MANUAL LATHE	MMM	

Safety and Basic Operation

MANUAL LATHE

MMM

THE LATHE MAKES CYLINDRICAL OR CONICAL PARTS IN METALS AND PLASTICS.

MATERIALS

ALLOWED MATERIALS

+ Most metal
+ Most plastics

BANNED MATERIALS

+ Wood
+ Carbon fiber and composites

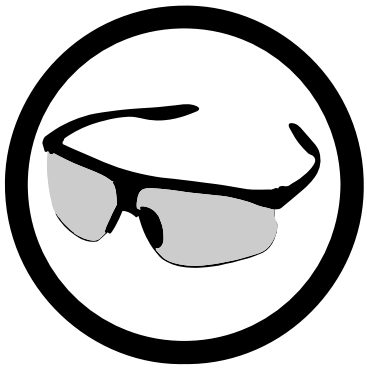
SEE SHOP STAFF FIRST

+ All other materials

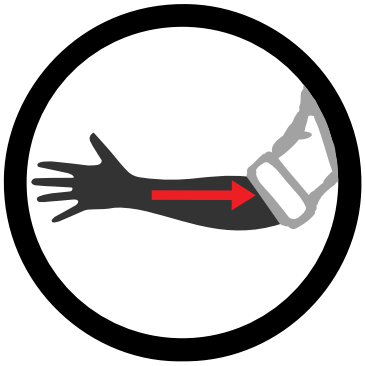
MANUAL LATHE

KEEP IT SAFE

USE PERSONAL PROTECTIVE EQUIPMENT WHEN OPERATING THE LATHE.

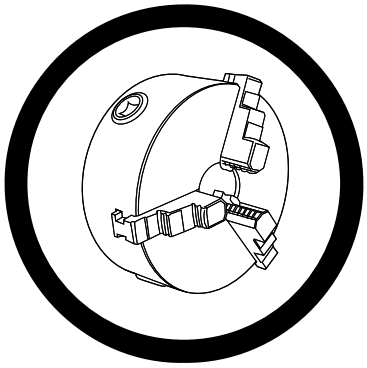


Always
wear safety
glasses.



Always wear short
sleeves, or rolled
sleeves, pull back
and tuck in long hair,
remove jewelry and
lanyards, etc.

Do not wear gloves.



Using a chuck or collet
is required for all work.

SAFETY FIRST

KEEP IT SAFE

1. Do not operate this machine before proper training and approval of MMM Instructor.

2. Do not run this machine without knowing the function of every control key, button, knob, or handle. Ask MMM staff or a qualified instructor for help when needed.

3. Protect your eyes. Wear approved safety glasses (with side shields) at all times.

4. Don't get caught in moving parts. Before operating this machine remove all jewelry including watches and rings, neckties, and any loose-fitting clothing.

5. Keep your hair away from moving parts. Long hair should be pulled up and tucked away.

6. Wear close toed shoes. No sandals or flip-flops.

7. Take off gloves before you start the machine. Gloves are easily caught in moving parts.

8. Remove all tools (wrenches, chuck keys, etc.) from the machine before you start. Loose items can become dangerous flying projectiles.

9. Never operate any machines after consuming alcoholic beverages, or taking strong medication, or while using non-prescription drugs.

10. Protect your hands. Stop the machine spindle and ensure that all movements have stopped:
    - Before changing tools
    - Before changing parts
    - Before you clear away the chips. Always use a chip scraper or brush
    - Before you make an adjustment to the part, fixture, or take measurements

11. Protect your eyes and the machine as well. Don't use a compressed air hose to remove the chips or clean the machine.

12. If you don't know, stop and ask.

13. Observe and practice all shop safety procedures.

14. Prevent slippage. Keep the work area dry and clean. Remove the chips, oil, coolant and obstacles of any kind around the machine.

15. Avoid getting pinched in places where the table, saddle or spindle head create "pinch points" while in motion.

16. Securely clamp and properly locate the workpiece in the vise, on the table, or in the fixture. Use proper holding clamping attachments and position them clear of the tool path.

17. Use proper cutting tools for the job. Pay attention to the rotation of the spindle: Left hand tool for counterclockwise rotation of spindle, and right hand tool for clockwise rotation of spindle.

18. Prevent damage to the workpiece or the cutting tool. Never start the machine (including the rotation of the spindle) if the tool is in contact with the part.

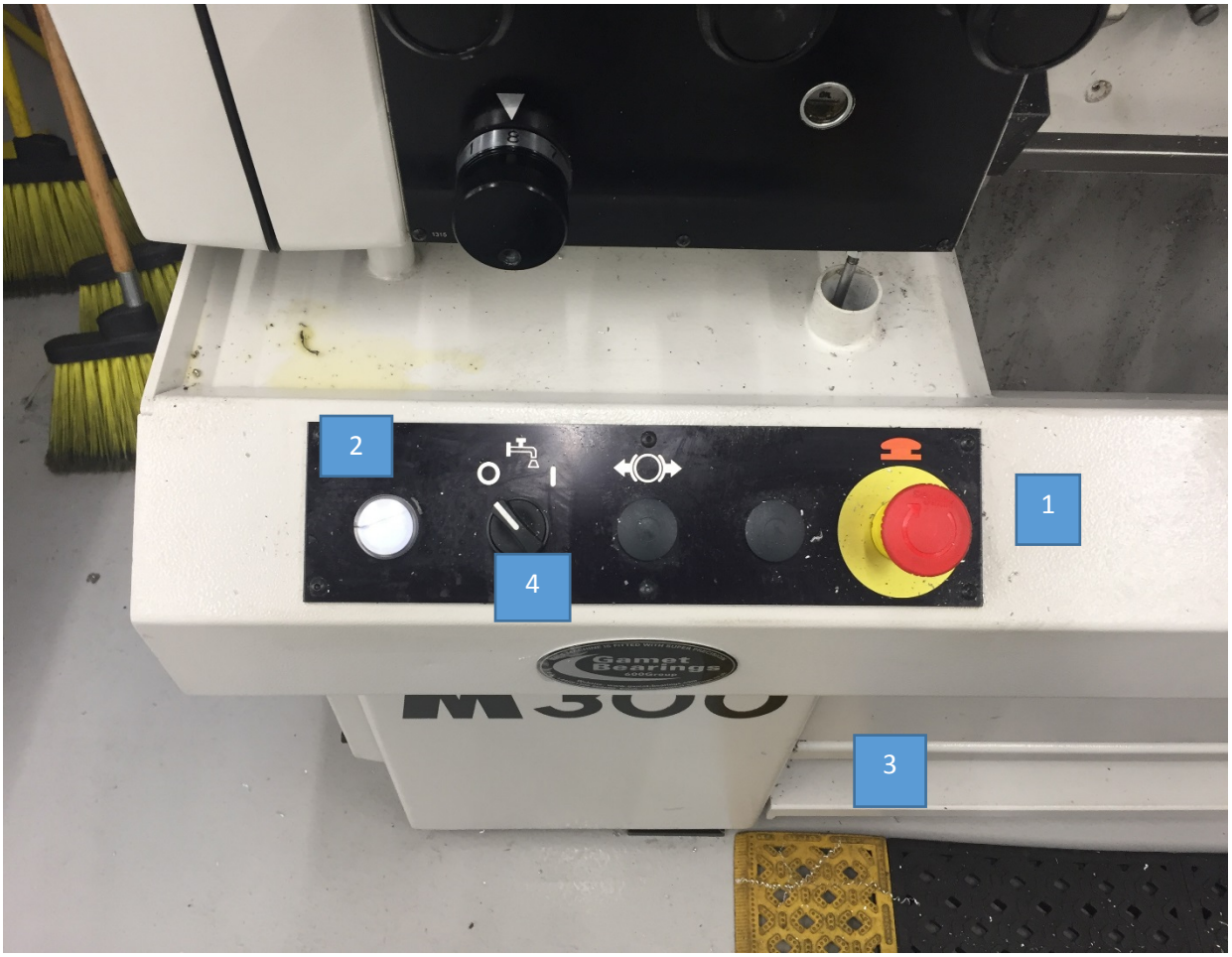
19. Check the direction (+ or -) of movement of the table when using the jog or power feed.

20. Don't use dull or damaged cutting tools. They break easily and become airborne. Inspect the sharpness of the edges, and the integrity of cutting tools and their holders. Use proper length for the tool.

MANUAL LATHE

Lathe Control Panel

Start and Emergency Stop



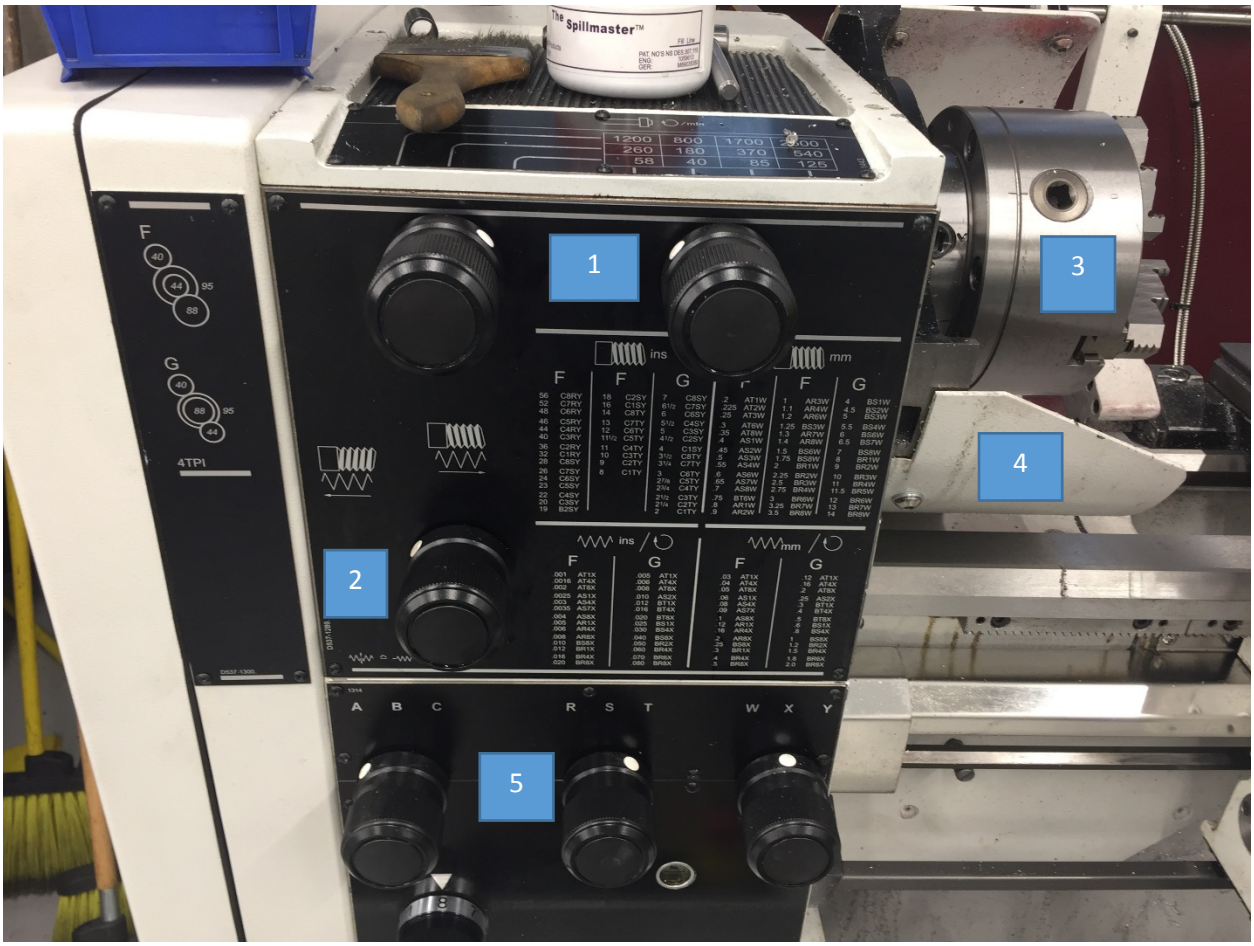
Twist the E-Stop button to engergize lathe. The power lamp should be lit and the lathe is ready to operate. The MMM has several lathes each with slightly differnet controls. Make yourself familiar with each machine before proceeding with operation.

1. E-Stop (kills all power)
2. Power Lamp (illuminated when power is on)
3. Foot Brake (stops the spindle rotation)
4. Coolant Switch (use spray bottle or brush)
5. When in doubt ask a staff member.

MANUAL LATHE

Lathe Headstock

Machine feeds and speeds set here



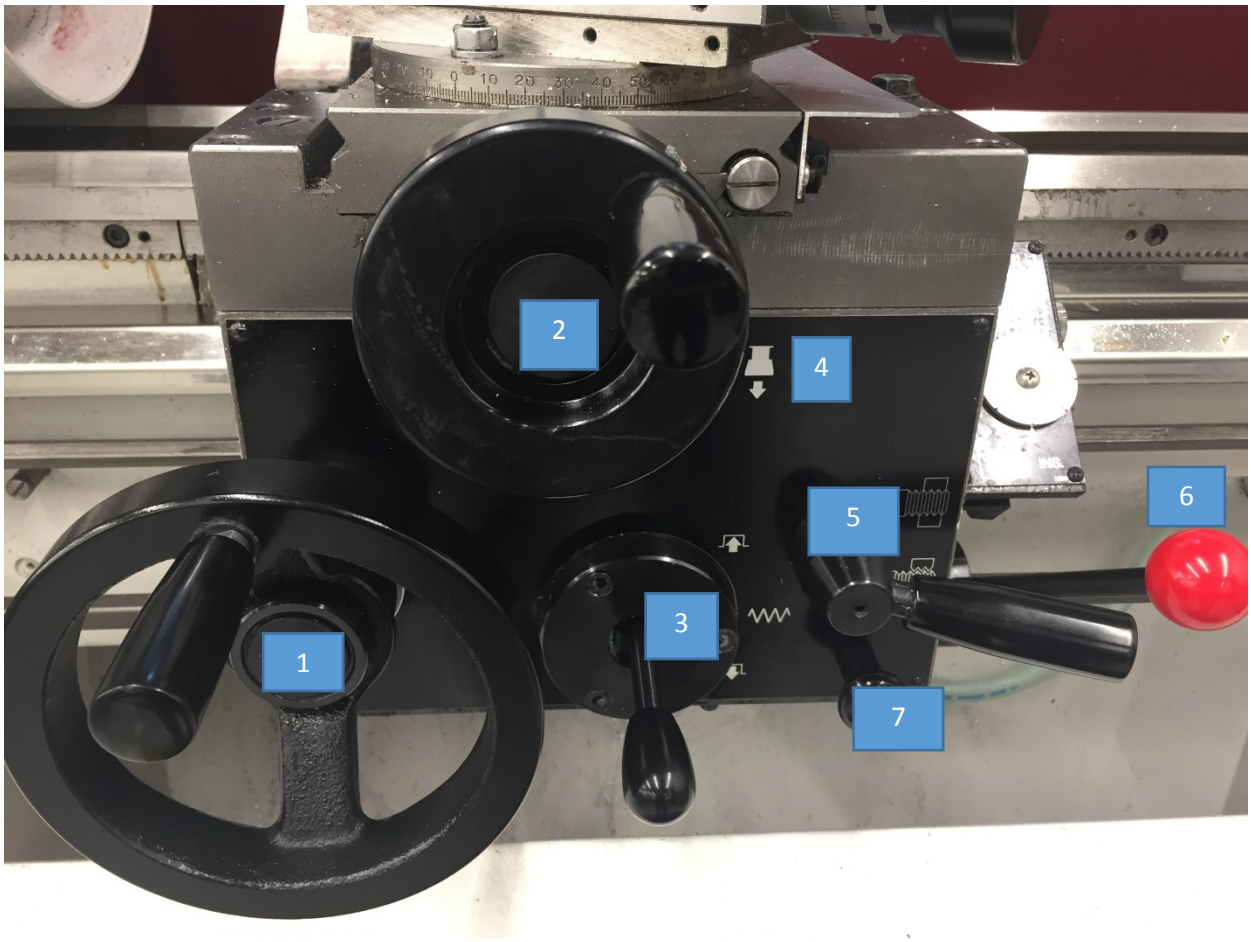
1. Spindle Speed Selection (low and high)
2. Feed Direction (left and right)
3. Three Jaw Chuck (work holding)
4. Chuck Guard (safety guard)
5. Feed Selection (threading and turning feeds)

- Use the foot brake to stop the spindle prior to making any adjustments.
- Never leave the chuck key in the 3 jaw chuck.
- Do not remove the chuck guard or any other safety device.

MANUAL LATHE

Lathe Carriage

Machine movements



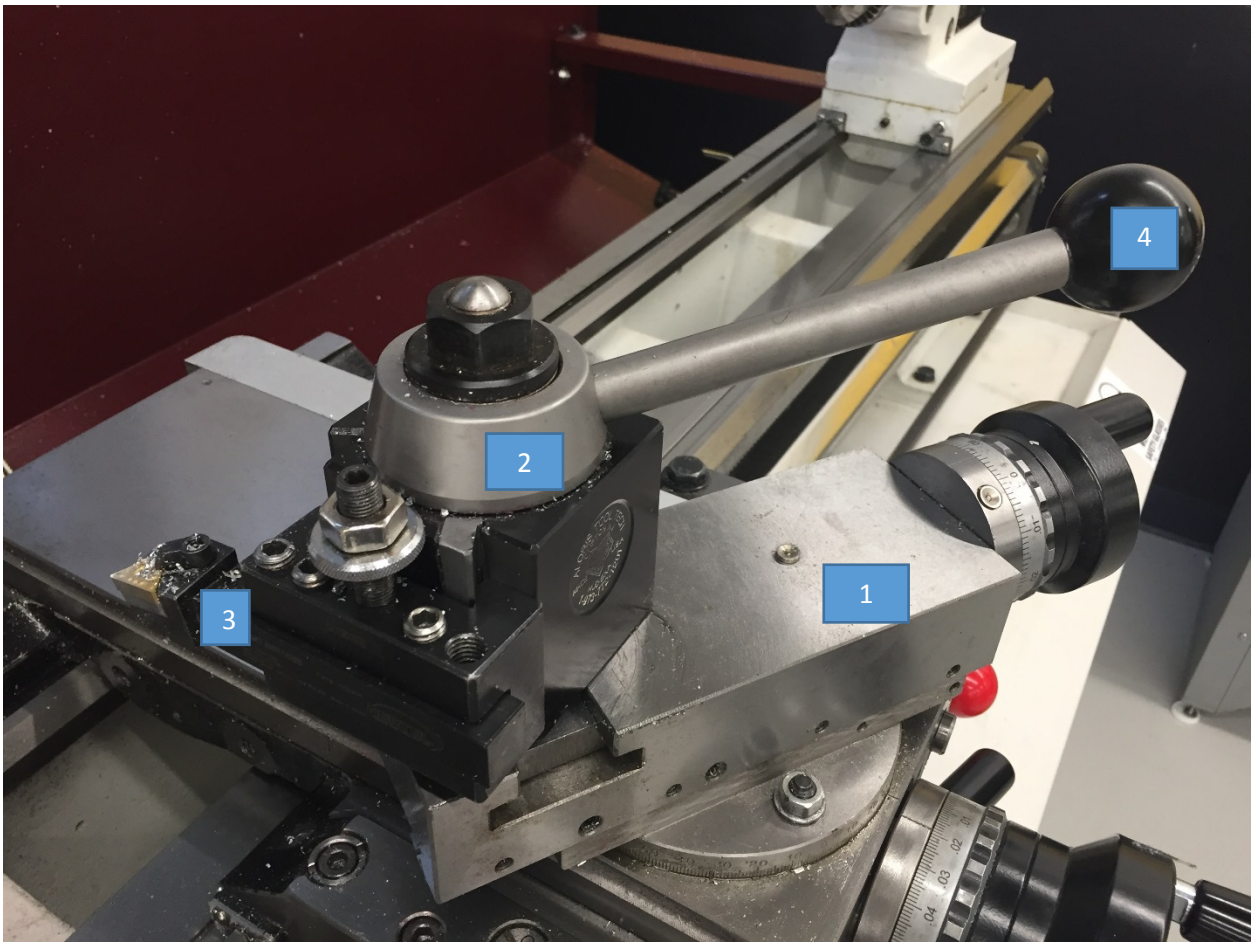
1. Z Axis Hand-wheel (moves carriage along the Z axis)
2. X Axis Hand-wheel (moves carriage along the X axis)
3. Power Feed Lever (engages the power feed)
4. Feed Direction (toggles feed from Z to X)
5. Half Nut Lever (used for threading)
6. Spindle Start Lever (starts spindle)
7. Lubrication Knob (when pulled oil is pumbed to friction points)

- Check feed and speed settings before using lathe. (see staff)
- Become familiar with lathe movement. (X and Z)
- Extra training is required for threading. (see staff)
- Secure work piece with chuck or collet. (remove chuck key)

MANUAL LATHE

Holds cutting tools and can cut tapers.

Tool Post and Compound



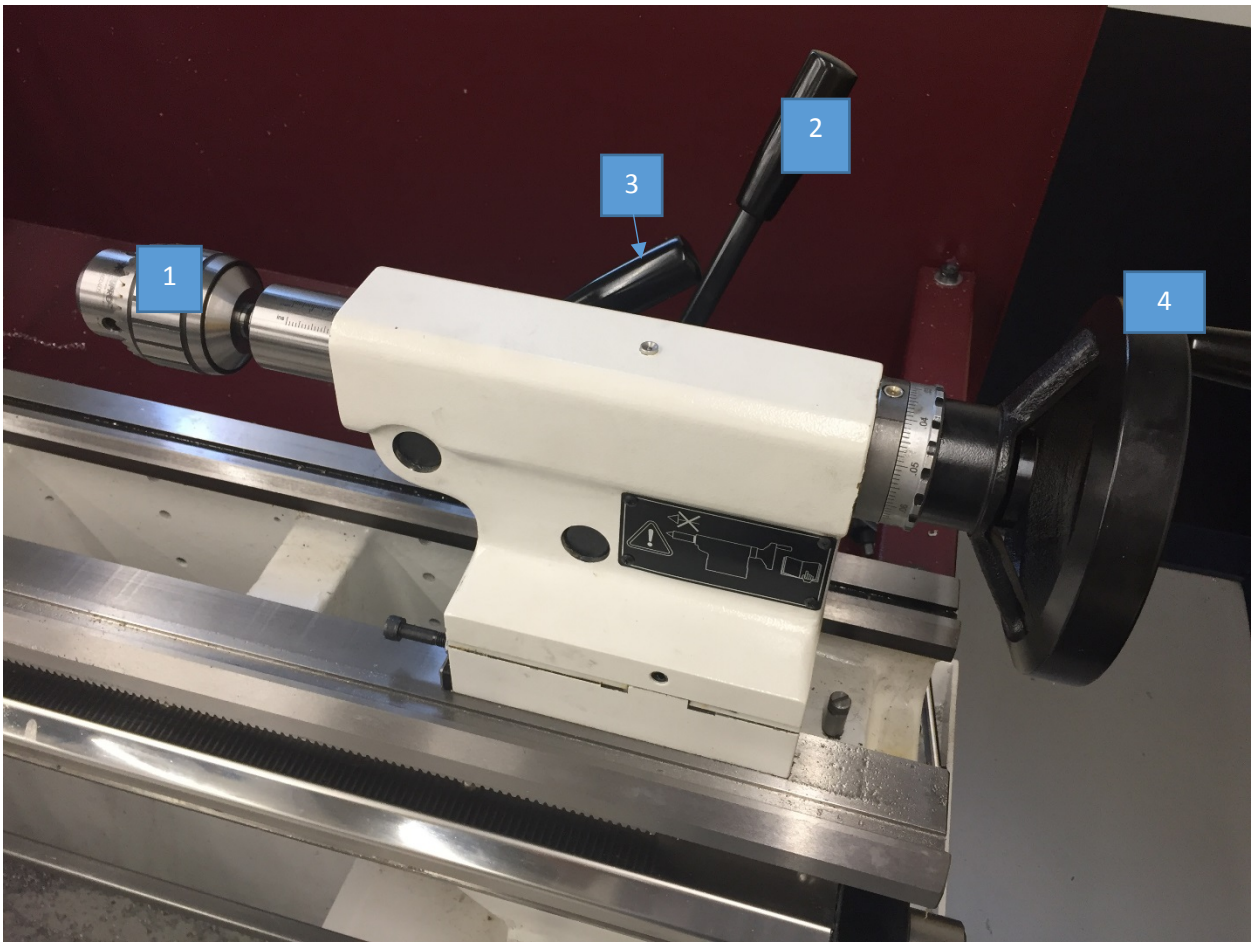
1. Compound Slide (can be adjusted to cut angles)
2. Quick Change Tool Post (Holds and adjusts cutting tool)
3. Cutting Tool (carbide inserted tool)
4. Tool Post Handle (rotate to lock or remove tool)

- See staff for help with cutting tapers.
- Adjust cutting tool height to the center of work piece.
- Use allen key to replace worn or chipped cutting tool. (see staff)

MANUAL LATHE

Tailstock

The Tailstock is used for drilling and securing long work with a live center



1. Drill Chuck (used for drilling in the lathe)
2. Tailstock Lock (locks in place)
3. Quill Lock (lock the quill when using live center)
4. Quill Handwheel (moves quill in and out)

- Secure drill in chuck using drill chuck key.
- Use live center for work extending out of the chuck. (see staff)
- Rotate Quill handwheel counter clockwise to remove drill chuck.
- Lock the tailstock when drilling .
- Lock the quill when using a live center.

MANUAL LATHE

COLLETS

COLLETS ARE A GOOD OPTION FOR HOLDING SMALL DIAMETER PARTS.

A collet is an easy method for holding small diameter parts. Each collet is sized to fit a specific diameter, and must fit snugly. The collet is threaded into the end of the spindle, after the chuck is removed and the collet clamps down on the workpiece.

1. Press the E-stop.
2. Select a collet that is the correct size for the workpiece.
3. Ensure that the outside of the collet and the inside of the spindle are clean.
   - ▸ Wipe with a clean shop towel.
4. Slide the collet into the spindle.
5. Slide the material into the collet. ▸ Never close an empty collet.
6. Push the collet closer handle towards the tailstock (to the right).
7. Rotate the collet closer ring to pull the collet deeper into the spindle. ▸ Stop when you feel a bit of resistance.
9. Flip the tab on the collet closer ring to keep the ring from rotating.
10. Move the collet closer lever to the left to secure the material.
    - ▸ When closing, you should feel a "click" as the mechanism engages.
    - ▸ If you don't feel the click, tighten the ring and try again.
    - ▸ If the mechanism is too tight, loosen the ring and try again.
11. Rotate the workpiece by hand to ensure the spindle is unlocked.

Note: See staff for more instructions.

MANUAL LATHE

CHUCKS

CHUCKS ARE USED FOR HOLDING LARGE WORKPIECES.

There are several common ways to hold materials on the lathe. Usually, the 3 jaw chuck is installed on the lathe. It is a self centering chuck, meaning that all the jaws move together, and keep the workpiece centered. The 3 jaw chuck only works on round material, or materials with a number of sides divisible by 3.

+ A 6 jaw chuck works the same way, with the same rules.

For holding square, rectangular or odd shapes, a 4 jaw chuck can sometimes be used.

+ See Shop Staff for 4 jaw chuck use.

Using the 3 or 6 jaw chuck

1. Press the E-stop to ensure safety.
2. Use the chuck key to open the jaws.

NEVER LEAVE THE CHUCK KEY IN THE CHUCK, EVEN FOR A MOMENT. THE ONLY SAFE LOCATION FOR THE KEY IS IN THE KEY HOLDER ON THE LATHE, OR IN YOUR HAND.

NEVER OPEN THE CHUCK JAWS SO THEY EXTEND MORE THAN HALFWAY BEYOND THE CHUCK BODY.

3. Place your part in the jaws.
   - The workpiece must be inserted into the jaws deep enough for a secure grip.
   - If more than 3x the workpiece diameter is sticking out of the chuck, you must use a center to hold the end. For example, if the material is 1" in diameter, and 4" is sticking out of the chuck, use a center.
   - To help center the workpiece in the chuck, wiggle it when tightening the jaws.
   - Ensure that there is enough material sticking out of the chuck to keep the tool from hitting the chuck.
4. Tighten the jaws with the key.
   - Remove the key.
5. Rotate the chuck by hand to ensure that the material is centered and that there is no interference between the chuck and any other part of the lathe.

USING A LIVE CENTER

1. Insert a drill chuck and center drill in the tailstock.
2. Slide the tailstock 1" from the workpiece and lock it.
3. Turn on the lathe.
4. Set the correct RPM.
5. Extend the quill until you drill into the workpiece about 1/4".
6. Turn off the lathe and replace the drill chuck with a live center.
7. Move the tailstock close to the workpiece and lock it.
8. Extend the quill until the center is snug in the workpiece.
9. Lock the quill.

SPEEDS AND FEEDS CHART

Use the wall chart to determine the correct RPM, cutting speed and maximum depth of cut.

If desired, you can use the following information to determine a suggested RPM.

CALCULATING THE LATHE RPM

Setting the lathe to use the correct speed (spindle RPM) for the operation is important. Determining the correct RPM takes a combination of research, observation and common sense.

Common materials have a calculated value, called **surface feet per minute** or **SFM,** for the maximum speed that a tool can move through the material, without excessive wear or damage.

The SFM is used to calculate the RPM of the spindle and workpiece. RPM is based on the material being cut, the material of the cutting tool and the diameter of the material being cut.

MATERIAL	SFM
Hard Steel (stainless, tool steel, etc)	50-60
Mild Steel (regular steel)	100-125
Brass	150-200
Aluminum	250-350

For plastics, check with the manufacturer or shop staff.

RPM = 4 X SFM / MATERIAL DIAMETER

To convert the SFM to RPM, use the following formula.

Example: 2" diameter stainless steel

4 x 50 / 2 = 200 / 2 = 100 RPM

Example: 1/2" diameter aluminum

4 x 300 / 0.5 = 1,200 / 0.5 = 2,400 RPM

Note: Observation and common sense will also help determine the correct speed. For example, if the tool is chattering and making lots of noise, something is wrong. Stop, look at the cutting tool, recalculate the speeds, and ask Shop Staff for help if needed. If the formula calculates an extremely high RPM, perhaps your math isn't correct. If you have questions about the RPM, see Shop Staff for help.

When it is time to start cutting, turn the spindle speed to a low number and start the spindle. Slowly turn up the speed until the readout is close to the calculated RPM.

PARTING AND DRILLING

When using the parting off tool, set the RPM to about 1/4 of the calculated value.

When drilling, calculate the RPM based on the drill bit diameter, rather than the workpiece size.

+ Using a small drill bit will calculate a high RPM. If the workpiece is large, you may need to reduce the RPM for safety. See Shop Staff if you have any questions about RPM.

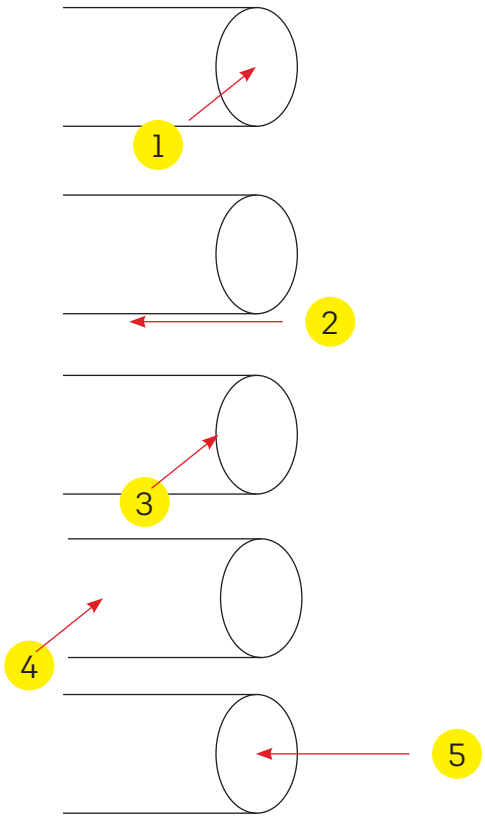
MANUAL LATHE

CUTTING OPERATIONS

THE BASIC OPERATIONS WILL ALLOW YOU TO MAKE MANY DIFFERENT SHAPES.

There are 5 commonly used types of cutting operations.

1. Facing
   - Removing the end of the workpiece, to make it flat as well as perpendicular to the length.
   - After facing, but before moving the carriage along the Z axis is a good time to set the Z axis to ABS 0.
2. Turning
   - Removing material along the Z axis of the workpiece.
   - The remaining material can be cylindrical or tapered.
3. Profiling
   - Using a shaped cutting tool to create a feature, usually a radius or chamfer, on the part.
4. Parting
   - Cutting straight into the workpiece along the X axis, in order to cut it to length.
   - Reduce the RPM to 25% and use lots of cutting fluid when parting.
5. Drilling
   - Using a drill bit to drill into the end of the workpiece.



Other lathe operations are possible, but not covered in this class.

+ Boring
   - Using a cutter to create a hole in the end of the workpiece.
   - Similar to drilling, but it's more accurate and the hole can be made any diameter, or even conical.
+ Threading
   - Cutting threads on the inside of a hole, or the outside of a shaft.

MANUAL LATHE

HANDS ON

OPERATING THE LATHE.

AREA AND MACHINE PREPARATION

1. Press the E-stop.
2. Clean and clear the lathe.
3. Secure the workpiece.
4. Select and install the cutting tool.
5. Calculate the RPM (speed) for your cutter and material.
6. Use the handwheel to rotate the chuck to check for collisions.
7. Turn the speed control to a low number.
8. Lock the Quick lever into the forward position.

ALL WORK MUST BE SECURED AT ALL TIMES.

MAKING THE CUT

1. Start the lathe.
   - Release the E-Stop.
   - Press start.
   - Move the spindle speed range lever to high or low.
2. Change the RPM to the calculated value.
3. Move the cutting tool close to the desired starting point.
4. Gently engage the cutting tool.
5. Make the first cutting pass.
   - This may be a good time to 0 the X or Z axis.
6. Move the spindle speed range lever to the center to stop the spindle.

AVOID ACCUMULATING LONG STRINGY CHIPS. STOP AND CLEAN THE LATHE IF NEEDED.

CLEANUP

1. Press the E-stop.
2. Remove the workpiece.
3. Clean the lathe and the area nearby.
   - Use brushes and a vacuum, not compressed air.
   - Chips may be sharp; use a tool to remove them.
4. Clean up any coolant spills.
5. Put away tooling, drill bits and tools.
6. Recycle scraps and put reusable pieces in the storage bin in the metal shop.

NEVER CLEAN OFF CHIPS WHILE THE WORKPIECE IS SPINNING.