

## Lathe and High Speed Grinder Training Guide

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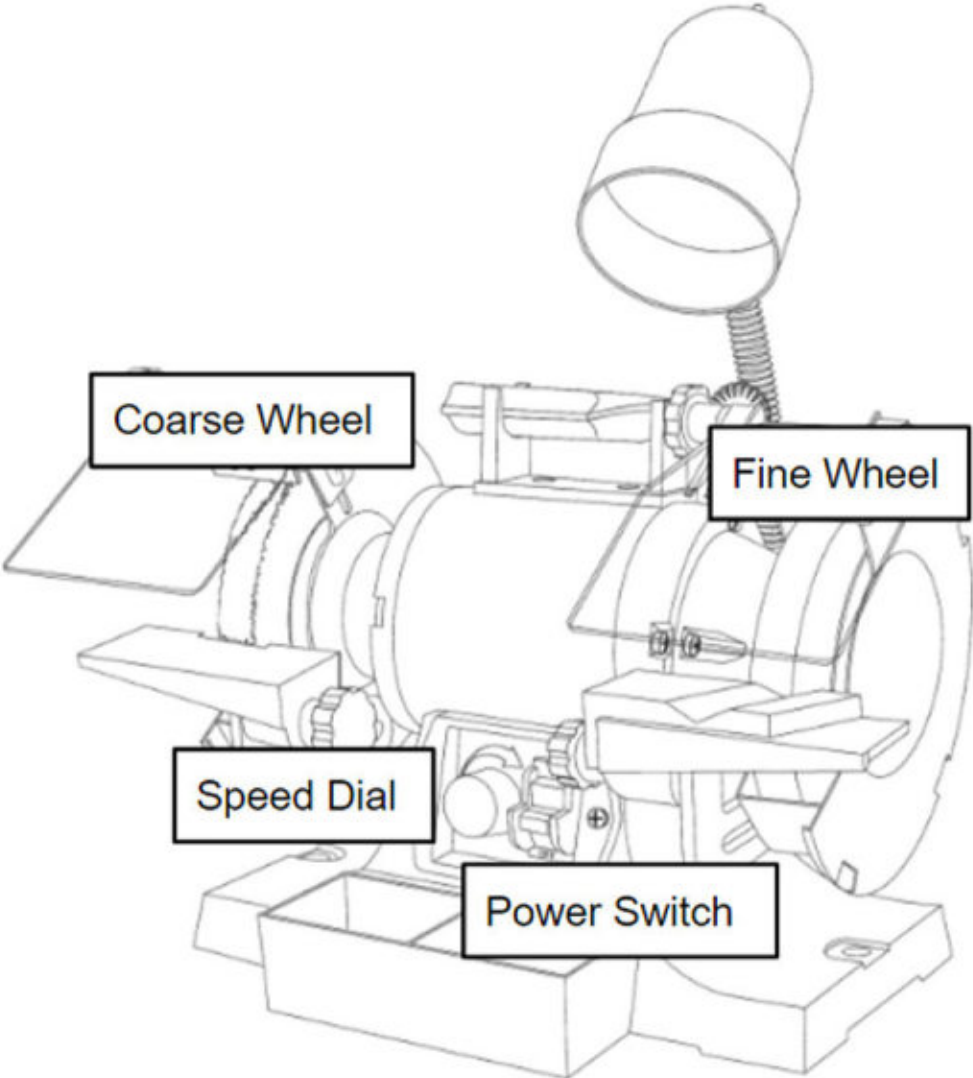
## **Bench Grinder Safety Rules**

1. Wear proper personal protection equipment:
  - a. Safety glasses are required.
  - b. Face shield is required.
  - c. Ear protection is encouraged.
  - d. Dust protection (mask or respirator) is recommended
2. Do not bypass any safety devices.
3. Keep hands, clothing, and hair, and jewelry clear of the spinning wheels.
4. **Never use non-ferrous (brass, copper, aluminum, wood, etc) materials on any of the sharpening devices.**
5. Inspect the wheels for clogged grit, coves, or beads in the surface prior to use. If defects are found, do not use the grinder, and notify one of the shop leads.
6. Always use the lowest speed setting
7. NEVER use the sides of the wheels to grind or sharpen tools
8. Do not use if excessive vibration occurs when the high speed grinder is running.
9. Do not leave the grinder until it comes to a complete stop.
10. If something is broken or breaks, notify one of the wood shop leads at ([woodshop@sparkmakerspace.org](mailto:woodshop@sparkmakerspace.org)).

## **Lathe Safety Rules**

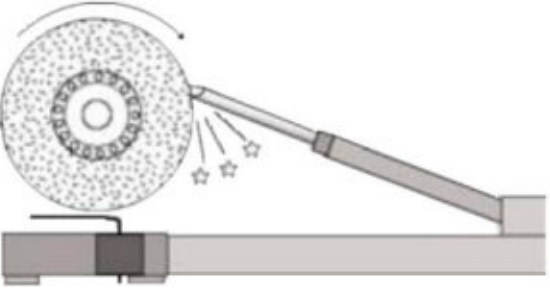

1. Wear proper personal protection equipment:
  - a. Safety glasses are required.
  - b. Face shield is required.
  - c. Dust protection (mask or respirator) is recommended especially during sanding
2. Do not bypass any safety devices.
3. Keep hands, clothing, and hair, and jewelry clear of the spinning material.
4. Always use sharp tools. Dull tools are prone to catch the material and could injure the user.
5. **NEVER USE A SPINDLE ROUGHING GOUGE FOR FACEPLATE TURNING.**
6. Provide as much support to the workpiece as possible (tailstock, spindle steady, etc.).
7. Let the lathe come up to full speed prior to engaging a tool with the piece.
8. Do not use your hands to slow down the lathe.
9. Let the lathe come to a stop prior to leaving the tool.
10. If something is broken or breaks, notify one of the wood shop leads at ([woodshop@sparkmakerspace.org](mailto:woodshop@sparkmakerspace.org)).

Grinder Diagram



## Grinder Instructions for Use

1. The bench grinder is reserved for lathe tools only
  - a. Sharpening tool steel on a power grinder can cause burning of the metal which causes the tool to lose its temper and its edge retention ability
    - i. Quenching is always required for non-alloyed carbon steel
    - ii. High speed tool steels such as M2 and M4 are more resistant to high temperatures but can still be burned. Quenching is recommended.
    - iii. Primary lathe tools available at Spark Makerspace are high speed steel (M2)
    - iv. If in doubt about tool steel alloy, use water to quench the tool
    - v. When quenching, keep a cup of water nearby while sharpening. Periodically (every few seconds of sharpening), dip the tool in the cup of water to cool the metal to prevent damaging the temper.
  - b. Carbide cutters shall NOT be sharpened on the bench grinder.
  - c. Other hand tools (chisels, plane irons) shall NOT be sharpened on the bench grinder and only sharpened by hand (Note 9/8/2022: Hand sharpening system still in work).
  - d. **Only the leads are to use the grinder in the corner by the chop saw**
2. **NEVER USE NON-FERROUS MATERIALS ON THE BENCH GRINDER**
  - a. Non-ferrous materials can clog the wheels and can lead to explosive results
3. Inspect the wheel before use
  - a. Surface should not have any hills or valleys in the surface
  - b. Surface should be clear of any clogged grit
  - c. Wheels should spin true
  - d. Notify the shop leads if the wheels exhibit any issues
4. Aluminum oxide wheels may have to be dressed periodically
  - a. Dressing is required when the surface of the wheels has bumps or undulations
  - b. Diamond dresser may be used to surface the wheels
  - c. Always wear dust protection when dressing aluminum oxide wheels
5. Always use the lowest speed setting on the bench grinder
  - a. Lower speeds cut slower and prevent the buildup of heat
  - b. Turn the speed dial all the way to the left prior to starting the bench grinder
6. Only apply light pressure on the tool when sharpening
  - a. Weight of the tool is enough pressure to sharpen the tool
  - b. Heavy pressure can cause the tool to dig into the wheels and damage them as well as causing burning of the steel
7. Only sharpen tools on the face of the wheels
  - a. Sides of the wheels **shall never** be used for sharpening
8. Variety of jigs are available for use to sharpen lathe tools
  - a. Spark woodshop has the Oneway Wolverine Grinding System which include: vee-arm base, the vari-grind attachment, and platform base

Sharpening Jig	Using the Jig
<p><u>Vee-Arm Base</u></p> 	<p>Sharpens constant bevel gouges: spindle roughing gouge, some bowl gouges</p> <ol style="list-style-type: none"> <li>1. Mark the bevel of the tool to be sharpened with a sharpie</li> <li>2. Loosen handle in base to shift vee-arm out away from bench grinder</li> <li>3. With the bench grinder off, plant the end of the handle in the vee-arm</li> <li>4. Spin the wheel by hand to verify that the distance set by the vee-arm is correct <ul style="list-style-type: none"> <li>o Correctly adjusted vee-arm should remove a constant width band of sharpie from the heel to the toe of the bevel</li> </ul> </li> <li>5. Remove tool from vee-arm and start up bench grinder at the slowest setting</li> <li>6. Drop handle in the vee-arm and slowly lower bevel onto the grinding wheel</li> <li>7. Only use the weight of the tool to perform sharpening</li> <li>8. Once the bevel makes contact with the wheel, rotate the tool back and forth while moving the bevel side-to-side across the face of the wheel to sharpen a consistent bevel along the edge of the gouge</li> </ol>
<p><u>Platform Base</u></p> 	<p>Sharpens chisels: skew chisels</p> <ol style="list-style-type: none"> <li>1. Mark the bevel of the tool to be sharpened with a sharpie</li> <li>2. Loosen the adjustment lever to angle the platform to the desired bevel angle</li> <li>3. Loosen the base lever to move the platform to be one-quarter to one-eighth of an inch from the wheel</li> <li>4. Spin the wheel by hand to verify that the angle and distance are correct <ul style="list-style-type: none"> <li>a. Correctly adjusted platform and base should remove a constant width band of sharpie from the heel to the toe of the bevel</li> </ul> </li> <li>5. Remove tool from platform base and start up bench grinder at the</li> </ol>

slowest setting

6. Firmly rest the tool on the platform without engaging the wheel
7. Slowly move the tool forward until the wheel engages with the bevel
8. Move the tool from side to side on the face of the wheel to sharpen a consistent bevel along the width of the tool

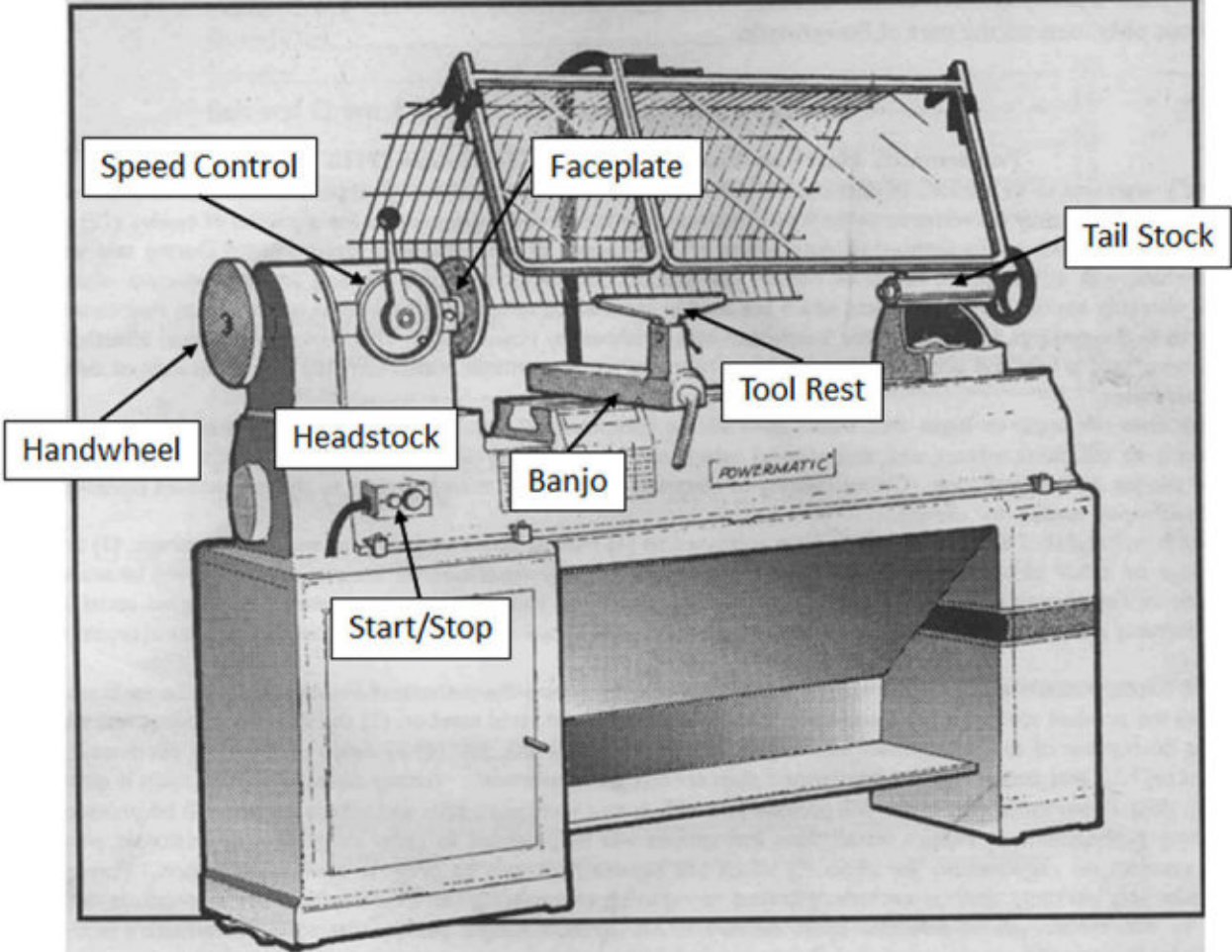
#### Vari-Grind Attachment



Sharpens fingernail grind gouges: bowl gouges and spindle gouges

1. Always used in conjunction with the vee-arm base
2. Mark the bevel of the tool to be sharpened with a sharpie
3. Loosen the thumb screw on the vari-grind attachment and insert gouge into the vari-grind attachment as shown to the left
4. Use the wooden block attached to the grinding bench to adjust the protrusion of the gouge past the end of the jig and tighten the thumb screw
5. Using a combination of the in-out adjustment on the vee arm base and the wing nut adjustment of the angle of the vari-grind attachment, adjust the compound angles such that the bevel at the nose and bevel at the wing both make full contact with the grinding wheel.
6. With the grinder off, verify that both the vee-arm base and vari-grind attachment setting are correct by spinning the wheel by hand
  - a. Correct adjustment should remove a constant width band of sharpie at both the toe of the gouge and on the wings
7. Remove the vari-grind attachment from vee-arm and start up bench grinder at the slowest setting
8. Place the arm of the vari-grind attachment in the vee-arm base and slowly lower either the left or right wing onto the grinding wheel
  - a. Only use the weight of the tool to perform sharpening
9. Start on one wing of the fingernail grind gouge and swing the tool arm while maintaining contact with the grinding wheel to sharpen the nose and other wing in one sweep

Lathe Diagram



## Lathe Instructions for Use

### Types of Woodturning

1. Faceplate turning
  - a. This form of woodturning positions the piece of wood so the wood fibers are perpendicular to the axis of rotation.
  - b. This method of woodturning is used to produce bowls, platters, and cross-grain hollow forms.
  - c. Common tools include: bowl gouge, parting tool, and scrapers.
  - d. **NEVER USE A SPINDLE ROUGHING GOUGE FOR FACEPLATE TURNING.**
2. Spindle turning
  - a. This form of woodturning positions the piece of wood so the wood fibers are parallel to the axis of rotation.
  - b. Things that are commonly made by this form of woodturning include: goblets, honey dippers, pens, boxes, bats, banister spindles, chair legs, and end grain hollow forms.
  - c. Common tools include: spindle roughing gouge, spindle gouge, parting tool, and skew chisel.

### Before Use

1. Wear personal protective equipment.
  - a. Safety glasses are required.
  - b. A face shield is required while operating the lathe.
  - c. Gloves may not be worn while operating the lathe.
2. No items may be worn that extend below the elbow.
3. Tie up loose hair.
4. Inspect the material for checking and cracks.
  - a. Checking and cracking can lead to wood flying from the lathe.
  - b. Severely cracked pieces should not be turned on the lathe.
  - c. Slight checking should be secured with CA glue prior to woodturning.
5. Balance the wood prior to mounting it in the lathe.
  - a. Out of balance wood induces machinery vibration.
  - b. Use the bandsaw to trim off corners and other protrusions to balance the piece.
  - c. Slightly unbalanced wood can be turned on the lathe, but speeds should be minimized to prevent vibration.
  - d. If the lathe vibrates at the lowest speed setting, the piece shall be rebalanced before proceeding.
6. Verify that the tools being used are razor sharp.
7. Ensure that the lathe speed control dial is at the stop setting.
  - a. Do not attempt to adjust the speed setting while the lathe is not spinning.
  - b. If the lathe speed control dial is not at the stop setting, turn the lathe on, and turn the handle to the stop setting prior to mounting any piece of material on the lathe.



8. Oil the lathe with a few drops of oil in the oil port prior to running the lathe or changing the speed setting
  - a. Oil can will be located on the shelf below one of the lathes

### **Mounting the Workpiece**

1. Always use as much support for the workpiece as practically possible
  - a. Workpieces mounted on a faceplate or in a chuck should use the tailstock to support the workpiece as long as possible
  - b. Long spindles turned between centers should use the spindle steady rest
2. All-thread rod can be used for knocking morse taper centers out of the headstock
3. Faceplate mounting
  - a. Use the center finder to determine the center of the workpiece on the side to be mounted on the faceplate
  - b. Mark the locations for the screws and drill pilot holes to the desired depth
  - c. Secure the workpiece to the faceplate with screws
  - d. Remove the spur drive from the headstock prior to mounting the face plate with knocker rod through headstock**
  - e. Screw the faceplate on the headstock spindle
  - f. Faceplate can be tightened down by depressing the spindle lock and tightening the faceplate with a wrench
  - g. Bring the tailstock forward to support the piece with the live center. The tailstock should be used until the piece is brought to round.
4. Between center mounting
  - a. Use the center finder to determine the center on both sides of the workpiece
  - b. Use a center punch to mark the center on each end of the piece.
  - c. Mount the drive center in the headstock. This equipment is identified by its multiple prongs to grip and spin the wood.
  - d. A cup or cone style live center should be used in the tailstock. A live center has bearings which allows the support to spin freely.
  - e. Loosen the tailstock and move to a position where the tailstock quill can be brought forward to support the piece. Extension of the tailstock quill should be minimized to provide maximum support of the workpiece.
  - f. Tighten the nut to secure the tailstock.
  - g. Turn the handwheel on the tailstock to advance the live center into the piece.
5. Worm screw and chuck
  - a. Use the center finder to determine the center of the workpiece on the side to be mounted in the chuck
  - b. Drill a hole corresponding to the worm screw diameter into the piece.
  - c. Remove the spur drive from the headstock prior to mounting the face plate with knocker rod through headstock**
  - d. Screw the chuck onto the headstock spindle.
  - e. Secure the worm screw in the chuck jaws.
  - f. While restraining the headstock spindle with either the handwheel or the spindle lock, screw the piece onto the worm screw.

6. Using the mortise or tenon with the chuck
  - a. Mortise and tenons are cut on the lathe and uses after the piece has been brought into round
  - b. When faceplate turning, a mortise or tenon is used to reverse the piece of wood.
  - c. The chuck jaws shall not be extended past the maximum reach as specified by the manufacturer. If unsure about the maximum reach, please consult the manufacturer's guide.

## Turning at the Lathe

1. Once the piece is mounted in the lathe, position the banjo close to the workpiece where the tool outreach will be minimized. Also verify that the piece can spin an entire 360 degrees without banging into the banjo or tool rest.
2. The tool rest height should be positioned to minimize the outreach of the tool and to keep the cutting edge at the axis of rotation.
  - a. Gouges and chisels performing shear cuts or planning cuts can be positioned above the axis of rotation.
  - b. Scrapers being used on the outside of a piece should be placed a hair below the axis of rotation while scrapers being used on the inside of a piece should be placed a hair above the axis of rotation
3. To start up the lathe, turn the speed dial from the stop position to the start position.
4. Adjust the speed of the lathe using the speed dial. If the lathe starts to vibrate, reduce the lathe speed. Do not exceed the speed at which the lathe vibrates.
5. Roughing the piece should be done at the lowest possible setting. Once the piece is brought to round, the speed may be gradually increased as long as vibration does not occur.
6. Larger diameter pieces should be turned at lower speeds than small diameter pieces.

### Bowl Gouge



Primarily used for bowl turning to form the outside and inside of the bowl

1. Tool is placed on the tool rest with the handle low and the work is rubbing the back side of the tool
2. Handle is raised until the edge of the tool begins cutting
3. Cut is performed by “riding the bevel” such that both the toe and heel of the bevel is in constant contact with the piece being cut
4. Handle is rotated such that the flute is pointed in the direction of the cut
5. Slide the tool along the tool rest to continue the cut
6. As the cut progresses along the workpiece, handle is swung as continue riding the bevel

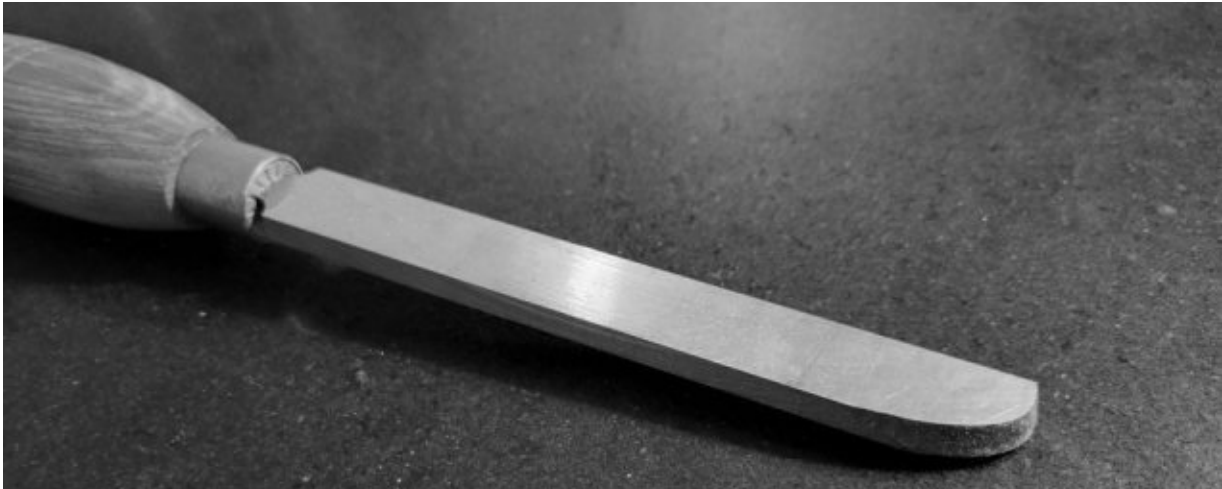
## Parting Tool



Used to “part” wood into separate pieces or cut a step in the wood

1. Tool is used differently whether faceplate turning or spindle turning
2. Faceplate turning
  - a. The parting tool is oriented horizontal to the floor with the thin face of the tool supported on the tool rest
  - b. Tool rest is positioned such that the point of the tool is aligned with the center of rotation
  - c. Parting tool is plunged into the workpiece
3. Spindle turning
  - a. Handle of the parting tool is dropped such that the parting tool is pointed to the sky
  - b. Bevel of the parting tool is rubbed against the workpiece
  - c. Handle is raised until the tool begins making a peeling cut
  - d. As the tool makes the cut, the handle is raised and plunged into the work to continue riding the bevel

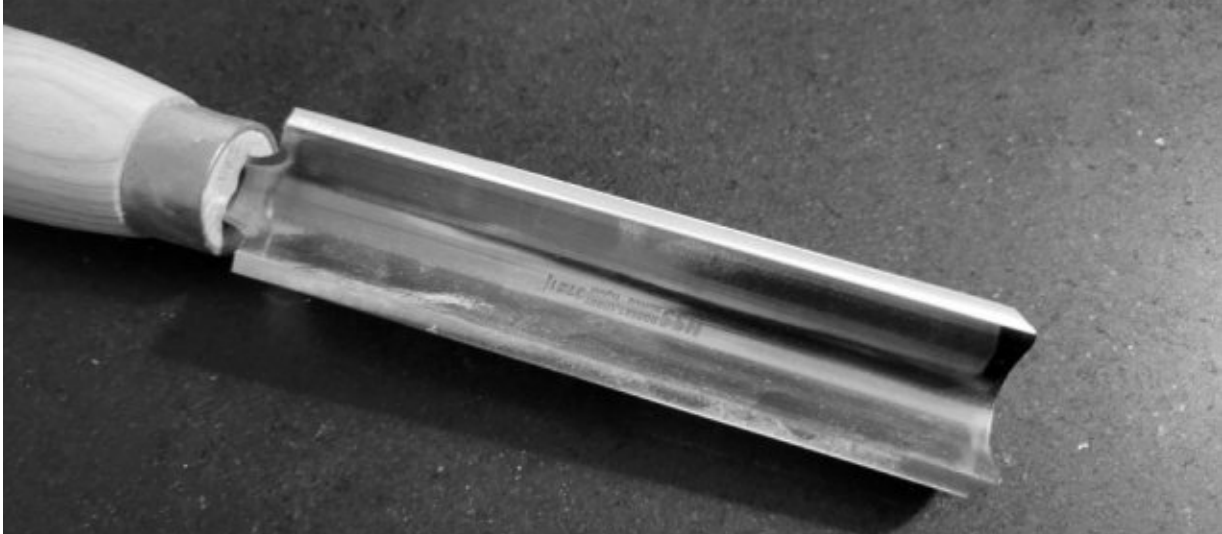
## Scraper



Burr is raised on the edge of the tool to perform a shearing cut on the inside of forms (bowls, goblets, boxes, etc.) and can also be used for outside turning as well (though other cutting tools will make a cleaner cut)

1. Inside turning
  - a. Tool rest is positioned such that the edge of the tool is just a hair above the axis of rotation
    - i. Minimizes the severity of catches
  - b. Tool is oriented horizontally with the bevel relief on the underside of the tool
  - c. Tool is lightly pressed into the wood to start the cut
  - d. Handle is swung to progress the cut
2. Outside turning
  - a. Tool rest is positioned such that the edge of the tool is just a hair below the axis of rotation
    - i. Minimizes the severity of catches
  - b. Performing a cut progresses identical to inside turning (see above)

## Spindle Roughing Gouge



Tool is used when spindle turning to bring a square blank into round

**NEVER USE A SPINDLE ROUGHING GOUGE FOR FACEPLATE TURNING**

1. Tool rest is oriented close to the workpiece while still allowing the workpiece to swing past the tool rest
2. Back of the spindle roughing gouge is placed on the tool rest with the handle low and the cutting edge pointed toward the sky
3. Handle is raised as the back of the tool rubs against the spinning workpiece
4. Continue raising the handle until the cutting edge begins making a cut - do not raise the handle any further
5. Rotate the handle to turn the flute in the direction of the cut
6. Slide the tool along the tool rest to make the cut
7. Once the end of the workpiece is reached, rotate the flute to point in the opposite direction and make a pass in the opposite direction
8. Continue making passes back and forth along the workpiece until the work is brought into round
9. Tool rest will have to be periodically adjusted to minimize the overhand distance of the tool
  - a. **Always keep the tool rest near the work to minimize the stress on the tang of the tool**

## Spindle Gouge



Spindle gouge is used to cut beads, and coves on the outside of spindles. This tool is also used to hollow end grain when spindle turning for cutting the cups of goblets and boxes

1. Spindle gouges require three simultaneous motions to cut beads and coves: lifting the handle, rotating the handle, and traversing the tool rest
2. Cutting beads
  - a. Begin with the tool riding the bevel with the flute pointed upwards
  - b. As the cut begins, move the tool along the tool rest, close the flute in the direction being cut and lift the handle to cut one side of the bead
  - c. Cut the second side of the bead using the same technique but moving the opposite direction along the tool rest
  - d. Always cut beads downhill
3. Cutting coves
  - a. Begin with the tool riding the bevel with the flute closed pointed towards the the center of the cove
  - b. As the cut begins, move the tool along the tool rest, open the flute and raise the tool handle
  - c. Stop once the bottom of the cove has been reached
  - d. Cut the second side of the cove using the same technique but moving the other direction
  - e. Always cut coves downhill
4. End grain hollowing
  - a. Advanced technique with the spindle gouge - will not be discussed here

### Skew Chisel



*Note: Various forms of the skew exist - oval skew is shown above*

Used for shear cutting spindles, peel cutting spindle, creating vee cuts, cutting beads

1. <<Add discussion of making vee-cuts here>>
2. Skew chisel is an advanced user tool and will not be discussed here - if interested in using the skew chisel, talk with the woodshop leads

### Powermatic Lathe Baseline Configuration

1. Headstock drive center mounted
2. Tailstock secured to ways
3. Banjo secured to ways



## Lathe Competencies

### **Basic User Competencies**

#### Knowledge

- Identification of various turning tools and their general uses
- Understanding of temper and not burning carbon steel tools
- Materials to use and not use on the bench grinder
- What tool to never use on faceplate turning

#### Sharpening

- Sharpening the various tools for spindle and faceplate turning
- Using the various jigs for sharpening including: vee-arm, platform base, and vari-grind jig

#### Turning

- Proper methods for mounting a workpiece
- Maintaining good speeds for woodturning
- Positioning the banjo and tool rest
- Riding the bevel
- Understanding of general motions, “the dance”, needed to maintain bevel support

### **Advanced User Competencies**

#### Additional tools that require advanced user sign-off

- Skew chisel (other than vee-cut)
- Hollowing tools, coring tools

#### Operations that require advanced user sign-off

- End grain hollowing with a spindle gouge
- Segmented turning
- Multi-axis (off-centered) turning
- Inside-out turning
- Hollow forms
- Coring