

STRANDS AND STANDARDS

MACHINING 2



Course Description

This course is the second in a sequence that will use technical knowledge and skills to plan and manufacture projects using machine lathes, mills, drill presses, and other equipment in safe working conditions to promote the manufacturing industries.

Intended Grade Level	10-12
Units of Credit	0.5
Core Code	40.10.00.00.070
Concurrent Enrollment Core Code	40.10.00.13.070
Prerequisite	Machining 1
Skill Certification Test Number	582
Test Weight	0.5
License Type	CTE and/or Secondary Education 6-12
Required Endorsement(s)	
Endorsement 1	Machine Tool
Endorsement 2	N/A
Endorsement 3	N/A



STRAND 1

Students will be able to understand safe practices and professional machine shop procedures.

Standard 1

Follow safety manuals and all safety regulations and requirements.

Standard 2

Use protective equipment.

- Wear protective safety clothing as recommended by OSHA, UOSHA, and the Utah State Risk Management Office.
- Maintain and use appropriate protective guards and equipment on machinery.

Standard 3

Follow safe operating procedures for hand and power machine tools.

- Identify and understand safe machine operating procedures.
- Demonstrate safe machine operations at all times.

Standard 4

Maintain a clean and safe work environment.

- Keep work areas clean.
- Clean machine and hand tools when work is completed.
- Put tools away when work is finished.
- Keep aisles clear of equipment and materials.
- Perform preventive maintenance as required.
- Understand chemical hazards and the use of Material Safety Data Sheets (MSDS).
- Keep storage rooms well organized and free of clutter.

Standard 5

Each student should earn a score of 100% on a required safety exam relating to general shop safety and each machine tool he/she will be operating.

Performance Skill

Understand safe practices and professional machine shop procedures.

- Follow safety manuals and all safety regulations and requirements.
- Use protective equipment.
- Follow safe operating procedures for hand and power machine tools.
- Maintain a clean and safe work environment.
- Each student should earn a score of 100% on a required safety exam relating to general shop safety and each machine tool he/she will be operating.

STRAND 2

Students will be able to apply mathematical concepts.

Standard 1

Perform basic arithmetic functions.

- Add, subtract, multiply, and divide whole numbers.
- Add, subtract, multiply, and divide fractions.
- Add, subtract, multiply, and divide decimals.

Standard 2

Convert fractions to decimal equivalents.

- Convert fractions to decimal equivalents.
- Convert decimal values to nearest fraction equivalent.
- Use Decimal Equivalent Chart for conversions.

Standard 3

Perform basic trigonometric functions.

- Solve for unknown angles.
- Solve for unknown sides.
- Calculate bolt hole patterns.

Standard 4

Calculate speeds and feeds for machining.

- Given appropriate reference materials, calculate RPM for various metals and tools.
- Given appropriate reference materials, calculate the proper feed for various metals, tools, and depths of cut.

Standard 5

Locate basic machining points from a Datum Point.

- Identify points using the Cartesian coordinate system.
- Identify points using the absolute dimensioning system
- Identify points using the incremental dimensioning system.
- Identify points using the polar coordinate system.

Standard 6

Perform calculations for sine bar and sine plate.

- Calculate gage block build up for 5" sine bar.
- Calculate gage block build up for 10" sine plate.

Performance Skill

Apply mathematical concepts.

- Perform basic arithmetic functions.
- Convert fractions to decimal equivalents.
- Perform basic trigonometric functions.
- Calculate speeds and feeds for machining.
- Locate basic machining points from a Datum Point.
- Perform calculations for sine bar and sine plate.

STRAND 3

Students will be able to interpret engineering drawings and control documents.

Standard 1

Identify basic layout of drawings.

- Identify types of lines within a drawing.
- List the essential components found in the title block.

Standard 2

Identify basic types of drawings.

- Identify orthographic views.
- Identify positions of views (top, front, side, and auxiliary).

Standard 3

List the purpose of each type of drawing.

- Identify and describe the purpose of orthographic (three views) drawings.

Standard 4

Practice geometric dimensioning and tolerancing (GD&T) methodology.

- Describe the purpose of GD&T.

Performance Skill

Interpret engineering drawings and control documents.

- Identify basic layout of drawings.
- Identify basic types of drawings.
- List the purpose of each type of drawing.
- Practice geometric dimensioning and tolerancing (GD&T) methodology.

STRAND 4

Students will be able to properly perform measurement/inspection.

Standard 1

Select proper measurement tools as they best relate to part characteristics and specified accuracy.

- Discuss how measurement tool selection can contribute to part accuracy/inaccuracy.
- Demonstrate proper manipulation and care of precision measuring tools.

Standard 2

Apply proper measuring techniques.

- Discuss factors affecting accurate measurement (dirt, temperature, improper measuring, tool calibration, etc.).
- Demonstrate how to check calibration of various precision instruments.

Standard 3

Accurately perform measurements with hand-held instruments.

- With steel rules (metric and/or inch) take six (6) different measurements to within 1/64th and accurately write each dimension.
- Provided an accurately calibrated micrometer, designed to read in .0001, consistently take at least four (4) different readings within the designed accuracy of the tool and numerically write each dimension.
- Measure a hole with a telescope gage and an accurately calibrated micrometer of appropriate size.
- Given a properly calibrated dial or digital caliper, measure to within .001" and phonetically write the measurement.

Standard 4

Accurately perform measurements on a surface plate.

- Demonstrate the proper care and use of the surface plate and related tools.
- Use surface plate accessories correctly (sine bar, gage blocks, etc.).
- Check for part squareness.
- Check part dimensions for accuracy.

Performance Skill

Properly perform measurement/inspection.

- Select proper measurement tools as they best relate to part characteristics and specified accuracy.
- Apply proper measuring techniques.
- Accurately perform measurements with hand-held instruments.
- Accurately perform measurements on a surface plate.

STRAND 5

Students will be able to understand project planning and recognize different manufacturing materials and processes.

Standard 1

Prepare and plan for machining operations.

- Read and interpret blueprints.
- Perform basic semi-precision and precision layout as necessary.
- Calculate proper speeds, feeds and depth of roughing and finish cuts for applications.
- Plan machining operations, write a plan of procedure.
- Describe machine-ability and chip formation.
- Use the best applicable and available cutter materials, especially carbides, to maximize productivity.

Standard 2

Demonstrate proper use of hand tools.

- Proper care and use of arbor and shop presses.
- Select the most appropriate hand file and properly demonstrate its use.
- Correctly identify and use hand taps.
- Identify common hand tools and describe their basic applications.

Standard 3

Identify common materials and explain basic properties.

- Discuss the classification systems for metals.
- Describe general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals.

Performance Skill

Understand project planning and recognize different manufacturing materials and processes.

- Prepare and plan for machining operations.
- Demonstrate proper use of hand tools.
- Identify common materials and explain basic properties.

STRAND 6

Students will be able to understand and demonstrate the use of drilling and grinding machines and band saws.

Standard 1

Demonstrate proper use of drilling machines.

- Proper setup and operation of drill presses.
- Demonstrate the proper cleaning and care of the drill press.
- Identify standard drills and reamer characteristics and major applications.
- Sharpen a twist drill using a bench or pedestal grinder.
- Properly set up the drill press and demonstrate the selection of the most appropriate and sharp drilling tool(s). Drill a hole at least 3/8" deep holding + or - 1/32" location and .005" size tolerance. Item "g" should be accomplished in no less than a five (5) minute time frame.
- Properly set up a drill press and drill a hole.
- Demonstrate the use the Machinery handbook as a reference for technical information related to the proper use of the drill press.

Standard 2

Demonstrate proper use of grinding abrasive machines.

- Demonstrate the proper use and care of bench and pedestal grinders.

Standard 3

Demonstrate proper use of band saws.

Performance Skill

Understand and demonstrate the use of drilling and grinding machines and band saws.

- Demonstrate proper use of drilling machines.
- Demonstrate proper use of grinding abrasive machines.
- Demonstrate proper use of band saws.

STRAND 7

Students will be able to understand and demonstrate the use of milling machines.

Standard 1

Demonstrate proper use of a vertical milling machine.

- Demonstrate the proper setup, operation, care, cleaning, and lubrication of the vertical milling machine.
- Correctly identify common cutters and explain their basic applications.
- Properly dial in the vertical milling machine head to within .002 TIR with at least a 6" off set.
- Identify the common work holding devices and select the most appropriate device based on part shape and type of machining to be done.
- Dial in a milling machine vise to within .001" TIR.
- Properly set up the Milling Machine and demonstrate the use of an edge finder. Locate a point within .001".
- Demonstrate proper procedure for dialing in on a pin or a hole to within .001" TIR.
- Accurately calculate speeds and feeds for an assigned milling machine operation.
- Demonstrate proper setup and procedure for squaring a part.
- Demonstrate the proper setup and procedure for reaming.
- Demonstrate proper setup and procedure for using an offset boring head to bore a hole.
- Demonstrate the proper setup and procedure for milling a slot or pocket.
- Demonstrate proper setup and procedure for power tapping.
- Demonstrate proper setup and procedure for milling an angle locating the work with an angle finder and holding it in a vise, producing at least a 63 micro inch finish. The angle should be within ½ degree of that specified.
- Demonstrate proper setup and procedure for milling an angle.
- Differentiate between conventional milling and climb milling.

Performance Skill

Understand and demonstrate the use of milling machines.

- Demonstrate proper use of a vertical milling machine.

STRAND 8

Students will be able to understand and demonstrate the use of metal lathes.

Standard 1

Demonstrate proper use of metal lathes.

- Demonstrate the proper cleaning, lubrication, and care of the metal lathe
- Identify and discuss the sizes and applications of common types of metal cutting lathes.
- Identify size, common parts, and demonstrate the proper use of the basic controls and adjustments on the engine lathe.
- Identify and demonstrate the proper installation and application of standard tools and tool holders for the lathe.
- Identify common work holding devices and demonstrate proper procedure for changing and installing them.
- Using a four-jaw chuck, demonstrate proper procedure for dialing in a part to within .001" TIR.
- Using appropriate reference material, accurately calculate relevant speeds and depths of cuts as required for two assigned applications.
- Demonstrate proper procedure for facing both ends of a part to length.
- Demonstrate proper setup and procedure for center drilling parts.
- Demonstrate proper setup and procedure while drilling a hole.
- Demonstrate proper setup and technique for power tapping a through hole on a metal cutting lathe.
- Demonstrate proper setup and procedure for reaming a hole.
- Demonstrate proper setup and procedure for boring a hole.
- Demonstrate proper setup and procedure for turning a part.
- Demonstrate proper setup and procedure for turning a 90 degree shoulder.
- Using the compound rest demonstrate the proper setup and procedure for turning a diameter and a taper.
- Demonstrate proper setup and procedure for turning between centers. (Optional)
- Demonstrate proper methods of filing and using strip abrasives while working on a metal cutting lathe.
- Demonstrate proper setup and procedure while single point cutting a thread to standard pitch diameter and shape specifications.
- Identify the common types of tapers used in a machine shop and discuss their major applications.
- Using a taper attachment, demonstrate proper setup and operations for cutting a taper.
- Demonstrate the proper procedure for grinding a HSS cutter bit.
- Discuss and demonstrate the proper setup, speeds, feeds, and use of indexable insert carbide cutting tools, carbide, and HSS cutters.
- Demonstrate the ability to use the Machinery Hand book as a reference for technical information related to turning.

Performance Skill

Understand and demonstrate the proper use of metal lathes.

STRAND 9

Students will be able to understand CNC machining processes.

Standard 1

Demonstrate proper planning for CNC machining.

- Prepare and plan for CNC machining operations.
- Demonstrate proper cleaning, care lubrication and operation of CNC machines.
- Properly identify common types of CNC machines and describe their size and general applications.
- Demonstrate ability to read and interpret complex blueprints.
- Create a plan of operation for CNC machining.
- Calculate speeds, feeds, and depths of cut for CNC machine operations.
- Use the Machinery's Handbook as a reference for CNC machining applications.

Standard 2

Select and use CNC tooling systems.

- Describe the machinability index and how it affects CNC machining.
- Identify tooling components and discuss their specific applications.
- Based on geometry, identify common carbide inserts and discuss their general applications.
- Based on material to be machined and part characteristics, select an appropriate insert and tooling system.
- Demonstrate ability to properly change inserts and set up tooling systems to industry standards.
- Work with vendors and produce a cost comparison report for comparable inserts and tooling.

Standard 3

Program common CNC machines.

- Identify common CNC operations.
- Identify common CNC machine control systems, and describe their major differences and applications.
- Demonstrate the proper applications of absolute and incremental coordinate systems.
- Create a plan of operation and manually write programs for CNC mills.
- Create a plan of operation and manually write programs for CNC lathes.
- Using a CAD system, select a pre-existing program and dump it onto a controller.
- Using a CAD-CAM system create a drawing for a part, and create a machine program for that part. Load it on to a controller and take all necessary steps to create the part.

Standard 4

Demonstrate proper use of CNC Machining Centers (mills).

- Demonstrate the proper care, setup, lubrication and operation of Machining Center.

- Select and properly install and align appropriate work holding devices to applicable standards.
- Demonstrate proper loading and aligning materials into the machine.
- Demonstrate proper loading of tools into machine.
- Demonstrate proper techniques of establishing accurate tool length offsets for each tool.
- Establish/set machine references to within appropriate tolerances.
- Load programs into CNC mill controller.
- Demonstrate working knowledge of all controls on the MCU.
- Demonstrate proper operation of CNC machining center to include single block, "dry run" and final production.
- Edit CNC programs for accuracy and optimum part production.
- Operate machine in DNC mode, if that capability exists.

Standard 5

Demonstrate proper use of CNC Turning Centers (lathes).

- Demonstrate proper setup care and operation of CNC turning centers.
- Identify common types of turning centers and discuss size and different applications and restrictions.
- Identify and describe common work-holding devices and discuss the major applications.
- Demonstrate proper techniques for changing and installing common work-holding devices.
- Select and install appropriate work holding device to match assigned project.
- Install and true soft jaws as required.
- Select appropriate tools and demonstrate proper loading into the machine.
- Establish accurate machine and part reference.
- Set initial tool offsets.
- Monitor/adjust offsets for accurate part production.
- Load programs into CNC lathe.
- Demonstrate working knowledge of all controls on the MCU.
- Demonstrate proper operation of CNC lathe to include single block, dry run and final production.
- Edit CNC programs for optimum part production.

Standard 6

Program CNC machines using CAD-CAM systems.

- Create plan of operation for machining assigned parts.
- Construct part geometry. (PS)
- Program tool path for roughing and finishing operations.
- Verify tool path.
- Generate CNC code.
- Prove program.

- Generate part to match required specifications.
- Inspect part to verify accuracy.

Standard 7

Demonstrate proper care, setup, and operation of electrical discharge machines.

- Identify common EDM machines and describe their applications.
- List advantages and disadvantages of the EDM process.
- Identify and discuss common electrode materials and their major applications.
- Machine EDM electrodes.
- Set up and operate sinker EDM machines.
- Calculate overburn.
- Identify generator setting of machine.
- Choose proper techniques for flushing.
- Estimate number of roughers and finishers.
- Demonstrate proper electrode mounting techniques.
- Utilize 3R tooling.
- Perform touch-off procedures.
- Recognize optimum machine settings, and make necessary adjustments to maintain this level of machining.
- Perform continuity checks.
- Determine R-MAX finish required.
- Set up and operate wire cut EDM machines.

Performance Skill

Understand CNC machining processes.

- Demonstrate proper planning for CNC machining.
- Select and use CNC tooling systems.
- Program common CNC machines.
- Demonstrate proper use of CNC Machining Centers (mills).
- Demonstrate proper use of CNC Turning Centers (lathes).
- Program CNC machines using CAD-CAM systems.
- Demonstrate proper care, setup, and operation of electrical discharge machines.

STRAND 10

Students will understand the importance of career readiness skills as it relates to the workplace and outlined in the SkillsUSA Framework – Level 2.

Standard 1

Understand and demonstrate reliability.

- Determine individual time management skills.
- Explore what's ethical in the workplace or school.
- Demonstrate awareness of government.
- Demonstrate awareness of professional organizations and trade unions.

Standard 2

Understand and demonstrate responsiveness.

- Define the customer.
- Recognize benefits of doing a community service project.
- Demonstrate social etiquette.
- Identify customer expectations.

Standard 3

Understand resiliency.

- Discover self-motivation techniques and establish short-term goals.
- Select characters of a positive image.
- Identify a mentor.

Standard 4

Understand and demonstrate workplace habits.

- Participate in a shadowing activity.
- Explore workplace ethics: codes of conduct.
- Recognize safety issues.
- Perform a skill demonstration.
- Exercise your right to know.

Standard 5

Understand and develop initiative.

- Develop personal financial skills.
- Develop a business plan.
- Investigate entrepreneurship opportunities.

Standard 6

Understand and demonstrate continuous improvement.

- Conduct a worker interview.
- Demonstrate evaluation skills.
- Examine ethics and values in the workplace.
- Develop a working relationship with a mentor.
- Construct a job search network.

Skill Certificate Test Points by Strand

Test Name	Test #	Number of Test Points by Strand									Total Points	Total Questions
		1	2	3	4	5	6	7	8	9		
Machining 2	582	5	15	10	9	3	7	14	4	4	71	64