 1/8" diameter holes, two through each arm, and insert brass pins and epoxy into each hole. Trim flush after curing.

V. Final assembly

Top Level Bill of Material

(Everything you need to build a saw.)

<u>Name</u>	<u>Part Number</u>	<u>Quantity</u>	
Frame assembly	FA-1	1	
Glide assembly	GA-1	1	
Screws, glide assembly hinge	HW-6	3	come with hinge
Bracket, angle setting	HW-9	1	
Screw, angle setting bracket	HW-10	2	#6 x ¾"
Arm assembly, 16" ARM24)	ARM16	1	(Or: arm assembly, 24"
Thumbscrew	HW-4	1	Mounts arm to adaptor plate
Washer, steel	HW-5	1	Goes with thumbscrew
Plate, access	F-4	1	2.5" x 2.5" x ¼" mdf
Bumper, felt	HW-11	1	¾" diameter

Final assembly process:

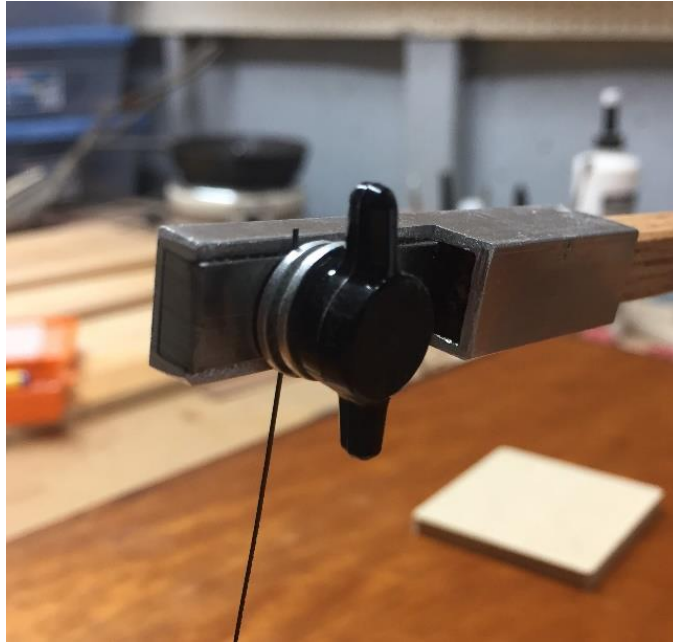
- Mount glide assembly to bottom surface of top using 3 screws from hinge package.
- Locate glide assembly at desired angle. 13 degrees is preferred for modern thin veneers. Clamp the mount in place. Then position the angle setting bracket by hand and mark the screw hole locations. Drill pilot holes and install screws.



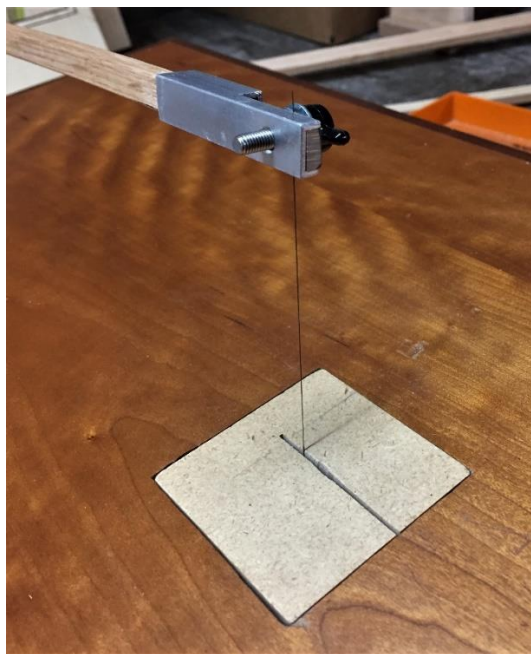
- Install felt bumper so that adaptor plate hits it centered.
- Install saw arm. Use thumbscrew and washer to affix arm to adaptor plate. Make sure the ferrule is seated in the adaptor plate slot.



- Install saw blade and apply tension. Use the stop hinge to hold the bottom arm. Clamp the bottom end of the blade into the bottom ferrule, with cutting teeth facing away from the operator and pointing down. Press down on the top arm with the blade held in place until the tip of the blade just protrudes above the top ferrule. Clamp the blade.



-
- The blade should protrude very slightly beyond the two ferrules. This will establish the proper blade tension.
- Align the access plate and mark the location where the blade hits the plate. Cut the access slot at the appropriate angle until it is open to the blade path. Make sure that the blade does not rub against the slot after tensioning. This could result in the blade catching the slot during cutting, resulting in blade breakage.



- Select an appropriate blade. Orient it vertically so that the teeth face the rear and point downward. Insert the bottom end of the blade into the ferrule and tighten the wingnut. Make sure the blade stays vertical. The shallow slot should help. Position the stop hinge so that the arm is restrained. Push down on the top ferrule, flexing the arm, until the blade is positioned in the clamping area with a slight protrusion. Tighten the top wing nut while maintaining verticality of blade.

The saw is now ready for use.

VI. Total Bill of Material

<u>Part No.</u>	<u>Name</u>	<u>Qty</u>	<u>Source</u>
FA-1	<u>Frame Assembly</u>	1	
F-1	Top, frame	1	¾" Cabinet grade plywood
F-2	Side, frame	2	¾" Cabinet grade plywood
F-3	Bottom, frame	1	¾" Cabinet grade plywood
F-4	Plate, access	1	¼" mdf
F-5	Cleat, frame	4	Hardwood (maple, cherry)
GA-1	<u>Glide Assembly</u>	1	
G-1	Mount, glide	1	Hardwood
G-2	Plate, adaptor	1	Machined aluminum. .375 x 1.00 alum bar
G-3	Handle	1	Hardwood
ARM-16	<u>Arm Assembly, 16"</u>	1	
A-1.16	Arm, laminated 16"	1	Straight grained hardwood.
A-2	Ferrule, top	1	Machined alum. 1/2" square tubing, 1/8" wall BuyMetal.com
A-3	Ferrule, bottom	1	
A-4	Insert, ferrule	2	Cold rolled steel, 3/16" x 3/8"
A-5	Ferrule Assembly, top	1	JB Weld 5 min epoxy for gluing metal
A-6	Ferrule Assembly, bot	1	

ARM-24	<u>Arm Assembly, 24"</u>	1	(sources same as for 16" arm)
A-1.24	Arm, laminated 24"	1	
A-2	Ferrule, top	1	
A-3	Ferrule, bottom	1	
A-4	Insert, ferrule	2	
A-5	Ferrule Assembly, top	1	
A-6	Ferrule Assembly, bot	1	

Hardware:

HW-1	Wood screws	8	#8 x 1 ¼"
HW-2	Glide	1	Accuride 2132 ¾ Extension Slide 14" From www.cabinetparts.com \$12 per two
HW-3	Spring, extension	1	length = 4.5". wire dia = .041", coil dia = 15/32". The spring is number SP-9621, purchased through Amazon for \$3 per package of 2.



HW-4	thumbscrew	3	10-32 x .75", wing knob Sold by Magic Hub, Amazon Approx \$2 per plus shipping
HW-5	Washer, steel	8	#10 flat washer

HW-6	Hinge, glide assembly	1	2" hinge, 6 screws
HW-7	Hinge, glide stop	1	1.5", 4 screws



HW-6



HW-7

HW-8	Washer, plastic	4	#10 flat nylon washer
HW-9	Bracket, angle set	1	1/2" x 1.5" x 1.5"



HW-10	Screw, angle brkt	2	#6 x 3/4" wood screw
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HW-11	Bumper, felt	1	3/4" felt bumper, local HW store
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HW-12	Machine screws	2	10-32 by 1", pan hd, Philips hd
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HW-13	Machine screw	1	10-32 by 3/8", pan hd
HW-14	Eye screw	2	½" eye by 1.5" long
HW-15	Hex nut, handle	2	10-32 hex nut

Raw materials:

1/8" round brass rod