KIRKWOOD
SCHOOL DISTRICT

PRECISION MACHINING I 9-12

Approved by KSD Board of Education: May 19, 2025

Course Description:

Precision Machining is an introductory course in manufacturing processes associated with metal fabrication. The course begins with students learning to work safely with common hand tools and power equipment found in industry, such as the drill press, horizontal bandsaw, metal lathe, vertical mill, and welding equipment. Students will construct projects focused on the proper setup and use of each of the machines listed above. Students will also master print reading, measurement and layout, and, most importantly, safety. There will be a set fee to cover the cost of the predefined project for this course.

Grade Level: 9-12 Grade (semester)

Unit Scope and Sequence

Unit 1: Safety and Measurement
Unit 2: Tools of the Trade
Unit 3: Manual Machining/Manufacturing
Unit 4: Fastening Techniques

Course Enduring Understandings:

- **Safety First**: Understanding and following proper safety protocols is essential to preventing injuries and ensuring a productive workshop environment.
- **Tool Mastery**: Proficiency in using hand tools, power tools, and machines is fundamental for shaping, joining, and finishing metal projects.

Course Essential Questions:

- What safety procedures must be followed when working with metal and operating tools and machines?
- How do we properly use and maintain hand tools, power tools, and machines in metalworking?

PRECISION MACHINING I 9-12
Unit 1: Safety and Measurement

In this unit, students will understand the proper shop safety and demonstrate proper use of precision measuring tools. Students will also be able to communicate measurements effectively.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Using proper safety procedures protects individuals, equipment, and the workplace environment. • Understanding and applying precision measurement techniques with tools like a ruler ensures components are made to the correct specifications, even at varying levels of detail. • Effectively communicating measurements on technical drawings is essential for ensuring accurate manufacturing and successful teamwork in machining projects.	• What is required to be a safe worker in the shop? • What are the different levels of precision when using a ruler? • What are the different levels of precision when using a dial caliper? • Can you dimension parts using a technical drawing? • How does understanding precision measurement impact the quality of a machined part? • Why is clear communication of measurements on technical drawings essential in machining?
Students must know:	***Students must be able to:***
• Shop safety protocol • How to measure and communicate measurements using a ruler. • How to measure and communicate measurements using a dial caliper.	• Demonstrate proper safety protocols and procedures in the metal shop. • Locate safety-related items in the shop (first aid, fire extinguisher, fire blanket, eyewash). • Dimension various parts with both a ruler and dial caliper depending on the precision level required. • Understand precision measurement with a ruler (1/32nd, 1/16th, 1/8th). • Understand precision measurement with a dial caliper (precise to 0.001in). • Communicate measurements on a technical drawing.

PRECISION MACHINING I 9-12
Unit 1: Safety and Measurement

Missouri Competency Machinist Standards (MCMS)

Priority Standard: Safety (MCMS.1).
Supporting Standards:
- Safety for fire prevention/suppression (MCMS.1.B).
- Safety using Personal Protective Equipment, or PPE (MCMS.1.D).
- Safety including Emergency Stop Systems (MCMS.1.G).

Priority Standard: Measuring and Test Equipment (MCMS.3).
Supporting Standards:
- Measuring including fundamentals of Coordinate Measuring Machines (MCMS.3.A.1).
- Measuring including fundamentals of Portable Measuring Machines (MCMS.3.A.2).
- Measuring including fundamentals of On-machine Measuring Equipment (MCMS.3.A.3).
- Measuring terminology and definitions (MCMS.3.B).
- Measuring hand-held measuring tools (MCMS.3.C).
- Best practices for measuring strategies (MCMS.3.E).

Priority Standard: Applied Mathematics (MCMS.4)
Supporting Standards:
- Applied mathematics of arithmetic (MCMS.4.A).
- Applied mathematics of right angle trigonometry (MCMS.4.F).

PRECISION MACHINING I 9-12
Unit 2: Tools of the Trade

In this unit, students will begin to explore both the hand tools and the power tools used in the metal shop.

Unit Essential Learning Targets

Enduring Understandings	***Essential Questions***
• Selecting the appropriate hand or power tool is critical to completing a task efficiently, accurately, and safely. • A tool's function allows machinists to transform raw materials into precise and functional components. • Proper use, maintenance, and storage of tools minimize risks and ensure a safe working environment for everyone.	• What are the appropriate hand tools and power tools for various sheet metal projects? • How do you properly use both hand and power tools for sheet metal work? • Why is it important to understand how different tools function when working with metal? • What key skills are needed to operate hand and power tools effectively?
Students must know:	***Students must be able to:***

• How to identify and use:
  ○ Aviation snips
  ○ Rivet guns
  ○ Punches
  ○ Files
  ○ Drills
  ○ Squaring shear
  ○ Box and pan brake
  ○ Hacksaws
  ○ Band saws
	• Identify which tools are best for which application in the metal shop.
	• Research and identify hand tools and power tools used in the metal shop.
	• Demonstrate proper application and use of hand and power tools in the metal shop.

Missouri Competency Machinist Standards (MCMS)

Priority Standard: Safety (MCMS.1).
Supporting Standards:
- Safety including Emergency Stop Systems (MCMS.1.G).

Priority Standard: Measuring and Test Equipment (MCMS.3).
Supporting Standards:
- Best practices for measuring strategies (MCMS.3.E).

Priority Standard: Machine Technologies and Accessories (MCMS.7).
Supporting Standards:
- Demonstrates understanding of the fundamentals of machine types and configurations (MCMS.7.A.1).
- Demonstrates understanding of the fundamentals of machine capabilities (MCMS.7.A.2).
- Demonstrates understanding of work holding devices (MCMS.7.B).
- Demonstrates understanding of accessories and attachments of machines (MCMS.7.C).

PRECISION MACHINING I 9-12
Unit 3: Manual Machining/Manufacturing

In this unit, students will become familiar with the operation of the manually operated machines in the metal shop (Vertical Mill and Lathe).

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Safety checks and proper operation of the vertical mill and metal lathe (Proper operation of manually operated machines requires understanding their components, controls, and safety features to prevent accidents). • Machines Enhance Precision: Manually operated machines, like the vertical mill and lathe, allow for the creation of accurate and complex parts that would be difficult to achieve with hand tools alone. • Planning Leads to Precision: Careful planning, including selecting the correct tools and sequences, ensures efficient and accurate machining on a vertical mill or lathe.	• How do we machine parts on the vertical mill? (What processes and methods are required to machine parts accurately on the vertical mill?) • How do we machine parts on the metal lathe? (What processes and methods are required to machine parts accurately on the metal lathe?) • What are the essential safety procedures for operating the vertical mill and lathe? • How do the vertical mill and lathe differ in their functions, and when should each be used?
Students must know:	***Students must be able to:***

• How to diagram the parts of both the vertical mill and metal lathe
• What each control/button/knob operates on both the vertical mill and metal lathe
	• Successfully set up and machine formative and summative projects on the vertical mill and metal lathe:
	  ○ Tic-Tac-Toe Board
	  ○ Metal Lathe Pen

PRECISION MACHINING I 9-12
Unit 3: Manual Machining/Manufacturing

Missouri Competency Machinist Standards (MCMS)
Priority Standard: Safety (MCMS.1). Supporting Standards: ● Safety including Emergency Stop Systems (MCMS.1.G)
Priority Standard: Measuring and Test Equipment (MCMS.3). Supporting Standards: ● Best practices for measuring strategies (MCMS.3.E).
Priority Standard: Applied Mathematics (MCMS.4) Supporting Standards: ● Applied mathematics of speed and feed calculations (MCMS.4.C).
Priority Standard: Machine Technologies and Accessories (MCMS.7). Supporting Standards: ● Demonstrates understanding of the fundamentals of machine types and configurations (MCMS.7.A.1). ● Demonstrates understanding of the fundamentals of machine capabilities (MCMS.7.A.2). ● Demonstrates understanding of work holding devices (MCMS.7.B). ● Demonstrates understanding of accessories and attachments of machines (MCMS.7.C).
Priority Standard: Machine Controls and Navigation (MCMS.8). Supporting Standards: ● Demonstrates understanding of the fundamentals of tool life management (MCMS.8.D). ● Demonstrates understanding on how to configure machine settings (MCMS.8.F).
Priority Standard: Cutting Tool and Holder Technologies (MCMS.11). Supporting Standards: ● Demonstrates understanding of the fundamentals of cutter types and application (MCMS.11.A.1) ● Demonstrates understanding of cutting parameters (MCMS.11.C).

PRECISION MACHINING I 9-12
Unit 4: Fastening Techniques

In this unit, students will be able to identify the appropriate fastener for any given application. Fastening techniques include riveting, bolting, threading, and welding.

Unit Essential Learning Targets

Enduring Understandings	***Essential Questions***
• Different techniques serve different purposes. Riveting, bolting, threading, and welding each have unique advantages and are used based on strength, permanence, and material compatibility. • Proper execution of fastening techniques is critical to ensuring the safety, strength, and longevity of a structure or component. • The effectiveness of a finished product depends on proper fastening methods, impacting both function and safety.	• Which fastening technique is best for a specific application? • How do different fastening techniques compare in terms of cost, speed, time consumption, and strength? • How do riveting, bolting, threading, and welding differ in their applications and advantages?
Students must know:	***Students must be able to:***

• How to:
  ○ Rivet sheet metal together
  ○ Thread a rod (die)
  ○ Thread a hole (tap)
  ○ Weld with both MIG and Stick
	• Identify the appropriate fastener for any given application.
	• Apply fastening techniques in different applications:
	  ○ Sheet Metal (Riveting)
	  ○ Lathe & Vertical Mill (Threading)
	  ○ Various Projects (Bolting and Welding)

Missouri Competency Machinist Standards (MCMS)

Priority Standard: Mechanical Design (MCMS.10).
Supporting Standards:
- Demonstrates understanding of limits and fixes (MCMS.10.A).
- Demonstrates understanding of fixturing concepts (MCMS.10.B).

Priority Standard: Cutting Tool and Holder Technologies (MCMS.11).
Supporting Standards:
- Demonstrates understanding of cutting parameters (MCMS.11.C).