Protohaven

Class Notes

Wood 104: Intro to Wood Lathe

Clearances

Wood Lathe
Woodshop Dust Collection

Contents

Welcome

Welcome to the Introduction to Lathe class at Protohaven!

Shop Rules

Be Safe

- Get safety clearances
- Wear protective equipment
- Watch and reset equipment after use
- Never use equipment that is red-tagged

Take Care of Each Other

- Be aware of your surroundings
- Don’t use a tool if it poses a danger to someone else

Take Care of the Tools

- Get tool clearances
- Do not alter of use equipment beyond limits
- Notify staff when maintenance is needed

Keep the Shop Clean

- Clean up after yourself
- Return tools to their original locations

Tool Status Tags

Every tool at Protohaven has a status to let you know if the tool is safe to use: green, yellow, or red.

If the tool status is *green*, the tool is safe to use. All features should be expected to work, and no extra care should need to be taken while using the tool. There are no tags for tools with green status.

If the tool status is *yellow*, the tool may still be used, but with extra caution. Tools with yellow status should have a physical tag on the machine. The information on the physical tag or in the online maintenance history will indicate what special care needs to be taken while using the tool. If the physical tag and the maintenance log disagree, alert a tech.

If the tool status is *red*: **DO NOT USE THE TOOL**. The tool is not safe to use. Tools with red status should have a physical tag on the machine. The information on the physical tag or in the online maintenance history will indicate what fixes are pending, and when a repair is expected.

If you are in doubt about the status of a tool with no visible tag, check the tool status by following the link in the QR code attached to the tool, or check the Protohaven website for the tool status page:

`https://www.protohaven.org/equipment/`

Class Safety

- Use a full face shield (Safety glasses at a minimum) whenever the lathe is turned on.
- Tie back long hair, do not wear gloves, and avoid loose clothing or objects that may catch on rotating parts or accessories.
- Always check the speed of the lathe before turning it on. Use slower speeds for larger diameter or rough pieces, and higher speeds for smaller diameter and pieces that are balanced. Always start a piece at a slower speed until the work piece is balanced. If the lathe is shaking or vibrating, lower the speed. If the work piece vibrates, always stop the machine to check the reason.
- Check that all locking devices on the tailstock and tool rest assembly (rest and base) are tight before operating the lathe.
- Position the tool rest close to work, about one inch away from the material. Check tool rest position often and as wood is removed, turn off the lathe and re-position the rest.
- Rotate your work piece by hand to make sure it clears the tool rest and bed before turning the lathe's motor on. Be certain that the work piece turns freely and is firmly mounted. A handwheel on the outboard side of the headstock simplifies this process of spinning the lathe by hand before turning on the switch.
- Be aware of what the turners call the *red zone* or *firing zone.* This is the area directly behind and in front of the work piece - the areas most likely for a piece to travel as it comes off the lathe. A good safety habit is to step out of this zone when turning on the lathe. When observing others turn stay out of the area.
- Hold turning tools securely on the tool rest, holding the tool in a controlled and comfortable manner. Always contact the tool rest with the tool before contacting the wood.
- Turn the lathe off before adjusting the tool rest or tool rest base (banjo).
- Remove the tool rest before sanding or polishing operations.
- Never leave the lathe running unattended. Turn the power off. Do not leave the lathe until it comes to a complete stop.

If you feel unsure of something, feel free to ask!

Introduction

Learning Objectives

In this class, students will learn:

- Safety procedures for operating the lathe
- Setting up and securing a workpiece in the lathe
- Turning the workpiece:
  - Roughing in a shape
  - Smoothing cuts
  - Finishing on the lathe
  - Parting off

Terminology

blank	A piece of wood rounded smooth or cut into a section for lathe use.
burl	A burl is an unusual growth on a tree, producing swirls and other interesting grain patterns.
heartwood	Heartwood is the fully developed wood surrounding the core, usually darker than sapwood and very dense.
sapwood	Sapwood surrounds heartwood and is usually softer. It transports sap from roots to leaves. Sapwood has a different color than heartwood.
spalted	Spalted wood in the process of fungal decay that shows as black lines in the grain. Woodturners prize spalted wood because the black lines add an artistic element to the turning.

Tools

Woodshop Dust Collection

Dust collection is an important part of any shop. Dust is a health hazard: dust is an irritant, and specific sizes of dust particles (PM2.5) can lodge in the lungs and accumulate there, leading to long-term and possibly severe health issues. Dust is also hard on metal tools, and can encourage surface rust and pitting.

Notes

Run the dust collection system when using any connected power tool.

Open the appropriate blast gates to insure air flow.

Keep unused blast gates closed to maximize airflow where it is needed.

The dust collection system also has three floor inlets, one next to the miter saw, and one behind the resaw bandsaw and one next to the drill press. These are useful for collecting floor sweepings.

Empty the dust collection bin when it becomes two-thirds full (at the seam). Running the dust collection system with an over-capacity bin will reduce system performance.

Parts of the Dust Collection System

Control panel

The control panel has power switches of the dust collection system.

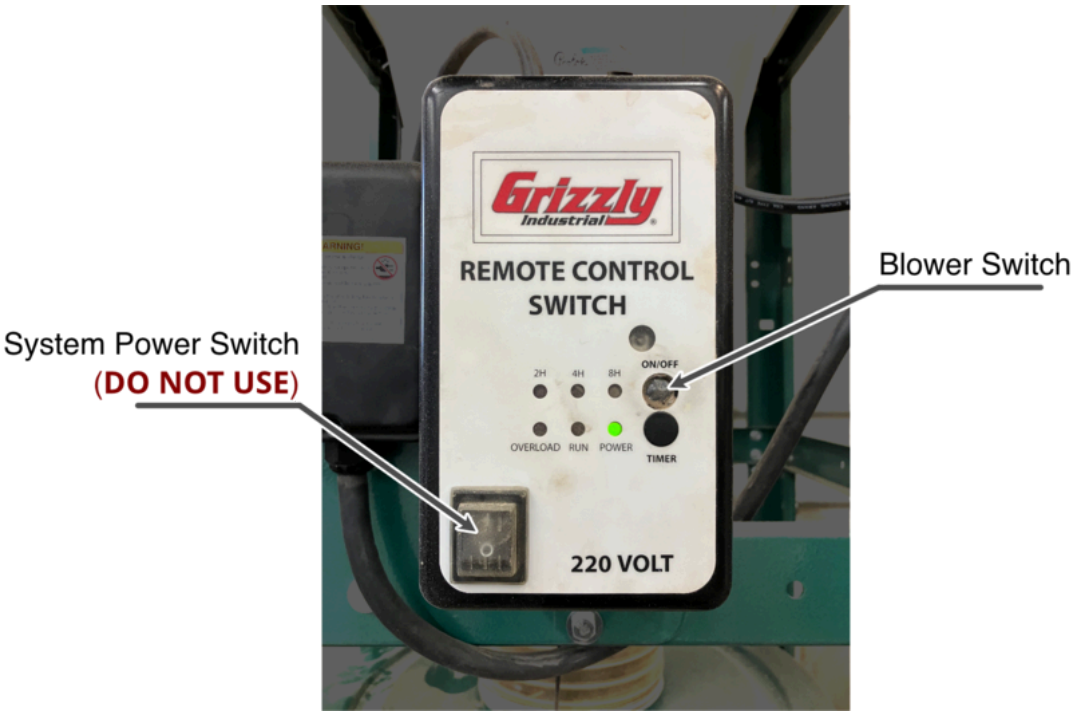

Figure 1: A close up of the dust collection control panel.

System Power Switch

The system power switch turns power on and off to the entire dust collection system, including the control panel. **DO NOT USE THIS SWITCH.** This switch should remain on at all times during open shop hours.

Blower Switch

The blower switch turns on the blowers that pull air through the system, collecting dust.

Dust Collection Bin

The dust collection bin holds all of the sawdust and light chips pulled in by the dust collection system. The lid is held in place by clamps.

Basic Operation

Turning On The Dust Collection

Press the blower switch while the dust collection system is off.

Turning Off The Dust Collection

Press the blower switch while the dust collection system is on.

Maintenance

If the dust collection bin becomes full:

1. Stop the dust collection blowers with the blower switch.
2. Unclamp the lip of the dust collection bin.
3. Remove waste from the bin.
   Scoop out waste into a wood shop trash can, and then roll the trashcan out to the dumpster and tip it in. If you need help lifting the bin up to the mouth of the dumpster, please ask!
4. Replace the dust collection bin lid, and secure the clamps.
   Ensure the gasket is attached.
5. If the wood shop is in use and dust collection is still needed, turn the blowers back on.

Wood Lathe

Notes

Safety

The following equipment is required while working at the lathe:

- Hearing protection

- Closed-toed shoes
- An industrial quality Face Shield

A well-fitting dust mask is also required for sanding.

Loose sleeves must be rolled up and long hair and scarves must be tied back. Avoid any dangling drawstrings or other articles of clothing that may come in contact with the lathe.

- Ensure that your piece is secure and mounted appropriately
- Wear a face shield and a well-fitted dust mask, especially while sanding
- Immediately stop turning if there is excessive vibration or a piece becomes loose

Common Hazards

The most significant safety hazard is getting a body part caught in the lathe and being drawn into the machine while it is rotating. This is a potentially deadly hazard and should be carefully avoided by:

- Wearing the proper clothes (nothing loose or dangling that can get wrapped around the workpiece or chuck)
- Positioning the tool rest properly (keep a good cutting angle, and keep your weight away from the lathe)
- Using break-away materials when sanding and finishing (e.g., applying finish with a paper towel instead of a cloth rag)

The most common hazard is material breaking off of the lathe and impacting the user. Stop turning immediately if there is excessive vibration or a piece becomes loose. This hazard can be minimized by:

- Wearing appropriate PPE
- Properly securing materials
- Turning at the proper speed
- Carefully turning glue-ups or potentially weakened materials

Pinching between the tool rest and the turning tool is also a common hazard, caused when the tool makes contact with the piece before being properly placed on the tool rest. Avoid this by always placing the tool against the tool rest, then feeding it into the turning piece.

While not a primary safety concern, woodturning *catches* can be frightening and result in damage to your workpiece, or in extreme circumstances, can cause a piece to break from the lathe. Catches are a part of woodturning and require time and practice to minimize.

Prohibited Materials

Do not use the wood lathe to turn:

- Rotted or split wood
- Improperly glued-up workpieces

- Off-center workpieces at high speed
- Metal

Rotted wood, split wood, and improperly glued-up workpieces have the potential to break apart while turning.

Off-center workpieces can cause excessive vibration, and may break loose while turning. Secure off-center workpieces carefully, and turn them at lower speeds.

Turning metal is inappropriate on the wood lathe. Use the metal lathe in the machine shop for turning metal workpieces.

Care

Stop use if you hear scraping or grinding sounds from the machine. This may indicate the machine requires immediate maintenance.

Beware of impacts on the tool rest. The tool rest should be smooth, and free of bumps and dips.

Parts of the Lathe

Full View

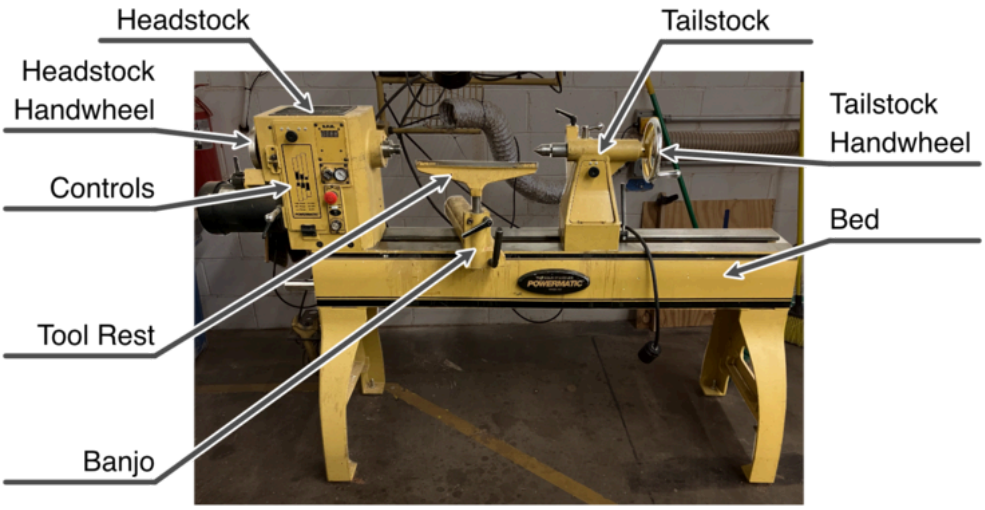

Figure 2: Annotated front view of the lathe.

Lathe Controls

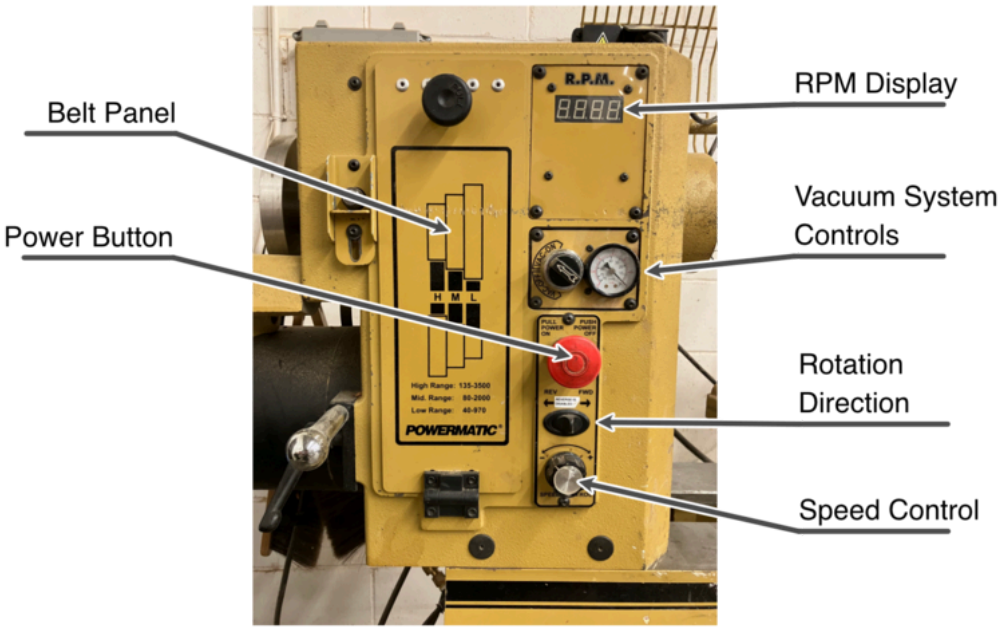

Figure 3: Annotated view of the lathe control panel.

Accessory Kit

Figure 4: Annotated view of the contents of the lathe accessory kit.

On/Off Switch and Emergency Stops

Pull the red power button to turn on the lathe.

Push the red power button to turn off the lathe.

The lathe has two emergency stop buttons. The red power button on the head stock doubles as an emergency stop. The lathe also has a remote emergency stop attached to the power supply. The remote emergency stop has a magnetic base, and can be attached to the lathe body where convenient.

Banjo

The banjo is an adjustable metal bracket that is mounted on the lathe bed. The banjo has a movable arm that can be adjusted to hold tools and accessories at different angles and distances from the workpiece. The banjo is commonly set up to hold a tool rest, used to support a tool while turning.

Bed

The bed supports and aligns that various components of the lathe.

Calipers

Calipers are useful to check if the workpiece has been turned down to a required size. Calipers are available in the accessory kit.

Chuck and Jaws

A device that holds the workpiece on the lathe. Always use an appropriate chuck to safely and securely hold a workpiece for turning. Various jaws suitable for various sized workpieces are available in the accessory kit.

Drive Belts

The drive belts can be adjusted to change the range of RPMs at which the lathe can spin the workpiece.

Drive Center

A drive center attaches to the workpiece and spins it for turning. Drive centers are used for spindle turning, with the workpiece secured between the drive center and the tailstock.

Faceplate

A device that holds the workpiece on the lathe.

A faceplate is mechanically connected to the workpiece by clamps, fasteners, or other means. The faceplate is then connected to the drive of the lathe to turn the workpiece. Faceplates are more complicated to set up than drive centers or chucks, but are very flexible, and can be used to mount a wide variety of workpiece shapes and sizes.

Headstock

Provides the drive for the workpiece, usually through pulleys connected by a belt to the drive motor of a lathe.

Headstock Hand Wheel

Use the headstock hand wheel to rotate the workpiece manually int he lathe. Use the hand wheel to check workpiece clearances, or to slowly rotate the workpiece for visual inspection.

Lights

The lathe has several work lights attached to help illuminate the workpiece. More light can be very useful when turning fine details.

Live Center

A live center is often used in the tail stock to support the workpiece on both sides for spindle turning. The live center should turn freely in the tailstock, without catching of binding.

Speed Controls

Use the speed controls to adjust the revolutions per minute (RPM) of the lathe.

Spindle Lock

Engage the spindle lock to keep the spindle from turning. This is an important safety feature to make sure the lathe will not spin in between turning operations.

Tailstock

The movable assembly opposite the headstock that slides along the lathe bed and supports workpieces.

Tailstock Handwheel

Use the tailstock handwheel to advance or retract the spindle on the tailstock.

Tool Rest

The tool rest is an adjustable bar that steadies and supports a turning tool while it is engaged with the workpiece.

The tool rest should be adjusted to that is as close the workpiece as possible. Once setting and locking the tool rest into place, manually rotate the workpiece to make sure it turns freely, and does not contact the tool rest.

Vacuum System

The lathe has a vacuum system to mount delicate, low-clearance workpiece to the drive spindle.

Turning Tools

Turning Tool Materials

Turning tools are commonly equipped with steel or carbide cutting tips.

Tools with steel cutting tips can be resharpened an reshaped as needed.[1]

Carbide tools use a small, replaceable tip of carbide for their cutting edge. Carbide is a very hard material that keeps a good edge for a long time, but can easily chip.

Turning Tool Types

For **spindle** turning:

[1] Do not reshape the tools in the accessory kit.

Roughing gouges are wide, u-shaped fluted turning chisels used to hog off large amounts of material from the workpiece. They are available in many shapes and sizes.

Spindle gouges are thinner, more delicate fluted turning chisels meant to apply fine detailing to the profile of the workpiece. They are available in many shapes and sizes.

Skew chisels are turning chisels meant for fine finishing and planing of the workpiece. Skew chisels are available with a right- and left-handed skew.

Parting tools are used to divide the workpiece, often paring away material at the end of the workpiece prior to removal.

For **bowl** turning:

Bowl gouges are heavy deeply fluted chisels for turning the inside and outside of a bowl.

Scrapers use a burr to scrape the surface smooth. They are useful for scraping fine finishes in the interior of a bowl.

Turning Speeds

Turning pieces at the proper speed will help ensure better results with greater safety. In general, use lower speeds for roughing and for long or large diameter work. Turn smaller pieces at higher RPMs and larger pieces at lower RPMs. This is not an exact science, so always begin turning a piece at close to the recommended RPMs (see Table 1), increasing speed only if necessary.

The shop Lathe Kit includes various carbide-tipped turning tools. The following speeds are recommended for carbide-tipped turning tools:

Workpiece Diameter	Turning Speed (RPM)	Notes
Under 2″	1500	
2″–4″	1200	
4″–6″	1000	
6″–8″	900	
8″–12″	800	
12+“	Max 700	Start slow! Gradually increase speed.

Table 1: Recommended turning speeds for carbide tools.

Drive Belt Positions

The wood lathe has an adjustable drive belt for supporting different speed ranges.

The drive belt can be set in three positions:

Speed	Range (RPM)
High	135–3500
Medium	80–2000
Low	40–970

Table 2: Drive belt speed ranges.

For the vast majority of turning projects, the belt should be left in the high setting:

Figure 5: The wood lathe drive belt in the high setting position.

If your project requires turning speeds lower than 135 RPM, please ask a shop tech for assistance in moving the belt.

Basic Operation: Spindle Turning

Setting up

1. Engage both emergency stops.
2. Set the speed control to zero.
3. If needed, set the belt position for the appropriate range of turning speeds.
4. Slide the tailstock and banjo away from the headstock.
5. Install a drive center, faceplate, or chuck to accept the workpiece.
6. Secure the workpiece in the lathe with a center in the tailstock.
7. Set the brakes on the tailstock arm and lathe bed to lock the tailstock in place.
8. Adjust the tool rest to the appropriate height, and leave a 1/8″ gap between the tool rest and the workpiece.
9. Rotate the workpiece one full rotation by hand to make sure the workpiece does not impact the tool rest.
10. Set the brakes on the banjo and tool rest.

11. Place turning tools within easy reach.
12. Secure loose clothing, tie back long hair, and put on PPE.

Workholding

Ensure that the workpiece is firmly secured in the lathe. If using a chuck, make sure the chuck is making good contact with the workpiece, and is properly tightened. If using spindles, make sure the spindles have good contact with the workpiece, and will not wander, or escape the workpiece.

Spindle Turning

1. Release the emergency stops.
2. Stand outside of the direct line of rotation for the workpiece.
   If something goes wrong, and the workpiece is ejected from the lathe, do not stand where the workpiece will go. Make sure you and any others are clear of the area.
3. Turn on the lathe, and slowly ramp up RPMs to the proper speed.
   Watch for vibration, loosening of the piece, or other hazards before beginning turning.
4. Round the workpiece with roughing tools.
5. Shape the workpiece with cutting tools.
6. If you are sanding the workpiece:
   a. Turn off the lathe.
   b. Remove the tool rest.
   c. Run the lathe at slow speed.
   d. Apply sandpaper with light pressure.
      Do not put so much pressure on the paper that you might fall into the lathe. If using a strip of paper around the workpiece, do not grip it so tightly that it could pull you into the lathe.
7. If you are finishing the workpiece:
   a. Turn off the lathe.
   b. Remove the tool rest.
   c. Run the lathe at slow speed.
   d. Apply finish with a paper towel, using light pressure.
      Do not put so much pressure on the paper towel that you might fall into the lathe.
8. Remove the piece with a parting tool:
   a. Part the piece down to a thin spindle.
   b. Turn off the lathe.
   c. Use a handsaw to cut away the remaining wood to finish the removal.

Cleaning Up

Woodturning generates a lot of wood chips and sawdust. Give yourself extra time, especially before the shop closes, to ensure you have enough time to fully clean the lathe area.

1. Wipe any finish or other waste from the lathe as needed: check the bed, tool rest, center(s), chuck, faceplate, and banjo.

2. Sweep up chips and place in a trash can.
3. Sweep and/or vacuum the lathe to remove any chips and dust.
4. Retract the live center into the tailstock housing if needed.
5. Remove the drive center with a rod hammer, or remove the chuck, faceplate, or adapter as appropriate.
6. Return all accessories to the Lathe Kit.
7. Clean the carbide tools of any chips or sawdust and return them to their case.
8. Push the tool rest in close to the lathe so it won't catch on anything passing by the lathe.

If there are any waste pieces large enough to be recycled, place them in the back recycling bin.

Basic Operation: Bowl Turning

Setting up

1. Engage both emergency stops.
2. Set the speed control to zero.
3. Slide the tailstock and banjo away from the headstock.
4. Install a drive center, faceplate, or chuck to accept the workpiece.
5. Secure the workpiece in the lathe with a center in the tailstock.
6. Move the tailstock to the far end of the lathe bed.
7. Adjust the tool rest to the appropriate height, and leave a 1/8″ gap between the tool rest and the workpiece.
8. Rotate the workpiece one full rotation by hand to make sure the workpiece does not impact the tool rest.
9. Set the brakes on the banjo and tool rest.
10. Secure loose clothing, tie back long hair, and put on PPE.

Workholding

Ensure that the workpiece is firmly secured in the lathe. If using a chuck, make sure the chuck is making good contact with the workpiece, and is properly tightened. If using a faceplate, make sure the faceplate is well secured to the workpiece, and is securely held.

Bowl Turning

1. Release the emergency stops.
2. Stand outside of the direct line of rotation for the workpiece.
   If something goes wrong, and the workpiece is ejected from the lathe, do not stand where the workpiece will go. Make sure you and any others are clear of the area.
3. Turn on the lathe, and slowly ramp up RPMs to the proper speed.
   Watch for vibration, loosening of the piece, or other hazards before beginning turning.
4. Round the workpiece with roughing tools.
5. Shape the workpiece with cutting tools.

6. If you are sanding the workpiece:
   a. Turn off the lathe.
   b. Remove the tool rest.
   c. Run the lathe at slow speed.
   d. Apply sandpaper with light pressure.
      Do not put so much pressure on the paper that you might fall into the lathe.
7. If you are finishing the workpiece:
   a. Turn off the lathe.
   b. Remove the tool rest.
   c. Run the lathe at slow speed.
   d. Apply finish with a paper towel, using light pressure.
      Do not put so much pressure on the paper towel that you might fall into the lathe.

Cleaning Up

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Reference

Recommended Turning Speeds for Carbide Tools

Workpiece Diameter	Turning Speed (RPM)	Notes
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4″–6″	1000	
6″–8″	900	
8″–12″	800	
12+“	Max 700	Start slow! Gradually increase speed.

Recommended Turning Speeds for Steel Tools

Workpiece Diameter	Roughing RPM	Cutting RPM	Finishing RPM
Under 2″	1500	3000	3000
2″–4″	600	1500	2300
4″–6″	450	1100	1500
6″–8″	450	600	1100
8″–10″	450	600	850
10″–12″	450	600	850
12″–14″	450	450	600