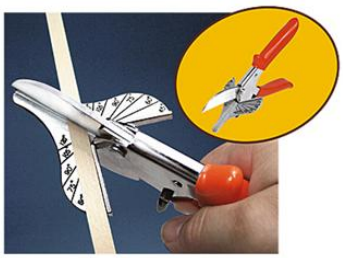
Guild of Oregon Woodworkers

Volume #28, Issue #6

June 2011

OREGON WOOD WORKS



Inside this Issue:

It's the Journey, not the destination

Bob Oswald, Editor

Well folks, summer is in full swing, at least the Oregon version. It's been a busy month in the shop, not so much a daylight to dark venture, but a little bit every day. This bedroom furniture project I've been mentioning is focused on the bed part, and specifically the footboard. Seems like on this project, you should be wondering, why is one piece taking so long to complete? Normally that would be a good observation, but for a couple of factors.

One, I try to keep these projects in 'hobby' mode, not forcing a deadline that makes it become a job. A little bit of work every day is more enjoyable than weeks of inactivity with a flurry of catch up. Like a long hike, the journey is as much the adventure as the destination And two, it's a complex structure. It's turning out very pleasing to the eye, discussing design points along the way.

Each day, thoughts about what to share with the Guild are always on my mind. Sometimes its lessons learned. Often it's just sharing a thought I find unique that might save you some grief. This month there were quite a number of things to share and you'll find them in the pages to follow. And I ran out of space, so there will be a head start on next month's newsletter.

My current anguish is over finishing, that prospect looming in the near future. I want to leave this Cherry natural. My wife wants a darker stain. A sacrilege I know, but she works in home building and daily experiences the fashions of today. So we're negotiating. My big concern is the quality challenge of staining a project this large, no matter the color. It's a combination of plywood and natural Cherry, which will probably finish differently. The absolute last thing on this earth I want, is to be writing an article next month on what *not* to do on a big stain project. Meanwhile, there's a little *invisible repair* work required for places where joinery didn't turn out the way it was supposed to. Some of that is behind me now and looks great, thanks to Lee Johnson.

So read onward, hopefully to learn, be reminded of, or just enjoy the journey with me.

A big thanks this month to Dave Miller for the personal look inside his own home. I know Dave well, have seen his work up close, and he's a master craftsman, absolutely meticulous.

And time for a public service announcement,. I just had a colonoscopy. A few things they found, all of which were fortunately harmless, reminded me why we do this. I must encourage all of you, especially my aging friends, to 'get it done'. Colon cancer is the most treatable disease, caught early. The procedure is, well I can't say *enjoyable*, but it's no big deal, especially if you like the taste of Gatorade.

Next Meeting—Wednesday—July 20, 2011 7:00pm

Bridge City Tool Works

Franklin High School, 5405 SE Woodward Portland, OR

Try out some of the finest hand tools produced anywhere. John Economaki will bring a number of his beautifully crafted woodworking tools which are made to order only in limited quantities. He will also discuss techniques and processes used in his shop. This is a hands-on event.

The CT-17 Dual Angle Block Plane pictured is just one example of the unique designs and high quality craftsmanship.

Directions: Crossing the Ross Island Bridge eastbound, take SE Powell to 55rd, a left turn lane a couple blocks past the light. North to SE Woodward 1/4 mile to the end. Left on Woodward a block; the shop is on the corner on the right.

Last Meeting: Darrell Peart

Bob Oswald

Greene and Greene, what's it all about. Darrell Pert, who owns a wood studio in Seattle, gave the Guild a delightful explanation of accents using their technique. His slide show took us through the Gamble House and the Blacker house in Pasadena. Most of the furnishings were made by Greene and Greene, as well as outdoor details in patios, construction details and walls.

Charles and Henry Greene developed this architectural style.

They developed stunning accents, obviously adding labor to the efforts, but making them unique.

Cloud lifts, where the wood that would normally follow a straight line, rises along an edge, or proud of a surface. Extensive use of Ebony plugs, for decoration and to make the observer think there were fasteners underneath. Breadboard ends provide an intriguing detail as a joinery technique for fastening two parts of a piece of furniture.

Darrell pointed out how you could spend days in one of the houses looking at their work, and not even notice half of the detail.

Show and Tell

It was a busy month for several members. Enough projects were presented to start an art show in itself.

Gary Martin, a Portland pattern maker, showed a pattern for a steam locomotive wheel he's making for Disney. The interesting description of the pattern and molding process would be a great meeting in itself.

Jim Hall brought another masterpiece made on his Rose Engine. With a delicate threaded top, Jim shared secrets about cutting threads in walnut without chipping.

A hand plane made by a student of Gary's demonstrated that people new to pattern making can be successful here.

Gig Lewis presented his completed table, created in Bill Bolstad's recent table making class. Another outstanding piece of furniture with many lessons learned.

Ed Vachel brought his portfolio on the Ferrari bed he's made for his granddaughter. Read about it in the May issue. It's headed for California now.

A Special Thank You

Bob Oswald

I would like to say ***thank you*** to Janet Setness, Bill Shockey's wife, for the proof reading she's been doing on the newsletter for many months now. She came to me in a meeting quite a while back and offered the help. It's become my challenge to put her out of a job, but careful as I try to be, it's never going to happen. So the newsletter takes a quality step forward because of the effort Janet puts forth.

Guide Bushings Extended

Bob Oswald

People ask frequently, what can I do with guide bushings? The most common applications is following the template of a dovetail jig. But somehow that doesn't seem to answer the real question.

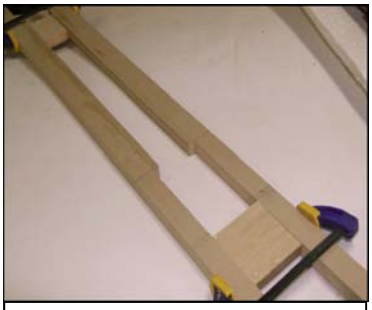
Another typical application would be following a template to mortise something such as a hinge. Beyond that it always seems difficult to give a good example. It's one of those kind of tools that, when you need it, it's the only solution and it becomes obvious.

Well, a unique situation arose on the bed project this month. The solution took a couple days to determine and when it did, guide bushing screamed out loudly.

The task, to "mortise" a complex shape, the turned leg with square segment and bun foot to the end of the bed frame. The frame is a triple torsion box, three inches wide at the top and bottom and two inches in the center. The photo shows the bed shape over which the leg must fit.

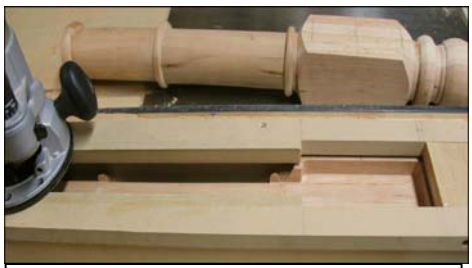
The template was easily made, having all straight lines, from some MDF scraps as shown in Figure 2.

Assembling a box to straddle the leg, the guide frame was screwed to the top of the box. The box was made to fit the leg closely, secured with clamps, so that this pattern could be accurately duplicated on two legs.



2. I-beam mortise template

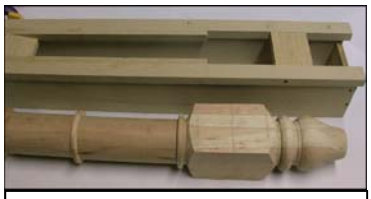
The router is shown in position in Figure 3. Increasing the depth of cut about 1/16" at a time prevented tear out around the beads. The depth of cut turned out to be amazingly simple to determine. As the cut was made deeper and deeper, and as the column started to flatten, the edges of the guide made certain that the width of the cut at the narrow spot was exactly two inches. When the flat column started to become recessed, it was time to stop



3. Routing using the template

There is an important requirement in making templates for guide bushings. The template has to be larger than the required cut to accommodate the offset created by the guide bushing. In this application, a 1/2" router bit was used with a 3/4" OD guide bushing. That's an offset of 1/8". So the template is made 1/8" larger on all sides.

Removing the routed leg from the frame for a test fit was a delight. It fit like a glove.



4. Guide 'jig' before routing

This is the most unique guide bushing situation I've ever encountered, and it's a good feeling to have discovered it before doing something tedious and awkward by hand.

5. Guide 'jig' after routing

Figure 4 shows the guide box before routing and Figure 5 shows it after the cut is complete.

6. An unusual mortise

A close up in Figure 6 reveals that the only additional work is to square up the corners with a chisel.

Installed on the bed frame, it looks impossible to have created.

89¢ Solution

Bob Oswald

Sometimes the obvious just isn't so obvious. The need arose recently for a five-foot pipe clamp. All of my pipe clamps are three feet long. So a trip to the big store for a couple of longer pipe pieces resulted in buying a 10-foot piece and cutting it in half. Cheaper than buying two five-foot pieces.

But wait, a day later ca,e the need for two eight-foot clamps. On the way to the store to get longer pipe, the brilliant thought materialized that a simple coupling would join two (or more) pipes together to make most any length clamp. So a $10 purchase dropped to 89 cents.

The "unnecessary " extra five foot pipes will come in handy anyway, but four couplings just added great versatility to the clamp rack. I opted for plastic, it threads easier and is plenty strong or a clamping application.

A Woodworker's Home

Dave Miller

What's in a Woodworker's Home….

It's been a while now since I tried to contribute for our Newsletter. Maybe the impact of Lee's passing, the unsettling thought of just how unpredictable the future is, or maybe just because of the responsibility for us all to keep on trying made me realize; I better get back to work myself.

In a recent article, Bob Oswald noted, below a photo he took in what I suspect is his own home, a woodworker's home should have a little of the woodworker in it. After all, it isn't like we don't know how. Even the beginner knows the most important thing of all….we want to do it!

This article is difficult since I'll be showing things I have done in our home. Kind of smacks of trying to show off, I fear. That, and the that our style doesn't necessarily fit everyone. Some of the things are simple, some a little more difficult, but I like to think each adds something that can't be bought anywhere, at any price. That is the true power our woodworker members have after all, a passion for what can be and the patience to gain the abilities to make it happen.

How this woodworker's home started?

When we bought our current house a little over four years ago, it was a 'vintage' 1963 ranch house. Pretty basic, a lot country, a lot smaller since we were downsizing. But, it was in a great location and included an oversized detached garage with office space above it. The ideal home shop! I like to tell friends we bought the garage and….unfortunately the house came with it.

Two problems then. 1. Our style is modern and the house was definitely country. 2. The smaller space called for designing and constructing a lot of built-in furnishings that didn't eat up square footage!

This is the kind of situation where woodworkers have the advantage. After all, it's not very often you can run out to the store to pick up that thingy that fits exactly in the wall by the whatever. But woodworkers CAN run out and pick up the material to build the right size, shape, and style accessory for that space.

Simple projects make a home a little more….you.

It's all too easy to overwhelm yourself into doing nothing. Over time (translated to mean I got old,) I eventually figured out that if you just picked one thing, and started it, the insurmountable turned out to be not so big after all. And, when you build something for, or in your home, you're rewarded with the chance to build a bit of your own personality into it. The best advice I can give you is….pick something and…forgive me Nike®…just do it?

This picture frame, for example, is a pretty simple project. You can build it using bits from your scrap barrel in fact. There are no drawings and no dimensions, just make it to fit your picture. Take liberties with how things are done! If you look closely, this picture isn't even sealed behind glass. It's protected, but open.

The frame itself is simple construction, basic half-lap joints connect the rails and stiles (see close up photo below). The one I built here uses inexpensive Lucite for the 'glass' which is attached slightly out away from the frame using notched dowels.

I think altogether, this project took me a few hours when you count the finish and the end result was just what that short wall in the hall needed to dress it up. If it had turned out badly, the most I would have lost was a few shorts from the scrap barrel and a couple of inches of 1/2 inch walnut dowel. Not much downside for the chance to work with wood and create something which turned out useful in the end!

When simple doesn't make it?

I can almost hear you saying "sure, but what about something a bit more complicated." There is no project so simple that we can't make it complicated if we try hard enough. Any project we undertake will have its own challenges of course, but the best thing about building things ourselves, regardless of skill levels, is we don't know enough to know what shouldn't be possible. One good example of that logic is the light bulb. In his day, Edison's contemporaries all knew it wasn't possible, but Edison didn't!

I wanted some display cases in the hallway to the bedrooms. The items I wanted to put in them required a shelf depth of about 11 inches. Unfortunately, the wall itself is only 5 inches thick. On the other side of the wall was going to be our home office. The solution? Cut a hole through the wall

Display cases built through a wall

and build a box that sticks through it! Sound ugly? Well, the only answer for that is to feature it! On the office side, I cut holes in the wall around those display cases which became book cases.

Back side becomes a feature.

By adding these bookcases above and below the display cases sticking through the wall, an eyesore became a design feature!

This works in our home because it's very geometric. The same concept however, can be modified to fit a lot more styles I think. Just remember to keep an open mind and look at problems for what they really are….opportunities to do something a little different.

The office area used to be a bedroom. In the remodeling process, I moved the wall adjacent to the hall in about 8 inches to make the hallway wider and appear less 'cozy.' At the same time, I put two entryways instead of just one. That limited the number of places to place a desk, chairs, etc. since open walls were getting hard to come by. The solution turned out to be a custom floating desk mounted just below the book nooks!

The desk has the benefit of two drawers (one on either side) and a pull-out tray for a key-board. The desk surface is oval, covered with Zebra wood veneer be-

cause….well I thought it was kind of cool looking. The unit is mounted to the wall so it 'floats' in the room gives a visual impression the room is larger than it really is. A nice side benefit is cleaning under it is a breeze!

The woodworkers least favorite project….

Nothing quite matches the boredom of building a kitchen. It's quite exciting and challenging for the first couple of drawers, and after that it gets downright tedious. Still, a kitchen does allow you to take liberties with what isn't available off the shelf! The fact is when you build your own cabinets, there will be no filler strips. The cabinets will actually fit the space! Most important, the cabinets will be built to last. It may take longer, but trust me, it isn't impossible. And….it will save you a lot of money!

Our kitchen is…well, modern? A lot of the design just didn't exist without going full custom somewhere. It really is just lots of boxes actually, so although building out a kitchen seems daunting, it's just lots of boxes and time measuring, designing, and then executing.

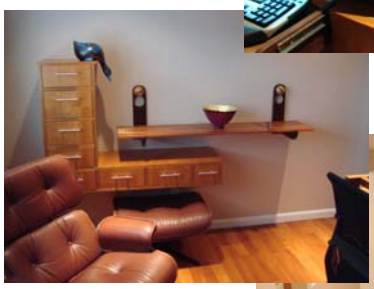
The doors on the upper cabinets lift up, assisted by pneumatic lifts available from several sources. All the drawers are fitted with soft close slide hardware, and the lower cabinets are equipped with slide out trays. All things that will really bump up the price if you buy your cabinets, but don't add much when you build your own. You will be surprised how much more you can do designing and building your own. The other benefit is the ability to orient and match grain patterns, and to end up with cabinets that fit where they are supposed to!

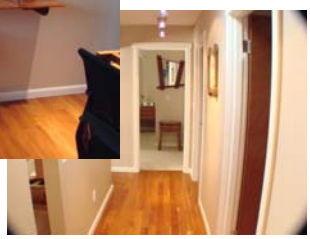
Custom designed cabinets will actually fit the space you need them to.

So, what's in a woodworker's home?

In a nutshell? The woodworker's home can be filled with passion and personality. Truth be told, it is simply filled with the love of doing, and the lessons of trying.

Life is short, get busy!





Community Projects

Bob Oswald

A number of Guild members spent a day at Franklin High School repairing wood vises. Here is a letter to the Guild regarding the activity.

PORTLAND PUBLIC SCHOOLS
5405 Southwest Woodward / Portland, Oregon 97206
Telephone (503) 916-5140 * FAX: (503) 916-2694

FRANKLIN HIGH SCHOOL

On behalf of Franklin High School and the students, faculty and volunteers who donated their time and resources last Friday to replace, repair and refurbish all of the workbench vises in the woodshop.

I greatly appreciate that the Guild members would donate their efforts for five hours on a Friday evening. The Guild refurbished twenty woodworking vises on nine work benches bringing these very "tired" and damaged tools back to "as good as new" condition.

Faced with extremely limited resources, the Franklin High School Woods program could not continue to operate without donations and volunteer assistance from individuals and organizations like the Guild. Again, I thank you for your generous assistance and look forward to continuing to work with the Guild in the future.

Jerome Mannenbach, Industrial Technology

Greene & Greene Class

Dennis Dolph

It has been a goal of the education committee to bring big name instructors to teach Guild classes. That's why we were so proud to have Darrell Peart, author of "Greene & Greene Design Elements for the Workshop" teach a class on that style.

Over the Father's Day weekend 10 students learned the secrets to making the "cloud lift", the "double bracket", the "square peg", the "ebony spline", and other elements which make Greene & Greene furniture unique and a core part of the northwest style.

Dear Bob Oswald, Norm Michaud and Bob Vaughn,

We don't know how to thank you enough for all the hard work you put into our flag cases and frames. Your dedication and generosity really touched us. Thank you for helping us with such an important keepsake for our son. We hope this donation helps to express our appreciation.

Many thanks, and God Bless,
The Topel Family

In your honor, a generous gift has been made to Wounded Warrior Project (WWP). This donation helps make it possible for WWP to fulfill its mission to honor and empower wounded warriors and provide assistance and programs to the injured servicemen and women who continue to go to extreme lengths to defend our freedom.

In Honor of:
the Guild of Oregon Woodworkers

Ross Topel
CMR 445 Box 1097
APO AE 09046

ARMY POSTAL SERVICE
JUN 2011

Ross & Jack Topel

Spindles, Piecewise

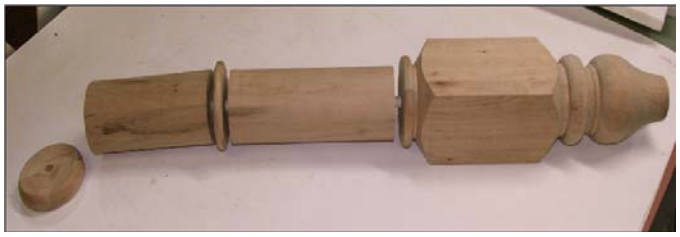
Bob Oswald

Turning spindles is fun, making a complex shape out of a single piece of wood. But it can be challenging and worrisome, the risk of making a mistake, of being able to duplicate the profile several times. Making a mistake is costly, for example, if you cut a bead in the wrong place.

Here's a variation on the theme that takes the worry out of the task. Make it in pieces. In the photo, the complex piece, the bun foot and pedestal above it, were done as one piece. These could have easily been divided into two pieces.

The columns were turned as a couple of thirty-inch lengths. It's relatively easy to turn a cylinder and surprising that the overall dimension across the length, can be held consistent to a few thousandths of an inch.

The disks are easy, a pretty simple bead rolled over the



end of a disk. The turning points where the lathe centers hold the disk can be parted down to a very small diameter that is then easily trimmed off on a band saw and a bit of sanding.

Assembly is a joy. Cut the various columns to length. Mix and match the disks and join them all with dowels. A convenient feature, the by-product of turning, is that most of the pieces have centers already marked, making the dowel drilling step accurate and easy.

The only important step is that as you divide a column into short segments, you must be sure that the ends are cut very square. When this tower is glued up, it must stand straight of course.

The final assembly in this example had the most crisp and perfectly formed beads. Two copies of the leg were identical to each other.

Quarter Round

Bob Oswald

Making quarter round sounds easy, and it can be. Or not.

As Figure 1 shows, using a round over bit, one-half inch in this case, to create a one-half inch quarter round, poses the problem that the stock does not contact the guide gearing. The first discovery of this is usually when you start the cut and it erratically tapers itself as it slides under the bearing and continues cutting. Simple solution use the router fence with the bearing flush. The fence then becomes the controlling element. That works fine if the piece is straight. But what about a curve piece of molding as shown in Figure 2? You need a curved fence as shown in Figure 3. As in the use of both fences, precise alignment is critical. If the bearing is set back inside the fence a little, your quarter-round will have a flat spot. If the bearing is proud of the fence (either one), it will cut deeper into the stock, leaving it not square, and in fact prone to an erratic cut.

Fig 1. No bearing contact

Fig 2. Curved molding

Fig 3. Requires curved fence

So with care, and ruining the first piece necessitating bending up another one, the result was pretty passable. A few little wobbles during the routing caused those slight variations you can feel but don't become visible until varnish is applied. So feeling for them, and a bit of touch with sandpaper, made them furniture ready.

Board Meeting Minutes

Bob Oswald

The board of directors of the Guild of Oregon Woodworkers meets monthly before the general meeting. Minutes of this meeting are available on the Guild website at www.GuildOfOregonWoodworkers.com. Click the "Board Minutes" entry in the left hand menu.

Classes

Steam Bending

Frank LaRoque at The Dalles
July 9, $70 including lunch & materials

This one day seminar will cover Steam boxes and equipment; bending of solid wood and wood strips; spot bending; and free form veneer bending. Contact Dale at dkp6640@q.com or call 503-304-2136.

Make a wooden Mallet

Dennis Rodrigues
July 12 at Franklin High School

Students will build a custom wooden mallet to fit their needs. Tuition $40 to include material and Pizza. Contact Chris at cfrazeur1@comcast.net

Using a Card Scraper with

Jeff Zens
July 13 at Franklin High School

A combination of Hands-On and discusion on the Care & Feeding of the Card Scraper. One of the handiest tools in the shop. Tuition is $25 and includes Pizza & Pop. Contact Chip at jdwebster@comcast.net.

Invisible Repairs

Frank LaRoque at The Dalles
July 23, $90 including lunch.

This one day seminar will cover various techniques used to "Mitigate" mishaps in the shop. Each student should bring sample problems that they want to work on. Frank will supply a set of his famous "L" blocks to each student with instructions. Contact Dale to sign up at dkp6640@q.com

Intro to Dust Collection

Gig Lewis
August 3 at Gig's shop in Beaverton

Intro class discussing various types of Dust Collection in the Wood Shop.Terms like CFM, Ducts, Slow Turns, & Runs, plus Safety ideas. Tuition $25 includes hamburgers fresh from the grill. Contact Ed at edvachal@gmail.com

Welcome New Members

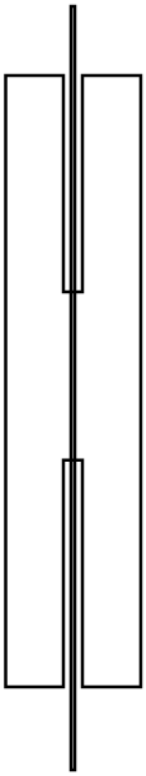
Bob Oswald

Hello to Kenneth Melvin and Rick Ginn.
We're happy to have you with us. Please introduce yourself at the next meeting. We'd like to know who you are.

Table & Bandsaw Resaw

Bob Oswald

A couple of issues ago a technique for resawing using the table saw was mentioned, one that only works if the saw can reach all the way through the board from both sides. A more common application is to use the table saw to make two cuts, one on each edge of the board, and then finish it with the bandsaw and a planer.



The Figure shows a board, having the two table saw cuts completed, and in position with the bandsaw blade to slice the two halves apart.

The only challenge, especially on a long board, is to get the bandsaw blade aligned in both the top and bottom groves. Sounds easy enough until you're six feet away from the start of the cut and the board has a bit of bow, warp or twist and closes on one of the table saw cuts.

All that said, with a bit of alignment care, you should be on your way . An important guiding factor is that the bandsaw is only cutting a small (relatively) piece, so it should cut easily. If you notice, as I failed to for a short distance, that it seems like the bandsaw is working hard, perhaps it IS cutting full length and you missed the slot.

The bandsaw cut, once started correctly, goes smoothly in that the bandsaw blade will tend to guide on the edges of the table saw cut.

With the board split in half, you'll want to run it through the planer to removed the ridge and make that final clean-up cut.

Miter Tool

Frank LaRoque

This Miter Master makes clean, sharp miters in plastic and wood. It's an excellent tool for modelers, picture frames and woodworking in general. It cuts miniature molding, dowels, plastic and wood structural shapes, strip stock, even full size picture frame molding. Razor sharp blade cuts across the grain with a clean, smooth shaving action and it's as easy to use as a pair of scissors! Has left and right hand, 45 degree miter fence and a scored mark for lining up stock for 90 degree cuts. Will cut stock up to 1/2 inch thick x 1-1/2 inches wide.

Some Lessons on Spraying Lacquer

Bill Wood

Guild member Chip Webster has been working very hard at helping the Guild and the folks at the Clackamas County Library with the Guild's year long project of building furniture for the new Happy Valley Library. The furniture I am speaking about is an odd looking piece which contains adjustable shelves on each side of an upright called a Gondola. This Gondola is narrow at the top and wide at the bottom. We designed the Gondola with slat boards on the side for the shelves to clip onto.

Chip restores antique furniture, as well as repairing and refinishing vintage furniture. He tells me he selects various finishes appropriate for the use, or in some cases to duplicate the finish presently utilized. When Chip offered to help with this project he decided on a POST CATALYZED LACQUER. The reason for using a post rather than a pre-catalyzed lacquer was because of the wear resistant properties. So what is the difference; what does that mean. A pre-catalyzed lacquer comes mixed with an acid built into the mix. When you spray the finish it partially melts any lacquer which already exists and gradually builds up a finish. It is great for fine furniture in a normal home environment, dries quickly and it is very easy to repair.

The Post catalyzed lacquer means you add the catalyst to the lacquer before you spray the finish. The finish builds layer by layer, similar to an onion, and also dries quickly. A post catalyzed finish is similar to the conversion varnish used on most kitchen cabinets and provides a hard, durable finish that will wear better in a library environment. The finish totally "cures" over the next 30 days, however over the next 24 hours this curing process stretches the finish into a tight, almost totally smooth finish. To "build" the finish you must lightly sand 320 grit foam backed paper between coats. At least 30 minutes after the previous coat we sanded the units and were ready to spray again another coat. We applied four coats to each "gondola" to reach a film thickness of approximately 5 mils wet, leaving a 2 mil dry protective coating after all the solvent vapors have left the finish. The units looked very professional after the finish cured.

Some observations:

I have had trouble with a stringing or fuzziness of the finish when I spray with lacquer. Chip indicates that is normal for the first application and does not indicate you are doing anything wrong.

If the finish turns white in color (called blushing) it means you are spraying when the humidity is too high.

I was surprised with the high volume, low pressure sprayer how close his gun tip was to the work. Six inches seems like you are almost on top of the piece.

I know you are supposed to over-spray the unit by going past the furniture with a sweeping motion of the gun. I didn't realize you also need to keep the spray moving; I have stopped the spray and then started it again just for a second so I am not spraying everything other than the piece. Chip says he gets better results if he keeps the trigger pulled continuously.

The finish will look better if you spray in patterns horizontally starting at the top and then slowly moving downward. Move from one side to the other and then move the width of the spray downward and move from one side to the other. When it is totally sprayed, change to a vertical spray pattern going up and down and then moving the width of the pattern to the next vertical strip to accomplish. If you want to see "The Man" in action, you can join the Work & Learn group which meets in Oregon City by writing Bill Wood at willm.wood@gmail.com.

Radius of an Arc

Bob Oswald

Have you ever needed to swing a gentle arc and had to figure out how to determine the radius. We usually do it by trial and error. Given the end points of the arc and the high point, here's how to do it first time.

A is the distance to the top of the arc.

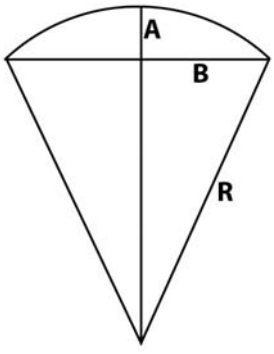
B is half the width of the arc

Doing a little trigonometry on the triangle starts with:

(B-A)^2 + (B/2)^2 = R^2

Solving for the radius gives:

$$\text{Radius} = \frac{A}{2} + \frac{B^2}{2 \times A}$$



Locating the center to swing the arc is simple. Take two pieces of string, each equal to the radius. Holding one end of one string at the right end of the arc and the other string at the left end, draw them tight and to a point at the loose end. They will intersect at the center.

The Guild of Oregon Woodworkers is a group of professional and amateur woodworkers like you, committed to developing our craftsmanship and woodworking business skills. The Guild offers many benefits for members, including:

- *monthly educational meetings*
- *monthly newsletter*
- *mentoring program to help members develop their skills in specific areas*
- *discounts*
- *woodworking shows*
- *network of business partners (the key to our development as members and as a Guild, providing additional learning opportunities)*
- *and a network of support.*

GUILD OF OREGON WOODWORKERS

P.O. Box 13744, Portland, OR 97213-0744

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