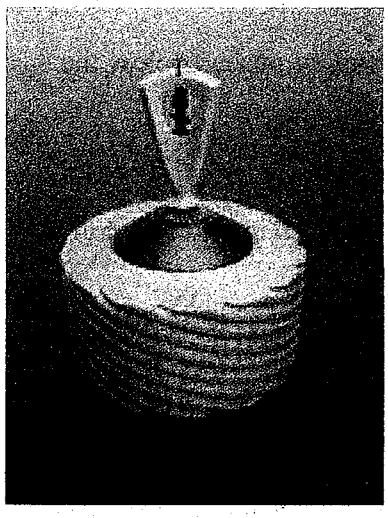
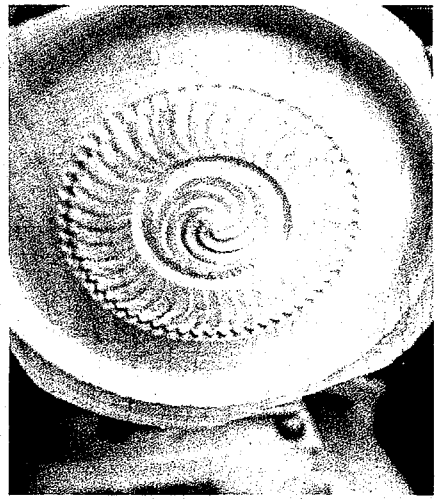






On-Lathe Textural Techniques

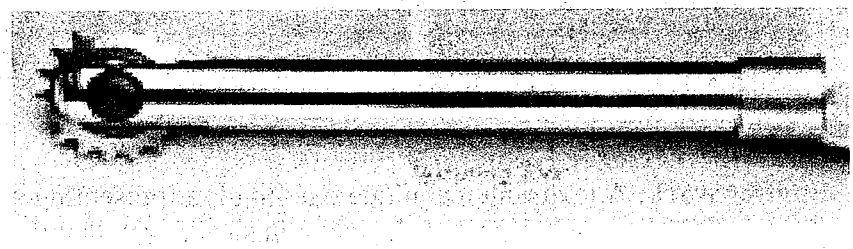
Chatter work: A texturing technique that involves presenting a cutting edge to the spinning wood surface in such a way that the resistance causes the tool to deflect and rebound in a millisecond, creating a textured surface that further perpetuates the vibration of the cutting tool.

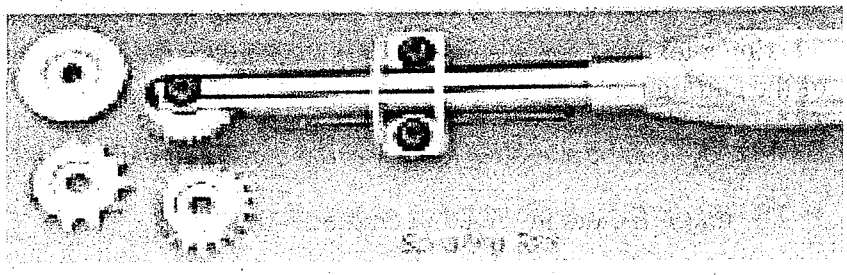
- Any tool can be a chatter tool- it is the cutting dynamics and conditions that create chatter
- The major factors involved in chatterwork are:
- **Material density:** end grain works best, due to the relatively even resistance, and the orientation of the fibers that allow for crisp detail. Side grain doesn't chatter as well due to the inconsistent resistance and the tendency for the fibers to compress rather then be cut
- **RPM:** the faster the work piece spins, the farther the surface will move between oscillations of the cutting tool. Slower RPM creates finer chatter / faster creates courser texture
- **Angle of tool presentation:** tools are more easily activated by pressure that is relatively perpendicular to the axis of the tool shank. The most effective chatter involves using the tool below centerline, at approximately the "7:30" position on the rotating surface relative to the axis of the lathe. The proportional area of edge contact to material density also effects the pattern, as does the orientation of the cutting edge relative to center.
- **Relative flexibility of the tool:** determined by the cross section of the tool shank and the relative distance of the tool rest to the surface being cut. The vibrating length of the tool produces a corresponding frequency: shorter = faster, requires relatively more force to activate ; longer vibrating length = slower frequency, requires relatively less force to activate.
- **Amount of force:** too little and tool won't chatter / too much and the texture becomes burnished or burned
- **Duration of tool contact:** over-chattering tends to pulverize the wood and ruins crisp detail
- **Direction of travel:** moving from large diameter to center tends to be better than from center out -due to the required 'flow' of wood over the tool required to make it vibrates

Embossing: can create detail in contrast to smooth surfaces.

- End grain embossing produces the best clarity of pattern since the fibers are simply pushed below the surface without bending.
- Cross-grain embossing sometimes requires the punch to actually sever the fibers.
- Common leather punches held in a simple device that fits into the tool rest base used in combination with indexing can produce interesting patterns
- The larger the surface area of the punch, the harder it must be pressed into the material.

Sorby Spiral Tools:

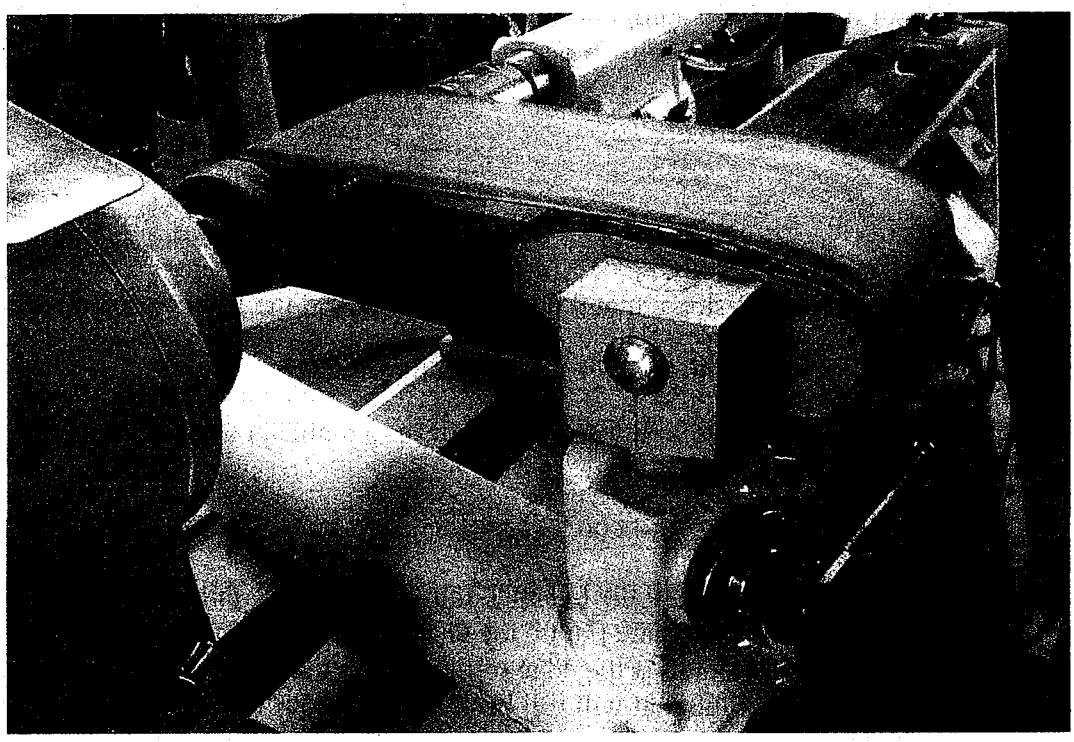




- SST wheels come in a variety of sizes and can be used to produce embossed textures and spiraled surfaces of different pitches
- Although the SST is advertized and demonstrated for use on side grain only, it can be used on other surfaces if a few factors are considered:
  - Material density: woods of even density produce more regular textures- avoid ring-porus woods like oak or ash
  - RPM: although slower speeds allow the cutters to work without jumping out of the cut, faster RPM is required for a cleaner cut and reduces the tendency for the cutters to cut deeper into softer areas such as side grain.
  - Angle of cutting edge presentation: the flatter the cutter is presented to the wood, the slower it will spin / the more angled it is, the faster it spins. If it is vertical, it will rotate in direct relation to the RPM of the spinning wood- engaging like a gear.
  - The wheels cut best at centerline- where the wood is flowing through the teeth vertically
  - Remember: the vertical edge of the wheel teeth is the control surface / the equivalent of the bevel
  - Think of the SST as a rotating negative-rake scraper. The cutting gear must rotate without vibration in the handle, which requires use of all 3 thin washers.

Sculptural Techniques for Small Turnings / Advantages of abrasive carving:

- Factors such as wood density and grain direction are of relatively lesser importance
- Creates less force to the surface being worked compared to conventional cutting tools
- Abrasive techniques provide a powered method of material removal that allows for hand-held manipulation of the work rather then requiring a static holding method of the piece.
- drums- commercial rubber drums- expensive, limited grit choices
- shop made rods & drums- can be made from turned rods covered with rubber or vinyl tubing. Spiral wrap with cloth-backed abrasives, secure with spray glue & tape the ends to prevent unraveling
- shaped sanding sticks- made to fit a particular form: use double-stick tape over 1/16" cork
- belts- a simple drum spinning in a drill press or in the lathe can drive a 3 x 24 or 4 x 24 sanding belt over a shaped block covered in graphite coated canvas.
- Turn a simple wooden drum to drive the belt. Be sure to slightly crown the drum so that the belt will track properly, and to give it adequate traction, cover the drum with rubber cut from motorcycle inner tubes.



Making Connections

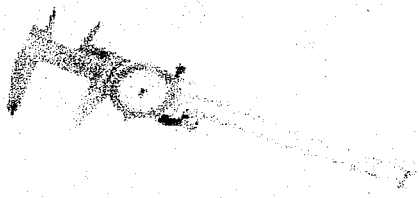
Drilling on the lathe: always cut a dimple in the center of the spinning wood to assure that the drill bit enters exactly in the lathe axis. If the drill bit is wiggling as you advance the tailstock ram, then the tailstock may not be accurately aligned with the axis of the headstock. This is a problem with many moveable headstock lathes

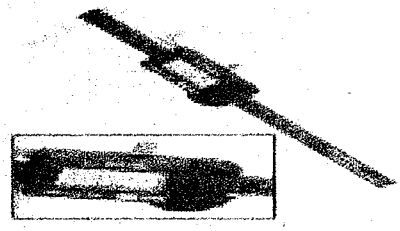
- Remember to ALWAYS hold on to the drill chuck when you are retracting it from the hole or it can pull out of the Morse taper in the tailstock and spin, burn the hole, or fall to the floor.
- Keyless chucks are now much more affordable, and when used on a morse taper with a CLEAN tailstock ram throat will produce accurate holes without slipping of the drill bit.

Calipers: Traditional "spring leg" calipers: be sure to file the tips slightly round, and make certain the legs are in the same plane and not bent. DO NOT wrap your hand around them or put your thumb or finger in the top spring- it can result in a disastrous and painful catch. To avoid a catch, hold them gently between finger and thumb from above and behind the spindle, perpendicular to the axis of the lathe, and in a vertical plane, *with gentle pressure on the top tip contacting the spinning wood.*

- Inexpensive stamped steel calipers that have a locking feature and can be used he spinning wood to set diameters with a parting tool. (General brand –available at home centers and Ace hardware stores)

- Dial or digital calipers: great for checking diameters with the lathe OFF. The thin contact points of the jaws will compress or cut the wood if it is spinning. (Can be purchased for under $20 from Harbor Freight and many other tool stores.)





- Very accurate tenons can be turned using a metal drill sizing plate and the following method:
  - Hold the tenon stock in a chuck and turn the tenon rough oversize
    - bevel the tip so that it is a bit less than the desired diameter and will start into a hole of that diameter
    - slow the lathe down to under 600 RPM
    - remove the live center from the tailstock ram, and with the tailstock locked tight to the bed of the lathe, place the drill plate flat on the end of the ram and use it to drive the plate over the spinning oversized tenon. If the edge of the hole in the metal drill plate is not rounded over, it should create e shaving that will roll back as the plate is forced onto the spinning tenon.
  - The shaving must be removed from the tenon to create a clean shoulder
  - Be sure to always have the drill plate flat on the tailstock ram and always moving on axis with the face of the plate perpendicular to the axis of the lathe.
  - Work down to the desired size by starting with larger holes and gradually reducing the tenon diameter.
  - This system doesn't work very well with plastic drill sizing plates

Hand-chased threads without using expensive woods
Getting clean and accurate hand-chased threads-

Contributing factors:

- Cutting geometry- grind / hone angle, clearance angle
- Angle of tool presentation and contact point relative to center.
- Relative support of the tool rest or moveable arm rest
- RPM: too fast = tool jumps out of the cut / too slow = tool cuts too aggressively in the softer grain causing the cut surface to be out of round and creates erratic threads. Speeds under 500 RPM work best.
- Proportions of bevel contact in relation to engaged cutting edges
- How much pressure is being applied- both axially and radially
- The feed rate and direction that the tool is being advanced into the material

Common problems with Hand–Chased Threads:

- Irregular "drunken" threads – caused by lathe running too slow, too much pressure, irregular feed rate, wrong cutting geometry, wrong tool rest position.
- crumbling threads / torn grain- the chaser could be dull, the tool rest is in the wrong position
- improper sizing / tapered threads- the handle should be parallel to the lathe axis when the final threads are cut.

Suggestions: Practice threading on short sections of PVC- it's cheap, readily available, and has very even density, so it is relatively easy to thread. However, it does stink when being turned, so use a fan and propereathing protection to divert the toxic fumes.

Sources of supply:

graphite canvas:	Econ abrasives	www.econabrasives.com
	WoodWorkers' Supply	www.woodworker.com
	Klingspor	www.klingspor.com
thread chasers & #2 MT sizing gauge :	Mark St. Leger	www.markstleger.com
Leather punches:	Tandy leather	www.tandyleatherfactory.com
Keyless chucks:	Woodcraft Supply	www.woodcraft.com

Hunter Carbide Tools: www.hunterwoodturningtool.com

Carbide inserts- Carbide Depot (10mm cutter recommended) carbidedepot.com/wood-turning.htm

Michael Mocho **www.mmocho .com** mmocho@mac.com

Cutting Dynamics: Critical Factors

Variables include:

1. **Material**: characteristics / specifics:
    a. grain orientation
    b. density / hardness
    c. moisture content
    d. figure
    e. specie
    f. abrasive quality of the material

2. **Tool selection**:
    a. shape
    b. size & proportion
    c. sharpness:
        I. cutting angle
        II. edge quality: relative roughness & durability
        III. proportion of cutting edge support (bevel contact) to edge engagement

3. **Angle of edge presentation / tool path**
    a. Tool Rest Height: relative to thickness of tool
    b. Area of cutting edge contact on the wood (usually midline or a bit above)
    c. Stance & Dynamics: linear / rotational
    d. Grip: hand position and stabilizing contact points
    e. Lathe height relative to turner

4. **RPM:**
    a. relative to material density (cutting resistance)
    b. proportion of surface area being removed
    c. speed of tool travel

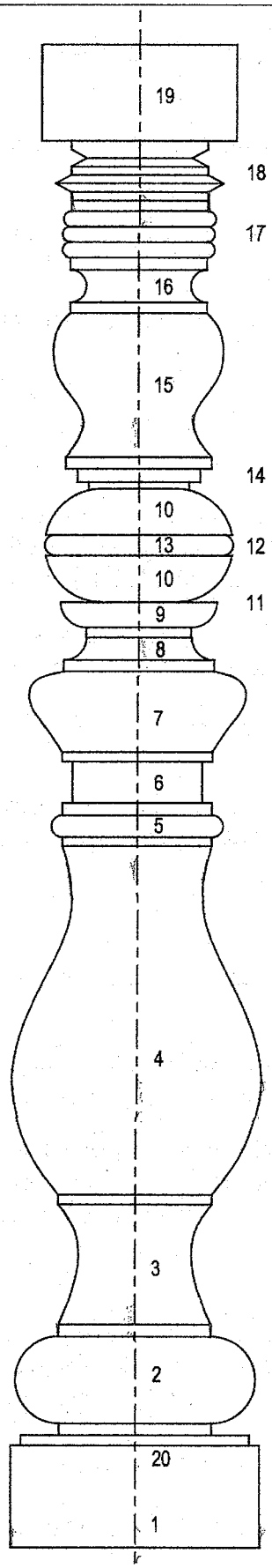
5. **Pressure**:
    a. On wood: firm bevel contact (control surface) to support edge engagement
    b. On to tool rest: takes the "punch" of the rotating wood forces

The cutting edge is supported by:

1. the tool rest
2. the bevel riding on the surface of the wood
3. proper hand grip

Effective cutting control requires the proper amount of pressure in the right places- to both move the tool into the wood *while also holding it back.*

6. **Other elements**:
    a. Equipment condition- headstock bearings / power / ease of adjustments
    b. Environmental factors:
        I. Lighting
        II. Temperature
    c. mental attitude: adequate patience & awareness are essential



SPINDLE TERMINOLOGY

1.	PLINTH	Large straight sided base
2.	TORUS	large semi-circular shape
3.	SCOTIA	Sunk in ovoid
4.	OGEE	"S" shape usually asymmetrical (large bulge below is Ogee (cymarecta)
5.	ASTRAGAL	Semi-circular form (smaller than a Torus)
6.	NECK	Straight section in upper area
7.	OVOLO	Protruding segment of an ellipse
8.	QUARTER	*Hollow (concave)*
9.	QUARTER	Round (convex)
10.	BALL	Can be elongated into an ellipse
11.	QUIRK	Transition between elements 9 & 10
12.	FLAT	end of the quarter round
13.	BEAD	beads are cut into surface (astragal protrudes above)
14.	FILLETS	3 stair stepped in reverse
15.	OGEE	large bulge above (Ogee, cyma-reversa)
16.	CAVETTO	cove semi-circular hollow
17.	REED	uniform series of beads, 3 or more.
18.	"V cut"	straight sided cut - positive or negative.
19.	ABACUS	straight sided section at top
20.	SCAMILLUS	secondary block or plinth, smaller than the plinth & without moulding.

Drawn by Geoff Whaling V1 Jan 2011

Lathe set-up: safety, manners, & protocols

1. ***EYE PROTECTION IS NOT OPTIONAL***- both at the lathe and when using the grinder. A full face shield is better protection for larger diameters work.

2. ALWAYS spin the workpiece by hand (use the handwheel) before starting the lathe to be sure it swings free of the tool rest.

3. It is good practice to always turn off the lathe when adjusting the tool rest, especially on large diameter pieces or out-of-round work.

4. When adjusting the tool rest- *put the tool down first!* Either set it in the rack (best) or tuck it under your left armpit while you loosen and move the tool rest base.

5. NEVER walk away from a lathe that is running!

6. NEVER leave the spindle locked when you leave a lathe!

7. ***Always*** turn the electronic speed dial DOWN (counter-clockwise) when you finish using a lathe, and see that the belts are returned to the mid or low range. Bring the speed up slowly- especially on large or un-balanced work. Stay within the capacity of the lathe and do not attempt to turn when the lathe is shaking.

8. Clean out the spindle throat on the headstock and the tailstock ram before inserting the morse taper drive, chuck, or live center. Even small bits of wood can cause the taper to run off center or damage the throat.

9. When using the knock-out bar, catch the taper when it comes loose to avoid it hitting the lathe or floor and mashing the pointed tip.

10. Be sure to tighten the tailstock to avoid it creeping on the bed when you turn. Check to see that it isn't sliding by placing your finger on the tailstock base where it meets the bed while you crank the tailstock in tight.

11. Keep the tailstock ram tight- especially in soft or wet wood.

12. When drilling on the lathe, always hold on to the Jacobs chuck- especially when retracting the bit. It can easily pull out of the taper when the pressure isn't into the tailstock

13. Be certain that the chuck key is inserted all the way before tightening or loosening the chuck. Always tighten the jaws firmly- using the key on both sides of the chuck- especially on soft or green wood.

14. When unscrewing the chuck- either lock the headstock or use the spindle wrench against the tool rest to loosen the chuck, then place your right hand under the chuck body to take the weight and use your left hand on the outboard handwheel to unwind the chuck from the spindle. *DO NOT twist the chuck off using your right hand!* - It is just too easy to drop it.

15. Use of the compressed air hoses:
    a. Wait till the tool are put away, the lathe is brushed down, and the bulk of the shavings are swept away from the lathe ***before*** using the compressed air hose. The air is to be used for clearing out small amounts of wood dust from hard to reach places- *it is not intended to replace a broom, dust brush or shovel.*
    b. If there are ambient air filters, turn them on and encourage everyone to wear a dust mask before using the air to blow the wood shavings in the corners.
    c. ***Use the air as little as possible.*** *Short bursts* rather than a full-out barrage works better, and puts less strain on the compressor and everyone's lungs.

Thank You

Woodturning Reminders:

1. **Woodturning is a form of carving:** *always know the proper cutting direction in relation to grain:*
   - Spindle turning: *grain parallel to lathe axis* / cut from large to small diameter on exterior forms / cut from center to large diameter on concave / end-grain forms
   - Bowl or Faceplate turning: *grain perpendicular to lathe axis* / always cut so that wood fibers are in compression; cut from small to large diameter on exterior surfaces / large to small on interior (concave) surface

2. **Turning is not about strength**: steer the tool / let the lathe motor do the work. A sharp tool moving at the right angle has very little cutting resistance unless the shaving is too thick.

3. **ANGLE IS EVERYTHING**: learn how to find the exact "sweet spot" where the bevel and the edge stay on the wood at the same time.
4. Any turning tool is stabilized in the cut by: **A. your grip, B. pressing the tool to the metal tool rest, and C. rubbing the bevel and the surface of the wood**

5. **A CATCH is always the same thing:** AN UNSUPPORTED CUTTING EDGE
   RUB THE BEVEL! *RUB THE BEVEL!* *RUB THE BEVEL!*
6. The first part of the tool that should touch the spinning wood is the bevel- **NOT THE EDGE**

7. **A good cut starts at the floor**: stance and body movement are critical factors

Spindle turning: shift your weight / very little movement with your arms / if your BUTT doesn't move with the tool, then you tend to rotate at the torso, which always effects the angle of the tool and makes a smooth cut much more difficult

Bowl / Faceplate turning: Move with the tool / more than just your arms / move from your ankles with smooth, fluid movements to create smooth curves

8. **A rough surface under the bevel creates a rough surface ahead of the bevel:** (especially if the cut is made with too much pressure). If the tool is riding on an uneven surface, the cut will only produce another uneven surface. Tool oscillation is caused by the tool riding on an uneven surface. Keep the tool steady as it cuts using adequate pressure on the tool rest.

9. **Don't attempt to correct a rough surface by using more force-** *it just doesn't work*. The only way to smooth out a rough surface is to cut off the high spots using a sharp tool with a light cut at the proper angle and pressure. (Higher RPM may help- the low spots go by faster.)

10. **The shape of the tool path becomes the shape of the form:**
Controlling the thickness of the shaving controls the shape of the form.
Learn to visualize the desired form inside the one you start with.

Effective Turning is rooted in:

- ❑ Understanding the cutting dynamics & variables
- ❑ Proper Stance & Body Movement
- ❑ Sharpening skills
- ❑ ***Feel:*** **knowing how much resistance is appropriate-** *firm* but not heavy pressure on both the tool rest and the bevel produce the best cutting action and surface quality

➢ Self-judgment can be one of the largest obstacles to skill development: Beware the pitfalls of trying to turn in a competitive environment- *especially with un-realistic ideas about where you think you should be.*

➢ You can't turn your 100th bowl first: ***TRUST IN TIME- your skills will improve by thoughtfully practicing the proper techniques!***

➢ Experience is meaningless without increased awareness / Experience is what you may get when you proceed without it.

Michael Mocho / Fine Woodworking

813 Headingly NW, Albuquerque, New Mexico 87107 www.mmocho.com e-mail: mmocho@mac.com 505 345-4674

Learning to Chase Threads by Hand: A Sequential Approach

The following notes are my attempt to share some of what I have learned and discovered about chasing threads by hand. Threading is a very old technique- it has been done for hundreds if not thousands of years, and is a HUGE topic that has been well documented and yet often mis-understood. Entire books have been written on the topic, yet there are seemingly endless nuances, details, and opinions about how it is done. Please understand that this is only my subjective approach, and an attempt to share some of the strategies that have worked for me. Trust that you will find what works for you given patience and practice. My hope is that some of what is described here will help you develop your abilities with a little less frustration. GOOD LUCK!

Threading myths:

Many people have stated that only certain woods are hard and consistent enough to be used for making threaded boxes. The belief that you must use ***only*** expensive woods like boxwood, blackwood, cocobolo, ebony, lignum vitae, etc. is HOGWASH. These woods certainly thread wonderfully, but are not essential- any material with relatively consistent density means that the cutting resistance is constant, and the tool won't be sinking into the soft spots, there by creating an irregular "drunken" thread.

I have found several little tricks for cutting crisp threads on domestic woods without chipping or torn grain, and have come to believe that if you can learn to thread on hard maple, then exotic woods will be a real treat.

Material selection:

I've had mixed results with attempting to thread softer woods -like big leaf maple, 'ambrosia' (southern) maple, or some species of walnut- I've found that the density of the annual rings seems to be a key factor, and some pieces just won't work, even with a very sharp chasing tool. Same thing with mahogany & cherry- the heavier, denser, tight grain pieces are your best bet.

I don't do much cross-grain threading- it creates at least 2 quadrants of every revolution that must be cut against the grain, plus the wood movement is across the axis of the threads, and results in a slightly oval diameter, which can lock a threaded wooden box closed when the humidity goes up.

I like to make boxes with the grain parallel to the axis of the lathe, I can get perfectly smooth threads on regular hard eastern maple using the methods described below, unless it is a particularly soft piece- with wide annual rings or 'punky' grain.

Practice:

Thread chasing is not "genetic information"- with a little patience and practice, just about anyone can learn to do it.

A great material to practice hand-chasing on is a short section of PVC pipe- any diameter. Although it stinks a bit when cut- and caution must be used to avoid catching the long shavings in the spinning chuck- It has a very consistent density, unlike most woods. The even cutting action will help you develop a feel for the chasing process before you try chasing on the irregular density of wood. Finding the right combination of variables: RPM, tool rest adjustment (keep the cutting action at centerline or just a tiny bit above), rate of tool advancement, and the number of teeth engaged in the cut (determined by the angel of cutter approach) are the elements of successful chasing.

Sequential Practice Approach:

Learning to chase threads by hand really isn't all that difficult, but it takes some time to get the feel for moving the tool towards the headstock at the proper steady pace in relation to the RPM. In order to help you develop that pace, I recommend that you try this sequence of practice exercises- they will help you gradually develop the feel for chasing threads by hand:

1. With a piece of maple (or PVC) rotating on the lathe at around 350 to 450 RPM- position the tool rest at centerline, and parallel to the axis about 1/8" away from the surface of the material.
2. Starting on the right (tailstock) end, use a sharp pencil horizontally, strike a line on the rotating piece from right to left with a steady movement. Keep the pencil perpendicular to the axis, and imagine that the line you are drawing is cutting a thread. Try to keep the horizontal spacing of the lines even as you move. You may find it easiest to accomplish this if you first practice the movement from right to left several times before you actually touch the pencil to the spinning wood. Rather then move the pencil with your arms alone, simply shift your weight from right foot to left foot and move from your ankles, keeping your upper body and arms still. Try not to rotate your torso at the waist- move parallel to the bed of the lathe by shifting your weight from right foot to left foot.
3. When you run out of length, return the pencil to the right end and try to strike the same line you just drew. Slow the lathe down a bit if it helps you to follow the steady spiraling line, and keep moving evenly- don't hesitate.
4. You can erase or sand off the pencil marks and repeat the above exercise as many times as it takes to establish a feel for the pace of movement in relation to the rotation of the test piece. Once you start to feel you are getting it, then try the following:
5. On a clean fresh surface, hold the pencil steady and at a point about an inch from the right end of the rotating piece so that a continuous line is drawn all the way around the turning cylinder. Draw several more lines spaced about 1" apart all the way down the rotating cylinder.
6. Using the pencil, strike a line in a steady motion up too but not past the mark. You will have to lift the pencil off the surface just as you approach the mark. With practice and a quick reaction

time, you can learn to get your spiral close to the mark without going past it. Once you can do this consistently you will be ready to strike you first thread with the chaser.

7. When you try your first cut with the chaser, don't worry about stopping it at a shoulder or on a drawn line- just move steadily at the right pace so that the teeth engage into the cut. Notice that when the chaser engages into the cut, it doesn't require any force to move the chaser from right to left- it will automatically pull the teeth across the cut as long as your body is moving with it at the same rate.
8. Once you have struck the thread with the chaser, practice dropping the chaser back into the cut, and play with the height of the handle to control the cutting action: rasing the handle will result in a more aggressive cut, dropping the handle will slow or stop the cutting action. Try to keep your movements steady without hesitation, and keep the tool perpendicular to the axis so that several teeth are engaged. **Don't let the first tooth on the left side of the chaser do all the cutting!**
9. You can use the pencil technique to practice the pace of movement on the interior (female) threads too. Drill or turn a hole and position the tool rest so that you can strike an evenly space line on the inside of the hole while it spins at about 350 to 450 RPM.

"Drunken" Threads:

As you know, the first strike of the chaser determines the thread- **you can only deepen the first strike, so if it isn't right, don't waste time trying to correct a 'drunken' thread-** cut it away and try again. This is why I don't make the undercut on a box until I have a good thread established. The drunken thread and the groove must be cut away- if there is no groove yet, I don't have to remove as much wood and the box won't loose as much height.

Interior threads:

Most boxes do not need more than a full rotation or two, but it makes more sense to thread a wider section and then cut some of it away. This allows the chaser to cut more smoothly because more teeth are engaged and it distributes the pressure of the cutting action over a larger surface.

I start by deliberately striking the thread at an angle, before making an undercut where I want the thread to stop. The tool rest is set perpendicular to the axis, and the rest height is adjusted so that the cutting edge of the chaser is *very slightly* above the centerline at the 9 o'clock position. The handle is always kept horizontal (parallel to the floor).

With the piece rotating at about 350 to 450 RPM, I practice the motion of the tool a few times before touching it to the wood. Practice will help you develop an instinct for this speed. The first actual contact of the teeth is very gentle- almost a "pretend" cut. By repeating this steady motion you will soon notice that the tips of the teeth will fall into the track without much force. I am careful not to push the chaser into the cut- it will simply be pulled by the screw action of the wood engaging the chaser.

This is the moment where you need to determine if the established cut is even and not "drunken". The chaser should be pulled at a steady rate of motion, not slightly faster and then slower. If it is noticeably irregular-STOP! Don't bother to keep cutting- it is just a waste of time, because you CANNOT correct a drunken thread. Cut away the entire groove, and strike a new one.

Once I know the interior thread is off to a good start, I can bring it to final depth parallel to the axis of rotation, but I only finish the thread after the interior of the box has been completely cut, sanded, and finished. This prevents problems of accidently sanding the finished thread.

The more the cutting action is spread out over a larger surface area, the less aggressive the cut of each tooth, and the less tendency for the threads to chip out. Starting the thread cutting action with the tool not quite parallel to the axis of rotation, but no more than about 15 degrees off, and try to keep the tool level (parallel to the floor), with the cutting edge ever so slightly above center.

If I get a bad start, I can trim the opening down past the bad thread before any undercut, so I won't have to remove any more wood than absolutely necessary. If I had already made the undercut slot down in the interior, I would have to cut all the way down past it before attempting another thread. I can always make the box a little shorter. It is important to use the proper terminology, especially if someone is watching you. This is called a design modification, not a screw up. (at least for the first three attempts).

Why I don't make an undercut groove on the female threads:

Lately I have been undercutting the ***entire interior*** after I get a good thread started rather then using an undercut tool to create a groove or slot. I prefer to cut the interiors using one of Jack's McDaniel's marvelous 'Eliminator' tools: www.jewelwood.com/products, the 10mm Hunter carbide tool,(http://www.hunterwoodturningtool.com/) or one of several home-made variations that all have the same super fine-grained super hard carbide cutters. I ALWAYS cut with these tools at a 45° angle- never flat- so that they shear cut rather than scrape. I rarely have to use sandpaper to refine the surface, and it is never courser than 220 grit.

Boxes:

I have found that by threading the interior (female) side of the thread first and fitting the tenon (male) side to it I get better results, though fitting interior to exterior will work too.

To try and clarify the sequence- it goes something like this:

1. Chuck what will become the female thread and turn or drill the interior to the desired diameter and depth. If this will become the bottom of the box, I will go to full depth in stages, being sure not to let the forstner bit choke in the bore by jammed shavings. The heat from the drilling process makes any moisture in the wood expand the shavings and they tend to prevent a forstner bit from backing out if the hole is drill in one plunge. If the shavings are not flowing out of the hole behind the bit, it is time to retract it so they will clear. ***Be sure to hold on to the drill chuck as you crank it out so it does not pull out of the Morse taper in the tailstock!***

2. I slightly round the corner if the hole edge to allow the chaser to enter without catching.

3. I slow the lathe down and apply just a few drops of threading lubricant to the area I am going to thread, waiting at least 15 seconds for it to soak in. (more detailed information about the lubricant below).

4. I set the RPM to the proper threading speed and practice the movement of the chaser before is actually touches the wood.

5. The first strike should be done with a smooth determined stroke- light pressure and towards the center of the bottom of the hole- with as many teeth engaged as possible. I deepen the thread gradually, applying more lubricant of the cutting action seems to indicate that the wood is tearing. I let the threaded section continue well down into the hole- usually more than ½", until I know it is well established.

6. If the first (or second or third or tenth) threading attempt doesn't work, I consider the beauty of a proportionally shorter box, and remove the drunken thread, adjust the RPM, and try again. Since I have only mis-cut the first few threads of the box, I can usually start over by removing less that 1/8" of wood. (Can't do that if you have already undercut).

7. Even though the threads are still tapered, I either undercut them with the undercutting slot tool, or I removed all but the first 1/8" to 1/4" with the Eliminator- enlarging the interior diameter of the bore below the section of threads I want to keep. Often I cut almost all the way to the bottom of the bore, trying to move the cutter at a steady rate so it cuts a smooth interior that will require less sanding.

8. I use a pair of locking surgical forceps that hold a piece of cloth-backed abrasive wrapped over a small wad of steel wool for padding, and sand the interior smooth, avoiding the threaded section.

9. I cut the interior threads to final depth- gradually moving the chaser handle so it is parallel to the axis of rotation. Clean off the ways of the lathe bed so you can use them as a visual reference –sighting over the handle of the chaser- to see that your final cuts are done with the **chaser handle parallel to the lathe bed.**

Cutting the tenon threads:

1. Prepare the tenon by sizing it about 3/32" larger then the hole you just threaded, and it is OK if it is slightly tapered.
2. Round off the corner of the tenon- about a 1/16 radius- but DO NOT sand it. Even a little grit that gets caught in the grain of the tenon will gradually dull the chaser.
3. Don't make the relief cut where the tenon meets the shoulder- not just yet. The reason is that if the thread should get ruined on the first try, you can remove only a little wood and try again, rather then having to cut off the entire tenon at the shoulder. Once the thread has been properly struck, and you are certain it is running true, then make the relief cut so the parts will screw together all the way to the shoulder stop.
4. When cutting the threads on the tenon, the first critical strike of the chaser should be at an angle rather then perpendicular to the axis of the lathe. This means that you DO NOT cut with the first tooth of the chaser (the first tooth on the left side of the male chaser). The rounded corner, a light touch, and a little lubrication will help to keep the chaser from stopping and running the thread.
5. Once the thread is established, use the pre-threaded female part and see if the thread will start to engage when you screw it on. *Be careful not to over tighten the thread if the tenon is still tapered- it can split the female part!*
6. Make note of how far the female piece screws on to the tapered tenon, remove it from the tenon, then bring the RPM back up in order to reduce the tenon diameter with a skew or bedan- cut clean, yet leaving some of the first strike of the thread.
7. Apply more lubricant and re-strike the thread
8. Gradually reduce the diameter of the tenon until the female part screws on, but don't screw it all the way to the shoulder until the relief cut is made.
9. The relief cut can be made with a thin parting tool, but I prefer to cut a clean "V" cut in the corner where the shoulder meets the tenon. I think it looks cleaner than the square cut made by the parting tool, and terminates the threaded section with a little more grace. A parting tool also tends to tear or fold the end-grain fibers of the shoulder, so cutting the end grain surface with a small sharp skew makes a cleaner surface. Make a small V cut with a skew (point down), but no deeper then the deepest part of the thread.
10. The wider the relief cut, the more milliseconds you will have to pull the chaser out of the cut before it touches the shoulder. It will be come obvious that letting the chaser hit the shoulder will immediately ruin the threads unless you withdraw the tool. Stay alert, and don't hesitate!
11. If the threads are well established, if often helps to slow the lathe down a bit so you can make the final cuts with the chaser all the way to the relief cut and have a few more milliseconds to pull the tool out before it ruins the threads. The slower speed can compromise the quality of the cut and surface smoothness, so there is always a trade off.
12. Once the relief cut is made, be careful not to over-cut the threads, which will result in a loose fit. This means that the threads may not fully engage and over-tightening can break the tips off the threads. The only solution to correcting over-cut threads is to remove the entire tenon and re-establish the thread.
13. It is possible to match the gain exactly by trimming the shoulder until the lid stops where the grain matches. (This is more likely when the amount of wood removed when parting the two pieces and the length of the tenon are kept to a minimum). Thin parting tools can

help, as well as the use of pre-sized thread starters. Caution is required so that the shoulder is not over-cut, which will require the removal of more wood - the distance of one full tooth width- so that the female thread screws on almost one full rotation more. The resulting tenon goes deeper into the recess, and sometimes doesn't look so good with the wider relief cut, and it also reduces the amount of engaged thread, creating a weaker connection of the parts.

14. There is certainly no rule that the two parts being threading together have to match grain, or even be made of the same wood. I find it useful to deliberately emphasize the interface with a bevel, step, cove, or some other detail rather than always risk a perfect grain match. A perfect match may look great for a while- especially on smooth cylinder or egg shaped boxes, but the delicate edge tends to eventually become more obvious over time, so I think it is better to deliberately ease the seam to make it look more intentional, rather that attempt to conceal it.

Details:

Buying and preparing the chasers:

I have used many brands of chasers- Sorby, Crown, Ashley Isles, I prefer the chasers that Mark St. Leger sells. They are double ended and retract into the spiffy wooden handle to protect the teeth from damage. They work great, cost about $75, and are available in 20 or 16 TPI from Mark at: www.markstleger.com Although they are not listed on his website, just call or write him to find out if he has any left, or when the next batch will be ready.

I use 20 TPI up to about 2" and 16 TPI for anything bigger. The finer the thread chaser, the easier it is to use, but the shallower the engagement of the parts, and the tighter the diameter tolerances have to be for the two parts being screwed together

Which ever chaser you purchase, (unless it is a St. Leger) it will most likely require a little tune-up before it is ready to use.

On the male chaser- take a good look at the first tooth on the left corner- it should be a FULL TOOTH, not a half tooth. If there is less that a full tooth on the left side, then grind it away until the next tooth becomes a full tooth. Make sure that the tips of all the teeth are in a straight line, and it helps to slightly soften all the shape edges of the tool shank

Make sure that the first tooth on the interior (female) chaser is also a full tooth, and that the edges of the shank are eased so as not to dig into the tool rest.

Some chasers are made with the notches that form the teeth cut perpendicular to the top surface of the chaser. Good chasers will have the grooves of the teeth *slanted* to match the pitch of the thread so the wood can flow through them with less friction. Perpendicular chasers can be corrected by grinding the underside of the tool until the teeth are properly angled as it sits on the toolrest- remove just a little metal on the left underside of the chaser to make it lean towards the direction it cuts- a minor detail, but it makes a difference in the quality of the cut.

Sharpening thread chasers:

I have found most chasers as you buy them are much too aggressive to use on softer woods- they are usually ground to a less than 90 degree angle, and I have had much better success by grinding a short negative rake bevel on the top of the teeth. Even just honing the tops of the teeth at a 5 to 10 degree slope will slow down the cut enough to force the chip back into the cut and thereby compress the fibers a bit where the cutting edge is breaking them off. This slower cutting action combined with the lubrication prevents the fibers from crumbling like a dry cracker, and seems to actually compress and burnish the threads.

Important factors:

Tool rest height:

The cut should occur at the 9 o'clock position- this is where the wood is moving vertically, and the cutting forces travel directly into the tool rest. Cutting higher or lower results in the tool being slight pulled into or forced away from the surface of the spinning wood. Keep in mind that just like every other turning tool, chasers have a bevel that functions as the control surface for the cut. The tool rest height determines how much of that control surface rubs on the wood and thereby how much resistance prevents the teeth from cutting too aggressively.

RPM:

Finding the proper RPM for a given diameter is a matter of experimenting. Too fast and the chaser jumps out of the cut -or in the case of cutting the male thread with a shoulder- rips off the threads when the tool hits the shoulder and stops advancing. Too slow and the chaser cuts deeper across the flat-sawn areas and less deep across the quarter-saw surfaces of the grain. Softer materials and smaller diameters require slightly higher RPM.

Once I have found the proper RPM of a given diameter, I simply put a mark on my lathe's speed dial so I can remember the speed in the future. The RPM range tends to be between 350 to 550 on most diameters under 4". Fine-tuning the RPM for a given material an diameter will come with time and experience. (Experience is what you tend to get when you proceed without it).

Pressure:

As stated earlier, the more the cutting action is distributed over a given surface, the less each individual tooth sinks in. This is why I always make the tenon I am going to thread (male thread) about twice as long as I need, especially on softer woods and smaller diameters. The extra length allows the chaser to 'float' more and I can gradually thread up close to the shoulder without destroying the threads, and the teeth are less likely to cut a drunken thread because I can use a slightly higher RPM if I have a few more milliseconds to engage the chaser in the cut before I have to remove it. It is easier to remove the unwanted length rather than attempt to perfectly engage fewer teeth on a shorter tenon. This can be especially difficult on a larger diameter tenon where the delay is longer between the moment the first tooth cuts and the next tooth engages in that cut.

One way to reduce the risk of ruining the tenon is to use pre-threaded thread starters (see below).

Lubrication:

I have discovered that the application of just a few drops of a lubricant can create a much smoother cutting action, and can prevent grain from crumbling. I have found that the chips come off the cutting edge more like 'slurry' than as dust, and it seems to make the fibers a bit less brittle. I have been using regular 'Dawn' dishwashing liquid, sometimes thinned about 10% with denatured alcohol or glycerin- anything to make it thin enough to penetrate just a bit, but still viscous enough to also remain on the surface. I have a small squeeze bottle with a thin tip, and slow the lathe down as far at it will go so a few drops will roll over the surface of the area to be threaded and gradually sink in. Waiting about 15 seconds before I bring up the rpm and start cutting allows the juice to sink in a bit and soften the wood. Because I tend to finish with shellac and wax, I haven't had any issues with the lubricant interfering with the finish, though it may effect lacquer or other finishes a bit. I don't apply so much that the stuff splatters the box interior, and once the threads are cut I like to rub wax into them and take out the excess with a rag and a toothbrush.

The lubricant makes the chaser gum up, but my theory is that the crud in the teeth also makes the chip compress as it comes off the cutting edge, so it doesn't rip out the soft grain as it crosses over the hard grain.

I have also tried using wax as the threading lubricant, and it seems to work fine, though the thread chaser can scrape it away more quickly than the liquid soap that tends to sink in a bit more.

Matching diameters:

If the threaded tenon (male) starts into the threaded hole but seems too tight, **don't attempt to reduce the diameter with the chaser**- it almost always causes the threads to crumble as the wood hits the bottom of the tooth groove. It is better to slightly reduce the diameter taking off just the points of the cut thread with a light cut from another tool (parting tool, bedan, scraper, or skew) and then deepen the remaining thread with the chaser to get the proper fit.

I have found that coloring in the areas to be threaded with a soft red pencil can help you to see when the chaser has cut deep enough to make a strong thread, yet still leaves a bit of the original surface on the points of the thread to assure that you haven't bottomed out the chaser. Once the thread is fit, the remaining red marks are easily removed with steel wool.

Using threading starters:

One useful trick that I have discovered makes it possible to thread even a short tenon by using a thread starter. A short pre-threaded section of wood that matches the diameter of the piece to be threaded can be pressed up to the end of the blank in the chuck by using the tailstock. The chaser can be engaged on the existing threads, and once the chaser is allowed to move onto the uncut blank, it will already be moving at the proper rate driven off the pre-threaded piece. This makes it much easier to prevent drunken threads on the tenon (male thread), and is also the best method for cutting threads on a short tenon that would otherwise be unlikely to have enough surface area to allow for accurate threading.

Making thread starters that are matched to nominal sized (preferably carbide) forstner drill bits can provide a level of certainty that reduces much of the risk involved with chasing male (tenon) threads boxes.

I believe it would also be possible to make a pre-threaded started ring for striking interior threads, though I have not bothered to try it. It would be essential to temporarily attach the interior thread starter ring in front of the hole to be threaded so that it is secure, yet could be removed after the interior thread has been successfully struck. Chances are it may not be worth the effort, but if you try it, please contact me and let me know how it works.

The "Arm Brace":

Although I have used the arm brace that Allan Batty and many others employ when cutting interior threads, I have come to find it unnecessary- as long as the cutter is sharp, and light cuts gradually deepen a properly struck thread. The one advantage that I think it provides is that it can be used to restrict the lateral movement of interior chaser so it will cut at constant depth- regardless of the consistency of the rotating wood. The hook on the arm brace prevents the chaser from moving away from the surface you are threading, though only if the arm brace does not move towards the axis of rotation. The circular motion of the chaser that is described in the Batty video- in which the vertical position of the chaser is slightly varied by the use of the arm brace as the interior thread is struck- seems to be one method by which the cutting action is regulated. This has more to do with the relative position of the chaser and its point of engagement on the wood in relation to center line (the horizontal plane running perpendicular to the axis). The aggressiveness of the cutting action is controlled by adjusting the presentation angle of the chasing tool, and thereby the proportion of bevel contacting the wood. Tilting the top of the chaser downward has the same effect as a negative rake grind, except that it reduces the proportional contact of the bevel and thereby the beneficial resistance.

If the chaser is not held precisely horizontal- that is, if the handle is dropped or raised as it travels inward- then the resulting thread may not be accurate and the lid will **not** contact the shoulder evenly when it is screwed on.

Other threading strategies:

Making prepared inserts- both male and female threads can be turned out of a suitable material (i.e. boxwood) and then glued into a prepared hole in any wood.

For large diameter threads- such as creamation urns- pre-threaded inserts can be cut off of existing PVC, ABS, brass of other metal components and epoxied in place, though it is essential to compensate for hygroscopic movement.

Acknowledgements:

Any success I have had with hand chasing is due to the instruction, feedback, encouragement and support I have received from the following people. I am very grateful for their help and generosity in sharing what they have learned:

Mark St. Leger

Alan Batty

Stuart Batty

Bonnie Klein

Dale Larsen

Mike Mahoney

Chris Stott

Richard Raffan

Mike Darlow

PASS IT ON! Once you learn this (or any other) technique, I ask that you share it freely with anyone who is interested in learning it.

Thank you,

-Michael Mocho

www.mmocho.com