Metal Lathe Rubric

November 2021

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Intro

By the end of this class the student will be able to demonstrate beginner level usage of the metal lathe, as well as awareness of the limits of their knowledge. They will be able to identify when / where to seek additional information / help. Further study and practice is required to increase comfort with this tool.

Safety

Machine Safety: Common Hazards

General Safe Shop Attire:

- No baggy clothing
- Long hair tied back
- Nothing below the elbows – sleeves, rings, gloves, bracelets, etc.
- Close-toed shoes
- Tool-specific PPE (See PPE section below)

- Spinning / moving things - chuck and jaws, workpiece, lead screw
- Stationary things that could accidentally move - workpieces, tools, etc.
- Heavy things - chucks and workpieces
- Sharp things - tools, chips, burrs on workpieces
- Hot things - tools, chips, workpieces

Personal Protective Equipment - Lathe

- Eye Protection - When operating the lathe, eye protection is absolutely required, whether in the form of safety goggles or a full-face shield.
- Hearing Protection - Hearing protection is strongly encouraged but generally not required.
- Clothing – A well-fitting apron is encouraged if wearing clothes you do not wish to get dirty.

Workholding

General

Workholding is a fundamental part of all metal shop operations. Unlike softer materials, e.g. wood, without consistent and proper workholding serious injury can, and will, occur.

Basic workholding consists of mechanically clamping the workpiece by at least two points. Clamping by only one point creates an axis on which the piece can spin and behave erratically, leading to injury.

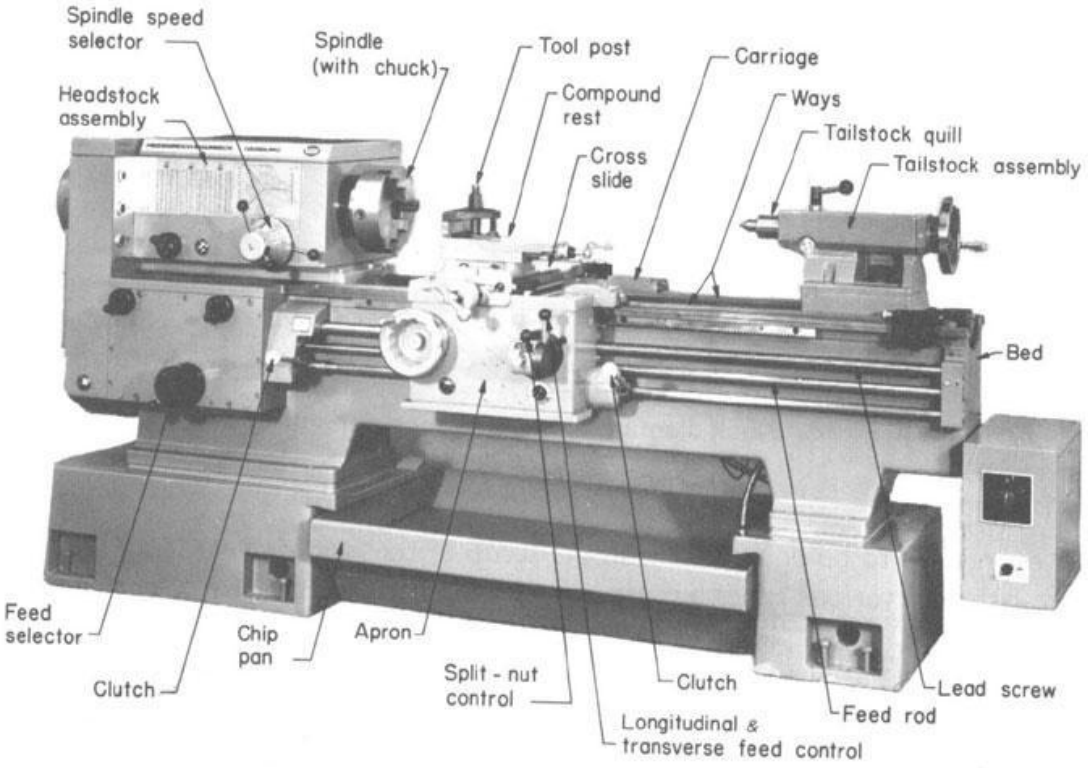
Several methods exist whether with conventional clamps, vise, chuck, T-slot + rails, etc. and varies by machine.

Lathe

Workholding on the lathe is different from conventional methods in that a 3 or 4 tooth chuck is used to hold the workpiece while the tooling remains static.

Ensuring the workpiece is aligned and secured tightly are the main concerns before beginning an operation.

Parts of the Lathe



- Headstock, spindle
    - Spindle on/off and direction control
    - Spindle speed control
- Chuck, chuck jaws, chuck key
- Collets & draw tube
- Bed and ways
- Carriage/saddle, cross slide, and compound
    - Feed handles for each
    - Compound angle adjustment
- Toolpost lock, rotation
- Tailstock handle, locks
- Turning, facing, and boring tools

Turning on the lathe

The picture above is a generic representation of a metal lathe. The current one the metal shop possesses (JET Mini Lathe) has a FORWARD / OFF / REVERSE knob as well as a belt-tension handle that must be engaged to spin the workpiece. FORWARD is the common cutting direction.

Changing Speeds

On the left hand side of the machine is an enclosed belt-driven gearbox.To change the speed of the output, simply open this box, and manually move the belt to connect two of the three (A, B, C) pulleys. A diagram on the front of the machine denotes which connections to make for the desired RPMs, where **A** is the pulley connected directly to the motor, **B** is the intermediate pulley, and **C** is the output pulley.

Lathe Tools / Carriage / Speeds + Feeds

Safe Operation Checklist

Properly demonstrates:

- removal and mounting of chuck (cleans nose, correct force)
- mounting / removing of collets
- work-holding in 3 jaw
- feed and speed selection
- cutting tool selection
- mounting of cutting tool in toolpost (orientation, height)
- turning and facing techniques
- center drilling with tailstock
- cleaning the lathe

Allowable Materials

- Ferrous - Steel / Stainless
- Non-Ferrous - Aluminum, Brass, Bronze, Copper
- Plastics - Nylon, Delrin
    - **DANGER** plastic shavings do not break like metal, but form a continuous string. Grabbing / clearing these while the machine is spinning can be fatal.

Tool Selection

- Select an appropriate cutting tool for a basic task - a more expensive tool stays sharp longer, but generally speaking provides no other benefit
    - Good ($) – High Speed Steel (HSS)
    - Better ($$) – Quick Change Carbide Tips
    - Best ($$$) – Solid Carbide
- Understand how tool properties like tool geometry, tool material, etc. affect correct tool selection and setup
    - Dull tools are not only inefficient, but dangerous as well
- Determine correct feeds, speeds relative to material

Movement of the Carriage

The carriage has two main movements across the major (X) and minor / cross (Y) axis of the lathe. Additionally, the compound tool rest can rotate around the Z axis of the carriage, providing an additional refinement of tool movement.

The compound rest, through some trigonometry, can provide extremely fine adjustments. Additionally, it can be adjusted to relative angles required for thread cutting.

Speeds and feeds

Speed refers to the speed at which the tool or workpiece moves, in the case of the lathe it is the rotation speed of the workpiece. Feed refers to the rate at which a tool and workpiece are moved in relation to one another.

Several tables / lookups exist in the shop and online to find guidelines on the material and tooling you're using, however experimentation will be required to achieve optimal results as both materials and tooling are constantly changing and evolving.

Cleanup and Shutdown

Please ensure the lathe and surrounding area is free from debris / chips / etc. and oil splatter at the end of your usage. Several brushes and vacuums are available within the metalshop.