Machine Shop Fundamentals

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Contents

How to Use This Resource

Welcome! To explore the contents of this resource, click on the "contents" option located on the left side. There will be three sections: Measuring Tools, Engine Lathes, and Milling Machines. Click the "+" symbol next to each part to access specific chapters. You can also move to the next section by clicking the "Next:" in the bottom right of the page. This resource is designed to provide a seamless and sequential learning experience. Therefore, it is recommended to progress through the content in order to allow a solid foundation to be built. However, each learner's needs are unique, so feel free to navigate as you see fit, skipping sections that you may already be familiar with or wish to explore at a later time.

About This Resource

This resource aims to provide comprehensive guidance on essential skills required for working in a machine shop, focusing on foundational skills such as reading measuring tools and the safe operation of lathes and milling machines. This resource was designed to cater to the needs of secondary educators in Alberta, offering resources to impart these skills to their students . However, the content extends beyond the classroom setting and can benefit anyone looking to enhance their understanding of machining techniques and safety practices.

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General Machine Shop Safety

Ensuring a safe work environment is essential in any setting, especially in a potentially hazardous space like a machine shop. The key to mitigating risks lies in implementing effective hazard control measures. By addressing potential dangers proactively, we can protect ourselves and others from accidents and injuries. Hazard controls can be achieved through 3 approaches:

1. **Engineering Controls**: Implementing safety measures directly into the design of the machines to minimize risks. Examples can include the installation of emergency stop mechanisms and designing machines with enhanced ergonomic features to reduce the risk of strain or injury.
2. **Administrative Controls**: Setting up proper policies and procedures to ensure everyone follows safety guidelines. Examples can include the development of policies and procedures that outline best practices and safe work methods. Establishing a machine sign-off so only qualified individuals can operate machinery.
3. **Personal Protective Equipment**: Equips workers with the necessary equipment to add an extra layer of protection. Examples can include safety glasses, face shields, and safety boots.

Here is a general list of machine shop safety precautions. Each machine will have a comprehensive safety chapter.

1. Canadian Standards Association (CSA) approved steel toe boots and safety glasses must be worn at **ALL TIMES.**
2. Hearing protection is always recommended but must be worn when noise levels surpass 85 decibels.
3. Gloves should never be worn while operating rotating equipment.

4. All rings, watches, and jewelry must be removed
5. Long hair must be tied back or put in a hair net.
6. No loose clothing is permitted.
7. Always keep hands and other body parts a safe distance away from moving machine parts, workpieces, and cutters.
8. Always use manufacturer-supplied guards or safety mechanisms. Do not remove or disable them.
9. Only operate machines if authorized to do so by the policy and procedures in place.
10. Never use compressed air to clean the machine, part, or yourself.
11. Concentrate on the work and do not talk while operating any machinery.

Please be aware that local and federal occupational health and safety laws may differ depending on jurisdiction. Ensure that you comply with your local laws and regulations. The Alberta Occupational Health and Safety Act can be found here.

PART I

MEASURING TOOLS

This section will explore precision measuring devices and their use, advantages, and disadvantages. Accurate measurements are the cornerstone of successful machining procedures. Precision measuring devices enable machinists to obtain precise measurements of components, ensuring strict tolerances and specifications are met. In addition, this section will discuss widely adopted measurement systems utilized within the machining trade.

Learning Objectives:

- Apply the imperial measurement system to machining work to ensure accuracy
- Describe the functionality and purpose of imperial calipers and micrometers.
- Demonstrate how to read measurements obtained using imperial calipers and micrometers.

1. Imperial Measurement System

Below is a 2-minute video discussing the imperial measurement system and related terminology. This is an interactive video that will pause at several points and allow you to provide answers to questions in the video. You can check your answer using the "check" button or press play to continue watching. A summary of your answers will be provided at the end of the video if you click the star icon. The Imperial measurement system is widely used across North America, making it essential for machinists to have a sound understanding of its applications and intricacies.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://openeducationalberta.ca/saitmachineshop/?p=92#h5p-1

2. Imperial Micrometers

Below is a 10-minute video on how to use, calibrate and read imperial micrometers. A short 5-question quiz is below the video. Click on "Start Quiz" to begin. You can take the quiz as many times as you like and have the option to check each answer immediately or review the results at the end. Micrometers (mics) are one of the most common measuring tools in a machine shop. It is commonly used on lathes to measure round pieces but can also be used for measuring the thickness, and outside dimensions of various components with a high degree of accuracy and precision.

For additional practice and resources, a PowerPoint presentation with practice questions is under Additional Measurement Resources.

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An interactive H5P element has been excluded from this version of the text. You can view it online here: https://openeducationalberta.ca/saitmachineshop/?p=55#h5p-4

3. Imperial Vernier Calipers

Below is a 17-minute video on how to use, calibrate and read imperial calipers. A short 5-question quiz is below the video. Click on “Start Quiz” to begin. You can take the quiz as many times as you like and have the option to check each answer immediately or review the results at the end. Vernier Calipers can offer the versatility to measure both internal and external dimensions and depths with a reasonably high level of accuracy. This versatility makes calipers (usually digital) the most commonly used measuring tool in machine shops.

For additional practice and resources, a PowerPoint presentation with practice questions is under Additional Measurement Resources.

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https://openeducationalberta.ca/saitmachineshop/?p=57#h5p-7

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://openeducationalberta.ca/saitmachineshop/?p=57#h5p-5

4. Additional Measurement Resources

Below are some supplementary resources to aid in reading Imperial micrometers and Vernier calipers. Measuring tool proficiency comes with practice, so please take all the time needed to understand these critical measuring tools.

Imperial Micrometer Practice Reading PowerPoint: here

Imperial Vernier Caliper Practice Reading PowerPoint: here

Measurement Tools Quiz (Please note all tools in this quiz are not covered in this resource): here

Below are some links for simulators by Eduardo Stefanelli. These two links will take you outside of the OER:

Vernier Caliper Simulator

Micrometer Simulator

PART II

ENGINE LATHES

This section will explore engine lathes, their operation, and safe use procedures. Lathes are one of the fundamental tools in a modern machine shop. These machines enable machinists to transform raw materials into finished components with high accuracy and finish.

Learning Objectives:

- Describe lathe safety and identify potential risks
- Perform calculations for lathe speeds and feeds
- Explain lathe operations and perform machining operations on a lathe

5. Lathe Safety

The lathe is one of the machine shops' most essential and versatile machines. It is used to shape various materials into precise components. However, like any powerful machine, the lathe poses inherent risks if not handled with caution and expertise. Therefore, understanding and adhering to a set of safety precautions is of utmost importance for the operators and those working in the area of these machines. The precautions listed below are not recommendations but strict rules to protect operators and prevent accidents. A safe and secure work environment can be established by diligently observing these rules. The following list has been adapted from the Canadian Center for Occupational Health and Safety (2018).

1. Wear proper PPE around lathes. This can include CSA-approved safety glasses. Steel toe boots, ear protection, and face shields.
2. Only trained and authorized personnel should operate the engine lathe. Ensure all operators have received proper training and certification for lathe operation and safety.
3. Remove entanglement hazards (e.g., loose clothing, jewelry, etc.). Tie back and confine long hair.
4. Keep the floor free from obstructions or slip hazards.
5. Ensure the lathe has an emergency stop button.
6. Follow job specifications for the speed, feed, and depth of cut for turning materials. Make sure all work runs true and centered.
7. Remove the chuck wrench immediately after adjusting the chuck.
8. Remove all tools, measuring instruments, and other objects from the saddle or lathe bed before starting the machine.
9. Shut off the power supply to the motor before mounting or removing accessories.

10. Stop the lathe and put the clutch in neutral before taking measurements.

Below is a 4-minute video discussing general lathe safety, how to install a chuck and emergency shutdown procedures. Be aware that all lathes are different and may have unique features. Always consult the operations manual provided by the manufacturer for detailed guidelines.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=59#oembed-1

A general lathe safety sign-off that you can use can be found here.

Below is a picture with potential safety hazards. Click on the "+" to learn more about lathe safety. By engaging with these pictures, you can gain valuable insights into recognizing and mitigating risks, fostering a safer and more secure working environment when working with lathes.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://openeducationalberta.ca/saitmachineshop/?p=59#h5p-8

References

Canadian Center for Occupational Health and Safety. (2018).

Metalworking machines lathes. https://www.ccohs.ca/oshanswers/safety_haz/metalworking/lathes.html

6. Lathe Operation

This chapter will cover setting RPM, calculating speeds and feeds, lathe cutting tools, and machine operation. Additional resources such as recommended apps and practice tests can be found under Lathe Projects and Resources.

Calculating and Setting Revolutions per Minute

The speed at which the workpiece spins during a lathe operation is called RPM, which stands for "Revolutions per Minute." RPM is vital in machining because it affects the tool's cutting efficiency and overall lifespan. If the RPM is too high, the cutter will burn out. If the RPM is too low, the cut will not be efficient. To figure out RPM, you use a simple equation:

RPM = (Cutting Speed x 4) / Diameter of the workpiece

The Cutting Speed is the rate at which the tool moves in surface feet per minute (SFPM), while the Diameter signifies the workpiece size in inches.

The specific Surface Feet per Minute value varies based on factors such as the material being machined and the tool material used. Typically, the tool's manufacturer provides recommendations regarding optimal cutting speed. Here are some general guidelines for cutting speed:

Work Material (Common AISI/SAW Designations)	Highspeed Steel
Tool Steel (O1)	50
Plain Steel (1010, 1012)	90
Alloy Steel (4140, 4150)	80
Aluminum (1100, 3003)	300
Brass	200

Only use this chart as a reference, refer to tool manufacturer guidelines for accurate SFPM

Below is a 6-minute video on calculating and setting RPM on a lathe. Always refer to the machine's operation manual for instructions on your specific machine. This is an interactive video that will pause at several points and allow you to provide answers to questions in the video. You can check your answer using the "check" button or press play to continue watching. A summary of your answers will be provided at the end of the video if you click the star icon.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://openeducationalberta.ca/saitmachineshop/?p=104#h5p-9

Calculating and Setting Feedrate

The lathe's feed refers to how far the cutting tool moves along the work's length for every spindle rotation. For example, if the lathe is set to a 0.010″ feed, the cutting tool will move 0.010″ for each complete revolution of the work. It is suggested to adjust the feed rate separately for roughing and finishing operations. Generally, a higher feed rate is applied during roughing to expedite material removal, resulting in a coarser surface finish, which is ok as it's not the final size. The feed rate decreases for finishing, aiming for a smoother surface finish.

For most machining operations, roughing feed can be set from 0.010″-0.025″/revolution, and finishing can be set to 0.003″-0.005″/revolution.

Below is a 5-minute video showing how to set a machine's feedrate using the quick change gearbox.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=104#oembed-1

Below is an interactive picture showing the 2 different feedrates. Click on the "+" to see what the feedrate was set at. There is a noticeable difference in roughing and finishing feedrates

An interactive H5P element has been excluded from this version of the text. You can view it online here:

https://openeducationalberta.ca/saitmachineshop/?p=104#h5p-11

Lathe Tools

A wide array of lathe tools is available to machinists for various tasks. This section will focus on essential cutting tools frequently used on lathes, including turning, inside diameter (ID), knurling, and grooving tools.

Turning tools are employed to remove material from a workpiece's length or face, reducing diameter or length. As the workpiece rotates, the turning tool moves linearly, eliminating material from the outer diameter or face. ID tools, usually in the form of boring bars, enlarge holes already drilled or cast. Knurling tools create decorative patterns on cylindrical workpieces, enhancing appearance and grip. These tools feature toothed steel wheels (knurls) that imprint the desired pattern onto the workpiece surface. Grooving tools are used to cut grooves into workpieces such as O-ring grooves or have a blade-like cutting edge and are used to cut materials at a specific length. They plunge directly into the workpiece to separate the finished part from the stock.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://openeducationalberta.ca/saitmachineshop/?p=104#h5p-10

OD Turning (Top Right), Facing (Top Left), Knurling (Bottom Left), Parting off or grooving (Bottom Right)

The following 10-minute video explains commonly used lathe tools and demonstrates how to properly set them up in a tool block and adjust for center height.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=104#oembed-2

Below is an interactive element. Click and drag the image to match whether the tool is too high, low, or on center. Your results will show in the bottom left once completed.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://openeducationalberta.ca/saitmachineshop/?p=104#h5p-12

Lathe Operation

Below is a 2-minute video describing the levers and handwheels on a lathe. These components are crucial in controlling various aspects of the lathe's operations. Understanding how to operate these levers and handwheels effectively is essential for achieving accurate and efficient machining results.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=104#oembed-3

7. Lathe Procedures

This chapter will focus on lathe procedures, including facing, outside diameter (OD) turning, drilling, knurling, and taper turning. A set of videos is presented below to illustrate these skills, showcasing their application by creating a ball peen hammer. PDF versions of the drawings and procedures for this project will be listed under "Lathe Projects and Resources."

Introduction to the Project and Order of Operation

This video will lay the groundwork for the procedures to follow. Understanding the sequence of tasks is crucial for achieving precise and efficient results. This 4-minute video will outline the project's scope and provide a step-by-step guide in the order of operation.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=106#oembed-1

OD Turning, Facing, and Center Drilling

OD turning, facing and center drilling will be covered in this video. These techniques are the building blocks of working on a lathe allowing for more intricate operations in the future. Below the video introduces you to these topics.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=106#oembed-2

Knurling

Knurling adds both functionality and aesthetics to a workpiece. This video will explore the creation of knurled patterns on cylindrical surfaces.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=106#oembed-3

OD Turning To Shoulders

Building off OD turning, this video will demonstrate how to transition from one diameter to another, ensuring accuracy and consistency.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=106#oembed-4

Taper Turning

Taper turning requires precision and attention to detail. This video demonstrates the process of gradually increasing the diameter using a telescoping taper attachment.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=106#oembed-5

Hammer Handle Finishing

Finishing work is the final step in any machining operation. This video will cover how to safely create smooth surface finishes and the hammer handle's final stages.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=106#oembed-6

Hammer Head

This video provides an overview of how to create a hammer head using the skills learned in previous videos. This video will also cover how to use a tap on a lathe.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=106#oembed-7

8. Lathe Projects and Resources

Lathe Projects:

Hammer Drawings and Mark Sheet

Hammer Project Procedures

Lathe Safety:

Lathe Safety Signoff

Lathe Calculators:

This Machining Calculator is a free resource from Sandvik Coromat and provides valuable information on speeds and feeds for both milling and turning.

PART III

MILLING MACHINES

This section will explore milling machines, their operation, and safe use procedures. Mills are one of the fundamental tools in a modern machine shop. These machines enable machinists to transform raw materials into finished components with high accuracy and finish.

Learning Objectives:

- Describe mill safety and identify potential risks
- Perform calculations for mill speeds and feeds
- Explain mill operations and perform machining operations on a mill

9. Mill Safety

Along with lathes, milling machines are one of the most indispensable tools in a machine shop. Milling machines operate by feeding a rotating cutter into a workpiece. However, they can pose a severe risk if not handled with care and expertise. To ensure a safe and secure working environment, follow these rules adapted from the Canadian Center for Occupational Health and Safety (2018).

1. Wear proper PPE around milling machines. This PPE can include CSA-approved safety glasses, steel toe boots, ear protection, and face shields.
2. Only trained and authorized personnel should operate the milling machine. Ensure all operators have received proper training and certification for lathe operation and safety.
3. Remove entanglement hazards (e.g., loose clothing, jewelry, etc.). Tie back and confine long hair. Never wear gloves!
4. Keep the floor free from obstructions or slip hazards.
5. Keep a clear workspace. Keep hands, brushes, and rags away from the rotating milling cutter.
6. Hands away. Keep your hands well clear of revolving cutters.
7. Ensure that the correct cutting speeds and feeds are being utilized.
8. Always double-check to ensure your machine setup securely holds the work.
9. Ensure tooling and supporting components are firmly tightened.
10. Cleanup after milling. Use a vacuum, brush, or rag to clear cuttings only after the cutter has stopped moving. Never use compressed air.

A safety signoff can be found here.

Below is an 8-minute video discussing general mill safety, mill operation, and emergency shutdown procedures. Be aware that all mills are different and may have unique features. Always consult the operations manual provided by the manufacturer for detailed guidelines.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=61#oembed-1

Below is a short 5 question quiz test your knowledge on milling machine safety.

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://openeducationalberta.ca/saitmachineshop/?p=61#h5p-13

References

Canadian Center for Occupational Health and Safety. (2018). *Metalworking machines lathes.* https://www.ccohs.ca/oshanswers/safety_haz/metalworking/lathes.html

10. Mill Operation

This chapter will cover calculating RPM and feedrate on a milling machine, the different cutting tools used, how to dial in a milling vice, and how to tram the head of a milling machine .

Calculating and Setting Revolutions per Minute

The speed at which the cutting tool rotates is called Revolutions per Minute (RPM). Calculating RPM on a milling is similar to calculating it on a lathe. The main difference is that the cutter is rotating on a milling machine, not the workpiece. Therefore, the “D” value is the diameter of the cutting tool, not the workpiece. Like a lathe, if the RPM is set to high, it will significantly shorten the tool’s lifespan. If the RPM is set to low, the cut is not effective. The formula for setting RPM on a lathe is:

RPM = (Cutting Speed x 4) / diameter of the cutting tool

The Cutting Speed is the rate at which the tool moves in surface feet per minute (SFPM), while the diameter signifies the cutting tool size in inches.

The specific Surface Feet per Minute value varies based on factors such as the machining material and the tool used. Typically, the tool’s manufacturer provides recommendations regarding optimal cutting speed. Here are some general guidelines for cutting speed:

Work Material (Common AISI/SAW Designations)	Highspeed Steel	Carbide
Tool Steel (O1)	50	350
Plain Steel (1010, 1012)	90	360-400
Alloy Steel (4140, 4150)	80	350-400
Aluminum (1100, 3003)	300	1000
Brass	200	800

Only use this chart as a reference, refer to tool manufacturer guidelines for accurate SFPM

Below, is a short 7-minute video demonstrating how to set the RPM on a milling machine. Always refer to the machine's operation manual for instructions on your specific machine.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=108#oembed-1

Feedrate on a Milling Machine

The feedrate of a milling machine is typically expressed in inches per minute (in/min). This value determines the speed at which the cutter moves through a workpiece. Choosing an appropriate feedrate is crucial for achieving precise results, ensuring tool longevity, and correct surface finish.

The formula for milling machine feedrate is:

In/min= RPM x Chip load per tooth x # of teeth

RPM= The speed at which the spindle is turning

Chip load per tooth (Chip load)= The amount of material removed by each cutting tooth of the tool during each revolution (see chart below). Cutting tool manufacturers typically include the chip load on packaging.
# of teeth= The total number of cutting teeth or flutes on the milling tool.

General guidelines for chip load (always follow tool manufacturers guidelines) :

Tool Diameter	Steel	Aluminum
1/8	0.002-0.004”	0.0025-0.004”
1/4	0.0025-0.005”	0.0025-0.005”
3/8	0.003-0.005”	0.0035-0.006”
1/2	0.0035-0.006”	0.004-0.007”
3/4	0.0035-0.007”	0.004-0.007”
1	0.0035-0.0075”	0.0045-0.007”

Watch this 9 minute video, created by Brad Kingdon, to learn more.

Milling Cutting Tools

There are a countless number of milling cutters used in today’s machine shops. Below are some of the most common ones used:

End Mills: This cutter has cutting edges at the tip and sides. End mills are versatile tools for contouring, slotting, and face milling. They come in various configurations for specific tasks, such as square end, ball end, bull end, and corner radius end mills.

Face Mills: These cutters are suited for removing material from large, flat surfaces. They have multiple inserts for high-volume material removal. These cutters are used for squaring up and smoothing large workpieces.

Twist Drills: Twist drills are primarily designed for drilling holes in workpieces. They feature spiral flutes that help evacuate chips while drilling.

Center Drills: Center drills are used to create small starter holes in workpieces before using twist drills. Center Drills ensure accurate hole placement and drill from wandering.

Reamers: Reamers are used for high-precision hole finishing. These tools create very accurate hole sizes and can be accurate to 0.0005″ if used properly.

Taps: Taps are used to create threads on the inside of holes. Be aware that there are different types of taps for different operations. Below is a tapered tap (right) and bottoming tap (left). The tapered tap is used to start threads, while the bottoming tap is used to cut threads to the bottoms of holes.

Cutter Material: Milling tool cutter material is essential for tool longevity and performance. Common materials include high-speed steel (HSS) and carbide. Carbide cutters are typically favored for their hardness and ability to remove material quickly at a higher RPM and feedrate. However, this hardness comes with a trade-off, as it makes the tool brittle. This brittleness may cause the tool to chip. So, if the machining process requires a tough cutter, use a HSS one.

Below is a short 6-minute video describing different milling machine cutters and holders.

One or more interactive elements has been excluded from this version of the text. You can view them online *here:* [*https://openeducationalberta.ca/saitmachineshop/?p=108#oembed-2*](https://openeducationalberta.ca/saitmachineshop/?p=108#oembed-2)

Dialing in a Milling Vice

Dialing in a milling vice is crucial for precision and accuracy on a milling machine. An adequately aligned vice results in consistent and accurate cuts. Below is a 6-minute video demonstrating how to dial in a vice on a milling machine.

One or more interactive elements has been excluded from this version of the text. You can view them online here: [*https://openeducationalberta.ca/saitmachineshop/?p=108#oembed-3*](https://openeducationalberta.ca/saitmachineshop/?p=108#oembed-3)

Tramming in a Milling Machine

Tramming in the milling machine head is an essential maintenance task that should be completed regularly. Tramming the head ensures the milling machine head is perpendicular to the work table. Without proper tramming, the cutting tool may produce uneven surfaces, incorrect angles, tapers, or inconsistent dimensions in machined components. Below is a 12-minute video demonstrating how to tram in a milling machine.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=108#oembed-4

11. Mill Procedures

This chapter will focus on mill procedures, including squaring a block, using an edge finder, drilling, tapping, and using an endmill. A set of videos is presented below to illustrate these skills, showcasing their application by creating a dice and finishing the hammerhead.

Squaring a Block

This video describes how to square up a workpiece. This process is required when starting most work pieces on a milling machine.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=110#oembed-1

Using an Edge Finder

Using an edge finder is a fundamental skill on a milling machine. This video demonstrates how to use this tool.

One or more interactive elements has been excluded *from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=110#oembed-2*

Using an Endmill

An endmill is one of the most commonly used tools on a milling machine. This video describes how to use an endmill.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://openeducationalberta.ca/saitmachineshop/?p=110#oembed-3

Tapping on a Mill

This video demonstrates how to drill and tap on a milling machine.

One or more interactive elements has been excluded from this version of the text. You can view them online *here: https://openeducationalberta.ca/saitmachineshop/?p=110#oembed-4*

12. Mill Resources

Mill safety [sign-off].

Feedback

Receiving feedback on this resource is critical as it allows for the adaptation and enhancement of materials, tailoring it to your specific needs. This input plays a pivotal role in improving the effectiveness of this resource. If you have time, please take this short 5-minute survey. If there are any errors in the content, include this at the bottom of the survey and include the error's location and a short description.

Thank you!

[Feedback Link]

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