



## EXAM INFORMATION

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**Items**

64

**Points**

71

**Prerequisites**

NONE

**Grade Level**

10-12

**Course Length**

ONE SEMESTER

**Career Cluster**

MANUFACTURING

**Performance Standards**

INCLUDED

**Certificate Available**

YES

## DESCRIPTION

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Students will demonstrate technical knowledge and skills to plan, manufacture, assemble, test products, and modify metal parts using machine shop and CNC processes in support of other manufacturing, repair or design activities, or as an independent business.

## EXAM BLUEPRINT

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**STANDARD****PERCENTAGE OF EXAM**

1- Safe Practices and Procedure	6%
2- Mathematical Concepts	16%
3- Engineering Documents	13%
4- Manufacturing Materials and Processes	11%
5- Measurement Inspections	3%
6- Planning and Hand Tools	18%
7- Use of Drilling Machines	18%
8- Use of Milling Machines	11%
9- Use of Metal Lathes	4%
10- Use of Grinding Machines (Optional)	
11- CNC Machining Processes (Optional)	



## STANDARD 1

### STUDENTS WILL UNDERSTAND SAFE PRACTICES AND PROFESSIONAL MACHINE SHOP PROCEDURES

- Objective 1 Follow safety manuals and all safety regulations and requirements.
1. Demonstrate and assume responsibility for the personal safety of oneself and others.
  2. Develop and demonstrate a personal attitude toward safety.
  3. Have on hand a reference copy and understand and comply with applicable regulations and industry standards.
  4. Be acquainted and comply with established school safety practices.
- Objective 2 Use protective equipment.
1. Wear protective safety clothing as recommended by OSHA.
  2. Maintain and use appropriate protective guards and equipment on machinery.
  3. Locate and properly use protective equipment.
  4. Use lifting aids when necessary.
- Objective 3 Follow safe operating procedures for hand and power machine tools.
1. Identify and understand safe machine operating procedures.
  2. Demonstrate safe machine operations at all times.
- Objective 4 Maintain a clean and safe work environment.
1. Keep work areas clean.
  2. Clean machine and hand tools when work is completed.
  3. Put tools away when work is finished.
  4. Keep aisles clear of equipment and materials.
  5. Perform preventive maintenance as required.
  6. Understand chemical hazards and the use of Material Safety Data Sheets (MSDS).
  7. Keep storage rooms well organized and free of clutter.
- Objective 5 Request a courtesy State Risk Management inspection at least every 2 years.
1. Keep accurate records of and take appropriate action on their findings.
  2. Make a copy of their findings available to your administration.

Standard 1 Performance Evaluation included below (Optional)

## STANDARD 2

### STUDENTS WILL BE ABLE TO APPLY MATHEMATICAL CONCEPTS

- Objective 1 Perform basic arithmetic functions.
1. Add, subtract, multiply, and divide whole numbers.
  2. Add, subtract, multiply, and divide fractions.
  3. Add, subtract, multiply, and divide decimals.
- Objective 2 Convert fractions/decimals.
1. Convert fractions to decimal equivalents.



2. Convert decimal values to nearest fractional equivalent.
3. Use decimal equivalent chart for conversions.

Objective 3 Convert metric/inch measurements.

1. Convert inch dimensions to metric.
2. Convert metric dimensions to inch.
3. Use metric/inch conversion chart.

Objective 4 Perform basic trigonometric functions.

1. Solve for unknown angles.
2. Solve for unknown sides.
3. Calculate bolt hole patterns.

Objective 5 Calculate speeds and feeds for machining.

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

Objective 6 Locate basic machining points from a Datum Point.

1. Identify points using the Cartesian coordinate system.
2. Identify points using the absolute dimensioning system.
3. Identify points using the incremental dimensioning system.
4. Identify points using the polar coordinate system.

Objective 7 Perform calculations for sine bar and sine plate.

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

Objective 8 Calculate for direct, simple, and angular indexing.

1. Calculate for direct indexing.
2. Calculate for simple indexing (plain).
3. Calculate for angular indexing.
4. Use Machinery's Handbook for calculations.

Objective 9 Calculate depth of cut on round surfaces.

1. Calculate the number and depths of roughing and finish cuts for milling and turning.
2. Calculate depth of cut for flats to be machined on cylindrical pieces.
3. Calculate depth of cut for key ways that are machined on cylindrical pieces.

Standard 2 Performance Evaluation included below (Optional)

### STANDARD 3

STUDENTS WILL BE ABLE TO INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

Objective 1 Review blueprint notes and dimensions.

1. Explain basic blueprint terminology.
2. Identify the types of dimensions.
3. Identify general note symbols.



4. Locate notes on a print.
5. Interpret commonly used abbreviations and terminology.
6. Determine tolerances associated with dimensions on a drawing.
7. Determine the tolerance for a reference dimension.
8. Determine the surface finish for a given part, with a comparator gage and/or a profilometer if available.
9. List the essential components found in the general drawing notes.

Objective 2 Identify basic layout of drawings.

1. Identify types of lines within a drawing.
2. Identify item number symbols.
3. Identify general note symbols.
4. List the essential components found in the title block.
5. Locate bill of materials on a drawing.
6. List the components found in the revision block.

Objective 3 Identify basic types of drawings.

1. Identify orthographic views.
2. Identify positions of views (top, front, side, and auxiliary).
3. Visualize one or more views from a given view.
4. Identify isometric views.
5. Identify exploded isometric drawings.
6. Identify assembly drawings.

Objective 4 List the purpose of each type of drawing.

1. Identify and describe the purpose of orthographic (three views) drawings.
2. Identify and describe the purpose of isometric drawings.
3. Identify and describe the purpose of exploded isometric drawings.
4. Identify and describe the purpose of assembly drawings.

Objective 5 Verify drawing elements:

1. Determine the scale of the view or section.
2. Check for revisions and describe current specifications.
3. Recognize out-of-date blueprints and know appropriate related procedures.

Objective 6 Practice geometric dimensioning and tolerancing (GD&T) methodology:

1. Describe the purpose of GD&T.
2. Identify symbols for controlling location (or true position) of part features.
3. Identify symbols for controlling form (or alignment) of part features.
4. Identify symbols for showing datums and basic dimensions on drawings.
5. Identify symbols for Maximum Material Condition (MMC), Regardless of Feature Size (RFS), and Least Material Condition (LMC).

Objective 7 Use standards to verify requirements, i.e., size and fit standards for various threads.

1. Discuss the purpose of standards.
2. Discuss source and locations for standards.



Standard 3 Performance Evaluation included below (Optional)

## **STANDARD 4**

### **STUDENTS WILL RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES**

- Objective 1** Identify common materials and explain their desired properties.
1. Discuss the classification systems for metals.
  2. Describe general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals.
- Objective 2** Test metal samples for hardness.
1. Perform Rockwell hardness tests.

Standard 4 Performance Evaluation included below (Optional)

## **STANDARD 5**

### **STUDENTS WILL PERFORM MEASUREMENT/INSPECTION**

- Objective 1** Select proper measurement tools as they best relate to part characteristics and specified accuracy.
1. Identify basic semi-precision measuring tools and describe their major applications. Demonstrate proper reading of them to their finest graduation.
  2. Identify precision measuring tools and describe their major applications.
  3. Demonstrate accurate reading of them to their finest graduation.
  4. Justify the use of a particular measuring tool based on tool and part characteristics.
  5. Discuss how measurement tool selection can contribute to part inaccuracy/inaccuracy.
  6. Demonstrate proper manipulation and care of precision measuring tools.
- Objective 2** Apply proper measuring techniques.
1. Discuss factors affecting accurate measurement (dirt, temperature, improper measuring, tool calibration, etc.).
  2. Demonstrate how to check calibration of various precision instruments.
  3. Calibrate a micrometer type-measuring tool and discuss tool calibration as it may be done in industry.
- Objective 3** Accurately perform measurements with hand-held instruments.
1. Within a five (5) minute time limit, with steel rules (metric and/or inch), take six (6) different measurements to within 1/64th and/or .5 mm and accurately write each dimension.
  2. Provided an accurately calibrated micrometer, designed to read in .0001, within a three (3) minute time limit, consistently take at least four (4) different readings within the designed accuracy of the tool and numerically write each dimension.
  3. Provided a telescope gage and an accurately calibrated micrometer of appropriate size, within a three (3) minute time limit, accurately measure an applicable feature to within .001" and numerically write the measurement.
  4. Given a properly calibrated dial or digital caliper, within a two (2) minute time limit, consistently measure to within .001" and phonetically write the measurement.
  5. Measure with fixed gages (go and no go gages), and verbally express meaningful results. \\



- Objective 4** Accurately perform measurements on surface plate.
1. Demonstrate the proper care and use of the surface plate and related tools.
  2. Use surface plate accessories correctly (side bar, gage blocks, etc.).
  3. Check for part squareness.
  4. Check part dimensions for accuracy.
  5. Within a five (5) minute time limit, using a height gage, dial indicator, and other applicable tools, measure the length of at least two work pieces over 6" long to within 0.001" and numerically write the accurate reading.

- Objective 5** Perform inspections properly using stationary equipment. (PS)
1. Demonstrate proper use and care of optical comparators.
  2. With the machine in good repair and adequately equipped, demonstrate proper technique, and within a three (3) minute time limit, accurately measure the length of a part or feature within + or - .0005".
  3. With the machine in good repair and adequately equipped, within a three (3) minute time limit, demonstrate proper technique and accurately measure a part radius using a template to within + or - .005".
  4. Provided a properly tooled and working Optical Comparator, within a five (5) minute time limit, demonstrate proper technique and accurately measure a polar dimension to within + or - .001".
  5. Provided a properly tooled and working Optical Comparator, within a five (5) minute time limit, demonstrate proper set up and technique while accurately measuring a part angle to within + or - 15 minutes.
  6. Demonstrate the proper set up and operation of the Optical Comparator using the reflective mode, and within a three (3) minute time limit, measure a part feature to within + or - .0005".
  7. Set up and use a Coordinate Measuring Machine (CMM).

Standard 5 Performance Evaluation included below (Optional)

## **STANDARD 6**

STUDENTS WILL BE ABLE TO UNDERSTAND PLANNING AND HAND TOOLS

- Objective 1** Prepare and plan for machining operations.
1. Read and interpret blueprints.
  2. Perform basic semi-precision and precision layout as necessary.
  3. Calculate proper speeds, feeds and depth of roughing and finish cuts for specific applications.
  4. Plan machining operations, write a plan of procedure including selection of and cutting material, speeds and feeds, depths of roughing and finish cuts, etc. (See appendix for suggested format)
  5. Describe machine-ability and chip formation.
  6. Calculate speeds, feeds, and depths of roughing and finish cuts for common machine applications.
  7. Use the best applicable and available cutter materials, especially carbides, to maximize productivity.
  8. Use the Machinery's Handbook as a reference for machine applications.



## Objective 2

Demonstrate proper use of hand tools.

1. Demonstrate the proper care and use of arbor and shop presses.
2. Select necessary work holding devices and hand tools as dictated by the size and shape of the part plus the machining to be done.
3. Select the most appropriate hand file and properly demonstrate its use.
4. Identify and demonstrate the proper use of hand reamers holding a .001 diametrical tolerance and producing at least a 63 micro-inch finish.
5. Correctly, identify and use hand taps. Demonstrate their proper selection and use as required to within a five (5) minute time limit produce a class two (2) thread at least 1/2" deep in a blind hole.
6. Select and use a use a go/no go gage to verify thread characteristics.
7. Demonstrate the proper use of thread-cutting dies, and within a five (5) minute time limit, produce an external thread within standard pitch diameters and finish. Use a thread micrometer to verify pitch diameter.
8. Demonstrate the proper use and care of bench and pedestal grinders.
9. Identify common hand tools and describe their basic applications.

Standard 6 Performance Evaluation included below (Optional)

**STANDARD 7****STUDENTS WILL UNDERSTAND AND DEMONSTRATE THE USE OF DRILLING MACHINES**

## Objective 1

Demonstrate proper use of drilling machines.

1. Proper Setup and Operation of Drill Presses:
2. Demonstrate the proper cleaning, and care of the drill press.
3. Identify the different types of drill presses found in the machine shop and discuss their major applications.
4. Identify the standard drilling and reaming tools and discuss their characteristics and major applications.
5. Within a seven-minute time limit properly sharpen a Twist Drill, using a bench or pedestal grinder, and verify that it has been sharpened correctly by drilling a hole and observing equal chip distribution from each flute. The hole size should be within .003" of the drill size.
6. Within a three-minute time limit, using applicable reference material demonstrate accurate calculations of speeds for assigned drill press operations.
7. 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.
8. Properly set up drill press and demonstrate countersinking holding + or - 1/64th diameter and producing a chatter free finish. The time limit for this operation is five (5) minutes.
9. Properly set up a Drill Press and demonstrate reaming, holding + or - .001 diameter and at least a 63 RMS finish. The time limit for drilling and reaming is five (5) minutes or less.
10. Properly set up the drill press, demonstrate the proper procedure for tap drilling a thru hole, and by hand produce a 75% class two thread perpendicular within .010" over the length of the



tap. The drilling and tapping operations should be accomplished within a five-minute time limit. Use an appropriate go/no go gage to verify thread characteristics.

11. Demonstrate the use of the Machinery handbook as a reference for technical information related to the proper use of the drill press.

## STANDARD 8

### STUDENTS WILL UNDERSTAND AND DEMONSTRATE THE USE OF MILLING MACHINES

**Objective 1** Demonstrate proper use of vertical milling machine.

1. Demonstrate the proper setup, operation, care, cleaning, and lubrication of the vertical Mill.
2. Correctly identify common cutters and explain their basic applications.
3. Identify and demonstrate the proper use of all controls and adjustments on the vertical milling machine.
4. Within a four (4) minute time limit, properly dial in the vertical milling machine head to within .002 TIR with at least a 6" off set.
5. Identify the common work holding devices and select the most appropriate device based on part shape and type of machining to be done.
6. Within three (3) minutes, dial in a milling machine vise to within .001" TIR.
7. Within a five (5) minute time limit, properly set up the Milling Machine and demonstrate the use of an edge finder. Locate a point within .001"
8. Within three (3) minutes, demonstrate proper procedure for dialing in on a pin or a hole to within .001" TIR.
9. Provided appropriate reference material, within three minutes accurately calculate speeds and feeds for an assigned milling machine operation.
10. Select the proper cutter and work holding device, demonstrate their proper installation and setup to machine a part at least 4" long to length holding a tolerance of + or - .002" The above should be accomplished in less than ten (10) minutes.
11. Demonstrate proper setup and procedure for machining four surfaces of a rectangular part at least 4" long. All four surfaces are to be square with each other within .0015 over the entire length of the part while producing at least a 63 micro-inch finish. This operation should be accomplished with a twenty (20) minute time limit.
12. Within a three (3) minute time limit demonstrate the proper setup and procedure for reaming, holding a + or - .0005" tolerance and producing at least a 32 micro-inch finish.
13. Demonstrate proper setup and operation of a Vertical Mill while machining a shoulder .750 X .750" least 4" long holding depth and side tolerances of + or - .002" and producing at least a 63 micro-inch finish. The above operation should be accomplished within a fifteen (15) minute time limit.
14. Demonstrate proper setup and procedure for using an offset boring head to bore a hole holding .0005" tolerance on diameter and + or - .002" on location. The finish should be at least a 32 micro-inch. The above should be accomplished in less than seven (7) minutes.
15. Demonstrate the proper setup and procedure for milling a slot or pocket in a piece of flat stock .020 wider than a standard size cutter holding + or - .002" in width and length and + or - .003" on depth, and location. The finish should be a 63 micro-inch or better. The time limit for item "n" is thirty (30) minutes or less.





16. Demonstrate proper setup and procedure for power tapping a 75% class two thread in a thru hole holding appropriate go and no go gage tolerances. Drilling and power tapping should be accomplished in less than five (5) minutes.
17. Within fifteen (15) minutes 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  $\frac{1}{2}$  degree of that specified.
18. Demonstrate proper setup and procedure for milling and angle using a sine bar and gage block set up. Holding a + or - .005" angularity call-out and a 63-micro inch finish. (PS)
19. Demonstrate proper setup and procedure for using special vertical mill fixtures. (PS)
20. Demonstrate proper setup and procedure for machining dovetails. (PS)
21. Demonstrate proper setup and operation procedures for milling a standard key seat on a shaft holding a + or - .002 location and size tolerance. (PS)
22. Having properly installed a drill chuck and an appropriate work holding device, demonstrate how to locate and drill a hole in at least two kinds of metals holding a .005" location and .003" size tolerance.
23. Demonstrate the ability to use the Machinery Handbook as a reference for milling.

## STANDARD 9

### STUDENTS WILL UNDERSTAND AND DEMONSTRATE THE USE OF METAL LATHES

#### Objective I

Demonstrate proper use of metal lathes.

1. Demonstrate the proper cleaning, lubrication, and care of the metal lathe.
2. Identify and discuss the sizes and applications of common types of metal cutting lathes.
3. Identify common parts and demonstrate the proper use of all controls and adjustments on the engine lathe.
4. Identify and demonstrate the proper installation and application of standard tools and tool holders for the lathe.
5. Identify common work holding devices and demonstrate proper procedure for changing and installing them.
6. Within three (3) minutes using a four-jaw chuck, demonstrate proper procedure for dialing in a part to within .001" TIR.
7. Within three minutes, using appropriate reference material, accurately calculate relevant speeds and depths of cuts as required for two assigned applications.
8. Within five (5) minutes demonstrate proper procedure for facing both ends of a part to length holding + or - .003" tolerance and producing at least a 63 micro-inch finish.
9. Within three (3) minutes, demonstrate proper setup and procedure for center drilling parts.
10. Demonstrate proper setup and procedure while drilling a hole at least 3/8" deep, holding + or - .004" on diameter and 1/64" on depth. The finish should be 125 micro-inches or better. Item "j" should be accomplished in five (5) minutes or less.
11. Within a five (5) minute time limit, demonstrate proper setup and technique for power tapping a through hole on a metal cutting lathe.
12. Demonstrate proper setup and procedure for reaming a hole holding + or - .0005 diametrical tolerance and producing a 63 micro-inch finish. Drilling and reaming operations should be accomplished within a five (5) minute time limit.



13. Within a six-minute time limit demonstrate proper setup and procedure for boring a three-inch diameter or larger hole holding a diametrical tolerance of + or - .002" and producing a 63 micro-inch finish.
14. Within a ten (10) minute time limit demonstrate proper setup and procedure for turning a part at least 4" long to diameter using appropriate roughing and finish cuts holding + or - .002" tolerance on diameter and cutting to at least a 63 micro-inch finish.
15. With a ten (10) minute time limit demonstrate proper setup and procedure for turning a 90-degree shoulder at least .750 long and .250 deep on each side, holding + or - .002" on diameter and length. The finish should be at least a 63 without the use of abrasives.
16. Using the compound rest demonstrate the proper setup and procedure for turning a diameter and a stub taper holding the angle within ½ degree and cutting to finish of 63 micro-inches or better.
17. The skills in item "p" should be demonstrated in less than seven (7) minutes.
18. Demonstrate proper setup and procedure for turning between centers.
19. Demonstrate proper methods of filing and using strip abrasives while working on a metal cutting lathe.
20. Within a five-minute time limit, demonstrate proper procedure for aligning the tailstock center within .001" TIR.
21. Within a fifteen-minute time limit, demonstrate proper setup and procedure while single point cutting a coarse series thread to standard pitch diameter and shape specifications, and producing at least a 63 micro-inch finish.
22. Within fifteen a minute time limit demonstrates proper setup and procedure while single point cutting a fine series thread to standard pitch diameter and shape specifications and producing at least a 63 micro-inch finish.
23. Discuss fits as they apply to different classifications of threads.
24. Identify the common types of tapers used in a machine shop and discuss their major applications.
25. Within a fifteen-minute time limit, using a taper attachment, demonstrate proper setup and operations for cutting a standard Morse taper to gage. (PS)
26. Demonstrate the proper use of follower and steady rests. (PS)
27. Demonstrate the proper procedure for grinding a HSS cutter bit.
28. Discuss and demonstrate the proper setup, speeds, feeds, and use of indexable insert carbide cutting tools.
29. Using proper speeds and feeds, use HSS cutting tools.
30. Applying proper speeds, feeds, setup and use carbide-cutting tools.
31. Demonstrate the ability to use the Machinery Hand book as a reference for technical information related to turning.

Standard 9 Performance Evaluation included below (Optional)

### **STANDARD 10 (Optional)**

STUDENTS WILL UNDERSTAND AND DEMONSTRATE THE USE OF GRINDING MACHINES

**Objective I** Demonstrate proper use of grinding abrasive machines.



1. Identify common types of grinding machines and discuss the major differences and applications.
2. Describe and demonstrate the proper cleaning, lubrication, and care of precision grinding machines.
3. Discuss the identification, selection and application of common grinding wheels.
4. Properly inspect, mount, true, and dress, grinding wheels on a precision grinding machine. Item d. should be accomplished in twenty (20) minutes or less.
5. Discuss the variety and describe the proper selection and application of grinding fluids.
6. Within a twenty-five (25) minute time limit, properly setup a horizontal spindle reciprocating table surface grinder, with a part at least 3" wide and 4" long. Grind both surfaces of the part to within + or - .0005 of specified thickness and producing at least a 10-micro inch finish.
7. Properly set up a precision grinding machine and grind two surfaces of the same part square with each other within + or - .0005 TIR over their entire area. Each surface should be at least 4 square inches and should have at least a 10 micro-inch finish. Item g has a twenty-five-minute time limit
8. Discuss common problems and solutions in surface grinding.
9. Use the Machinery Handbook as a reference for Precision Grinding

## **STANDARD 11 (Optional)**

### STUDENTS WILL UNDERSTAND CNC MACHINING PROCESSES

**Objective 1** Demonstrate proper planning for CNC machining.

1. Prepare and Plan for CNC Machining Operations:
2. Demonstrate proper cleaning, care lubrication and operation of CNC machines.
3. Properly identify common types of CNC machines and describe their size and general applications.
4. Demonstrate ability to read and interpret complex blueprints.
5. Create a plan of operation for CNC machining.
6. Calculate speeds, feeds, and depths of cut for CNC machine operations.
7. Determine proper cutting fluids/coolants for CNC machining and demonstrate their proper application.
8. Use the Machinery's Handbook as a reference for CNC machining applications.

**Objective 2** Select and use CNC tooling systems.

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

**Objective 3** Program common CNC Machines.

1. Identify common CNC operations.



2. Identify common CNC machine control systems and describe their major differences and applications.
3. Demonstrate the proper applications of absolute and incremental coordinate systems.
4. Create a plan of operation and manually write programs for CNC mills.
5. Create a plan of operation and manually write programs for CNC lathes.
6. Using a CAD system, select a pre-existing program and dump it onto a controller.
7. 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.

### Objective 4

Demonstrate proper use of CNC Machining Centers (Mills).

1. Demonstrate the proper Care, Setup, lubrication and Operation of Machining Center.
2. Select and properly install and align appropriate work holding devices to applicable standards.
3. Demonstrate proper Loading and aligning materials into the machine.
4. Demonstrate proper Loading of tools into machine.
5. Demonstrate proper techniques of establishing accurate tool length offsets for each tool.
6. Establish/set machine references to within appropriate tolerances.
7. Load programs into CNC mill controller.
8. Demonstrate working knowledge of all controls on the MCU.
9. Demonstrate proper operation of CNC machining center to include single block, "dry run" and final production.
10. Edit CNC programs for accuracy and optimum part production.
11. Operate machine in DNC mode, if that capability exists.

### Objective 5

Demonstrate proper use of CNC Turning Centers (Lathes).

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

### Objective 6

Program CNC machines using CAD-CAM systems.

1. Create plan of operation for machining assigned parts.
2. Construct part geometry.



3. Program tool path for roughing and finishing operations.
4. Verify tool path.
5. Generate CNC code.
6. Prove program.
7. Generate part to match required specifications.
8. Inspect part to verify accuracy

Objective 7

Demonstrate proper care, setup and operation of electrical discharge machines

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



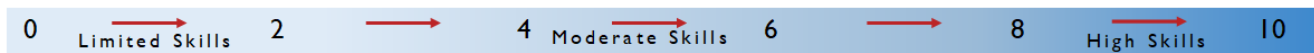
## Machining II Performance Standards (Optional)

Performance assessments may be completed and evaluated at any time during the course. The following performance skills are to be used in connection with the associated standards and exam. To pass the performance standard the student must attain a performance standard average of **8 or higher** on the rating scale. Students may be encouraged to repeat the objectives until they average **8 or higher**.

Students Name \_\_\_\_\_

Class \_\_\_\_\_

### PERFORMANCE RATING SCALE



#### STANDARD 1 Safe Practices and

Score:

- 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 environment
- Request a courtesy OSHA or State Risk Management inspection at least every two years

#### STANDARD 2 Mathematical

Score:

- Perform basic arithmetic functions: add, subtract, multiply, and divide
- Convert fractions-decimal equivalents and metric-inch measurements
- Calculate speeds and feeds for machining
- Locate basic machining points from a Datum Point
- Calculate for direct, simple, and angular indexing

#### STANDARD 3 Engineering Drawings and Control

Score:

- View blueprint notes and dimensions
- Identify basic layout and types of drawings
- Practice geometric dimensioning and tolerancing (GD&T) methodology
- List the purpose of each type of drawing
- Verify drawing elements

#### STANDARD 4 Manufacturing Materials and Processes

Score:

- Identify common materials and explain their desired properties



**STANDARD 5 Measurement/Inspection**

**Score:**

- 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 and on surface plates

**STANDARD 6 Planning and Hand Tools**

**Score:**

- Prepare and plan for machining operations
- Demonstrate proper use of hand tools

**STANDARD 9 Metal Lathes**

**Score:**

- Demonstrate proper use of metal lathes

**PERFORMANCE STANDARD AVERAGE SCORE:**