

Western Technical College

31444304 Tooling & Work Holding for CNC Machining

Course Outcome Summary

Course Information

Description	This course will provide in-depth instruction in the selection of tooling and work holding for CNC turning and milling operations. This course augments the CNC Milling and CNC Turning setup courses.
Career Cluster	Manufacturing
Instructional Level	One-Year Technical Diploma
Total Credits	1
Total Hours	36

Textbooks

No textbook required.

Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** Campus Shop. Required.

Proper footwear - \$35.00-75.00. **Vendor:** To be discussed in class. Required.

Scientific calculator (recommend T1-36x Solar). **Vendor:** Campus Shop. Required.

Program Outcomes

1. MACH 1. Apply basic safety practices in the machine shop
2. MACH 2. Interpret industrial/engineering drawings
3. MACH 3. Apply precision measuring methods to part inspection
4. MACH 4. Perform basic machine tool equipment set-up and operation
5. MACH 5. Perform programming, set-up and operation of CNC Machine Tools

Course Competencies

1. Select cutting tools for CNC machining processes

Assessment Strategies

- 1.1. In the classroom, lab, or shop setting
- 1.2. In written and applied assignments
- 1.3. Individually or in groups

- 1.4. On tests and quizzes
- 1.5. Given references, diagrams, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 1.1. learner uses references to select correct carbide insert grade for specific CNC applications
- 1.2. learner uses references to select correct carbide insert shape for specific CNC operations
- 1.3. learner uses print specifications to select correct carbide end mill for specific CNC applications
- 1.4. learner uses references to select correct carbide cutting tool size for specific CNC applications
- 1.5. learner demonstrates the correct procedures for changing carbide inserts and tooling
- 1.6. learner demonstrates the proper care and storage of carbide cutting tools
- 1.7. learner completes all activities with a minimum of 70% accuracy
- 1.8. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 1.a. Describe the characteristics of carbide inserts
- 1.b. Explain the factors to consider when selecting carbide grades
- 1.c. Explain the factors to consider when selecting carbide insert radii
- 1.d. Describe the effect of carbide insert shape selection on machining considerations
- 1.e. Select carbide cutting tools for CNC turning applications
- 1.f. Select carbide cutting tools for CNC milling applications
- 1.g. Describe how to use and care for carbide tooling

2. Describe material factors affecting cutting tool selection

Assessment Strategies

- 2.1. In the classroom, lab, or shop setting
- 2.2. In written and applied assignments
- 2.3. Individually or in groups
- 2.4. On tests and quizzes
- 2.5. Given references, diagrams, materials, and all available shop equipment and supplies

Criteria

- 2.1. learner correctly matches workpiece material to specific physical properties
- 2.2. learner correctly matches workpiece material to preferred cutting tool materials
- 2.3. learner correctly selects tools for roughing operations on various materials
- 2.4. learner correctly selects tools for finishing operations on various materials
- 2.5. learner correctly calculates speeds and feeds for various workpiece materials based on specific cutting tool material
- 2.6. learner correctly selects cutting tools to achieve specified finish on various materials
- 2.7. learner correctly selects speeds and feeds to achieve specified finishes on various materials
- 2.8. learner completes all activities with a minimum of 70% accuracy
- 2.9. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 2.a. List commonly used workpiece materials
- 2.b. Describe the properties of various workpiece materials
- 2.c. List common types of cutting tool materials
- 2.d. Describe the properties of commonly used cutting tool materials
- 2.e. Describe workpiece factors affecting cutting tool selection
- 2.f. Describe the differences between roughing and finishing tooling
- 2.g. Explain the effect of speeds and feeds on workpiece finish
- 2.h. Explain the effect of speeds and feeds on cutting tool selection

3. Determine workholding needs for CNC machining

Assessment Strategies

- 3.1. In the classroom, lab, or shop setting
- 3.2. Using CNC machine tools
- 3.3. In written and applied assignments
- 3.4. Individually or in groups
- 3.5. On tests and quizzes
- 3.6. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 3.1. learner creates workholding layouts for CNC machining center jobs
- 3.2. workholding layouts specify the workholding devices to be used
- 3.3. workholding layouts specify the workpiece location and locating devices to be used
- 3.4. workholding layouts specify workpiece and workholding orientation relative to machine coordinates and axes
- 3.5. workholding layouts specify clamping mechanisms to be used for securing work
- 3.6. workholding layouts indicate part or work set up details that must be avoided to prevent collisions
- 3.7. learner completes all activities with a minimum of 70% accuracy
- 3.8. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 3.a. Describe types of workholding for CNC machines.
- 3.b. Determine workholding support and location methods.
- 3.c. Determine workholding and clamping methods.
- 3.d. Discuss the location of the workholding device relative to the machine size
- 3.e. Describe precision grid plates as an alternative to dedicated fixtures
- 3.f. Explain considerations related to preventing collisions during tool changes
- 3.g. Explain the use of stops and locating blanks with regard to precision
- 3.h. Explain problems that can occur from excessive clamping forces

4. Describe types of workholding for CNC machines

Assessment Strategies

- 4.1. In the classroom, lab, or shop setting
- 4.2. In written and applied assignments
- 4.3. Individually or in groups
- 4.4. On tests and quizzes
- 4.5. Given references, prints, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 4.1. learner analyzes drawings and operations and selects the correct jig or fixture for each application
- 4.2. learner correctly identifies specified workholding devices in the machine tool lab or shop
- 4.3. learner correctly states the three primary types of modular workholding systems
- 4.4. learner correctly matches the type of modular workholding system to a description
- 4.5. learner correctly identifies various types of fixtures
- 4.6. learner correctly identifies the components of modular workholding systems
- 4.7. learner correctly explains the function of pallet changing systems
- 4.8. learner selects workholding devices for given applications
- 4.9. learner completes all activities with a minimum of 70% accuracy
- 4.10. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 4.a. Describe jigs
- 4.b. Describe fixtures
- 4.c. Explain the types and functions of various jigs
- 4.d. Explain the types and functions of various fixtures
- 4.e. Identify various workholding devices
- 4.f. Describe other types of workholding devices used for CNC machines
- 4.g. Identify modular workholding systems
- 4.h. Describe power workholding methods
- 4.i. Discuss modular systems, components, and configurations
- 4.j. Describe safety considerations for installing new fixtures and workpieces
- 4.k. Define pallet changing
- 4.l. Describe the types of pallet systems and the benefits
- 4.m. Identify tombstone workholding fixtures
- 4.n. Describe applications for tombstone fixtures

5. Determine workholding support and location methods

Assessment Strategies

- 5.1. In the classroom, lab, or shop setting
- 5.2. Using CNC machine tools
- 5.3. In written and applied assignments
- 5.4. Individually or in groups
- 5.5. On tests and quizzes
- 5.6. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 5.1. learner analyzes drawings and operations and selects the correct locator or support for each application
- 5.2. learner correctly matches diagrams of locators to descriptors
- 5.3. learner sets up work in correct orientation on a table grid plate
- 5.4. learner demonstrate correct method for locating and securing workpiece on a table grid plate
- 5.5. learner completes all activities with a minimum of 70% accuracy
- 5.6. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 5.a. Identify the types of locators and supports used for jigs and fixtures
- 5.b. Specify the use of locators and supports
- 5.c. Explain the importance of using baselines or datums for locating and supporting workpieces
- 5.d. Explain how to locate work using the primary datum
- 5.e. Explain how to locate work using the secondary datum
- 5.f. Describe securing or supporting work using the tertiary datum
- 5.g. Identify location methods using table grid plates
- 5.h. Set up workpiece on a table grid plate
- 5.i. Select locating and supporting devices for specific applications

6. Determine workholding and clamping methods

Assessment Strategies

- 6.1. In the classroom, lab, or shop setting
- 6.2. Using CNC machine tools
- 6.3. In written and applied assignments
- 6.4. Individually or in groups
- 6.5. On tests and quizzes
- 6.6. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 6.1. learner demonstrates safe setup habits 100% of the time when setting up workholding devices in CNC machines
- 6.2. learner correctly identifies specified clamping devices available in the machine tool lab or shop
- 6.3. learner demonstrates correct method for setting up work in CNC milling machines
- 6.4. learner demonstrates correct method for setting up work in CNC turning machines
- 6.5. work set ups allow for machining clearance
- 6.6. work set ups hold work securely and safely
- 6.7. work set ups are appropriate for work size
- 6.8. work set ups are appropriate for machining operations to be performed on work pieces
- 6.9. work set ups are aligned correctly
- 6.10. learner demonstrates correct set up procedures using angle plates and clamps
- 6.11. learner demonstrates correct set up procedures using vises
- 6.12. learner demonstrates correct set up procedures using v-blocks and clamps
- 6.13. learner demonstrates correct set up procedures using clamps and the mill table
- 6.14. learner demonstrates correct set up procedures using tailstocks
- 6.15. learner accurately calculates tailstock requirements for turning operations
- 6.16. learner completes all activities with a minimum of 70% accuracy
- 6.17. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 6.a. Identify safety concerns related to workholding
- 6.b. Explain basic principles related to workholding
- 6.c. Describe workholding and machining clearance requirements
- 6.d. Describe workholding and rigidity
- 6.e. Identify differences between hydraulic and manual chucks
- 6.f. Determine mathematically when tailstocks are required for CNC turning operations
- 6.g. Select workholding and clamping devices for specific applications

7. Build fixtures for CNC machining

Assessment Strategies

- 7.1. In the classroom, lab, or shop setting
- 7.2. In written and applied assignments
- 7.3. Individually or in groups
- 7.4. On tests and quizzes
- 7.5. Given references, prints, parts, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 7.1. learner correctly lists the seven objectives of tool design
- 7.2. learner designs a simple fixture for a given application
- 7.3. learner designs a fixture for holding multiple parts
- 7.4. fixture designs include complete part lists
- 7.5. fixture designs are completely dimensioned
- 7.6. fixture designs contains all necessary views
- 7.7. learner builds a simple fixture
- 7.8. learner builds a multi-part fixture
- 7.9. fixtures accurately align and locate parts
- 7.10. fixtures are correctly labeled for specified applications
- 7.11. fixtures are built according to print and part specifications
- 7.12. learner completes all activities with a minimum of 70% accuracy
- 7.13. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 7.a. Describe basic construction considerations
- 7.b. Design a simple fixture
- 7.c. Construct a simple fixture
- 7.d. Design a fixture for holding multiple parts
- 7.e. Construct a fixture for holding multiple parts

8. Recognize problems with CNC machine operation related to tooling and workholding

Assessment Strategies

- 8.1. In the classroom, lab, or shop setting
- 8.2. Using CNC machine tools
- 8.3. In written and applied assignments
- 8.4. Individually or in groups
- 8.5. On tests and quizzes
- 8.6. Given references, prints, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

- 8.1. learner correctly identifies problems by analyzing machined parts
- 8.2. learner correctly identifies overclamping problems of machined parts
- 8.3. learner correctly identifies chatter problems when inspecting machined parts
- 8.4. learner correctly identifies part finish and size problems related to tool wear
- 8.5. learner correctly identifies set up problems with parts that have been incorrectly set up in CNC machines
- 8.6. learner accurately completes problem analysis documentation
- 8.7. problem analysis documentation contains recommendations for corrective actions
- 8.8. learner completes all activities with a minimum of 70% accuracy

8.9. learner scores a minimum of 70% on assignments, tests, and quizzes

Learning Objectives

- 8.a. Explain the relationship between chatter and part length
- 8.b. Explain machining forces relative to rigidity of workholding
- 8.c. Describe the effects of overclamping workpieces
- 8.d. Describe setup and machining problems related to part thickness, shape, and size
- 8.e. Recognize the effects of tool wear on surface finish
- 8.f. Recognize the effects of tool wear on part finish
- 8.g. Identify machine operation problems using auditory methods
- 8.h. Determine if tool wear has occurred
- 8.i. Determine when to change tools or inserts