



**The Manufacturers Association**

**TRAINING PLAN – CNC Machinist (YEAR 3)**

**Total Related Training Instruction (RTI) Hours: 144**

Learning Unit	Hrs. of Instruction
<b>Unit 1: Principles of CNC Machining</b> <ul style="list-style-type: none"> <li>➤ Introduction to CNC Machines</li> <li>➤ Basics of the CNC Lathe and Mill</li> <li>➤ Coordinates for the CNC Lathe and Mill</li> </ul>	18
<b>Unit 3: Introduction to CNC Controls</b> <ul style="list-style-type: none"> <li>➤ CNC Control Panel Functions</li> <li>➤ Overview of Fanuc, Hass, and Mazak CNC Mill Controls</li> <li>➤ Overview of Fanuc, Haas, and Mazak CNC Lathe Controls</li> </ul>	24
<b>Unit 3: CNC Operations</b> <ul style="list-style-type: none"> <li>➤ CNC Machine Offsets</li> <li>➤ CNC Mill and Lathe Operations</li> </ul>	83
<b>Unit 4: Advanced Metrology</b> <ul style="list-style-type: none"> <li>➤ CNC Machine Offsets</li> <li>➤ CNC Mill and Lathe Operations</li> </ul>	19

**Unit 1: Principles of CNC Machining**

The learning unit introduces the fundamentals of CNC Machining, including a brief history, the basics of the CNC mill and lathe, as well as an introduction to coordinates and how they are used in a CNC system.

Learning Outcomes and Content

1. Identify common components of CNC machine tools and controls.
2. Describe operating principles and applications for the CNC turning and machining centers.
3. Describe CNC dimensioning for multiple axes machining.
4. Identify the general machine components of a CNC lathe and describe their basic function
5. Identify the general machine components of a CNC mill and describe their basic function.
6. Describe how coordinates are used to program cutting operations on CNC lathes and turning centers.
7. Describe how coordinates are used to program cutting operations on CNC mills or machining centers.
8. Identify common specifications of CNC lathes and describe the options available on different machines.
9. Identify common specifications of CNC mills and describe the options available on different machines.

Learning Modules

Module	Hrs. of Instruction	Provider





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<b><u>Introduction to CNC Machines</u></b> – This learning module provides a comprehensive introduction to computer numerical control (CNC), which uses numerical data to control a machine.	1.5	ToollingU-SME
<b><u>History and Definition of CNC</u></b> – This learning module outlines the origin of today's CNC machines and explains how modern CNC evolved from its original designs.	1.5	ToollingU-SME
<b><u>Basics of the CNC Lathe</u></b> – This learning module explains the components and functions of both the chucker and bar machine CNC lathe varieties.	1.5	ToollingU-SME
<b><u>Basics of the CNC Mill</u></b> – This learning module explains the components and function of CNC mills which produces flat or curved surfaces on square or rectangular workpieces.	1.5	ToollingU-SME
<b><u>Coordinates for the CNC Lathe</u></b> – This learning module provides an overview of the coordinates used to program cutting operations on CNC lathes or turning centers.	1.5	ToollingU-SME
<b><u>Coordinates for the CNC Mill</u></b> – This learning module provides an overview of the coordinates used to program cutting operations on CNC mills or machining centers.	1.5	ToollingU-SME
<b><u>CNC Specs for the Lathe</u></b> – This learning module identifies common specifications of CNC lathes and describes the various features and options available on different machines.	1.5	ToollingU-SME
<b><u>CNC Specs for the Mill</u></b> – This learning module identifies common specifications of CNC mills and describes the various features and options available on different machines.	1.5	ToollingU-SME
<b><u>Introduction to CAD and CAM for Machining</u></b> – This learning module provides a foundational overview of CAD and CAM systems and how they are used in CNC machining operations. While CAD greatly streamlines the process of part design,	1.5	ToollingU-SME
<b><u>CAD/CAM Machining Practical</u></b> – This hands-on learning module introduces the application of CAD and CAM to the CNC Process, including a review of CAD design methods and CAM data conversion.	4.5	Facility

#### Unit 2: Introduction to CNC Controls

The learning unit introduces the CNC machinist to the CNC control panel. This unit covers common functions, found on a CNC controller panel, as well as specific overview of the most popular CNC controller manufacturers. The learning unit will teach a worker how to use the machine and control panel functions to operate a CNC lathe and mill

#### Learning Outcomes and Content

1. Explain the purpose of frequently used controls on the control panel of a CNC lathe.
2. Explain the purpose of frequently used controls on the control panel of a CNC mill.
3. Identify various sections of the Fanuc 0-C mill and lathe control panel.
4. Describe how to power up, power down, and home a Fanuc machine.
5. Identify various sections of the Haas mill and lathe control panel.
6. Describe how to power up, power down, and home a Haas machine.
7. Identify various sections of the Mazak mill and lathe control panel.



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8. Describe how to power up, power down, and home a Mazak machine.

#### Learning Module

Module	Hrs. of Instruction	Provider
<b><u>Control Panel Functions for the CNC Lathe</u></b> – This learning module explains how operators use the machine and control panel functions to operate a CNC lathe.	1.5	ToollingU-SME
<b><u>Control Panel Functions for the CNC Mill</u></b> – This learning module explains how operators use the machine and control panel functions to operate a CNC mill.	1.5	ToollingU-SME
<b><u>Fanuc Mill: Control Panel Overview</u></b> – This learning module illustrates the various sections of the Fanuc 0-C mill control panel as well as the steps for powering up, powering down, and homing the machine.	1.5	ToollingU-SME
<b><u>Fanuc Lathe: Control Panel Overview</u></b> – This learning module illustrates the various sections of the Fanuc 0-C lathe control panel as well as the steps for powering up, powering down, and homing the machine.	1.5	ToollingU-SME
<b><u>Haas Mill: Control Panel Overview</u></b> – This learning module illustrates the various sections of the Haas mill control panel as well as the steps for powering up, powering down, and homing the machine.	1.5	ToollingU-SME
<b><u>Haas Lathe: Control Panel Overview</u></b> – This learning module illustrates the various sections of the Haas lathe control panel as well as the steps for powering up, powering down, and homing the machine.	1.5	ToollingU-SME
<b><u>Mazak Mill: Control Panel Overview</u></b> – This learning module illustrates the various sections of the Mazak mill control panel as well as the steps for powering up, powering down, and homing the machine.	1.5	ToollingU-SME
<b><u>Mazak Lathe: Control Panel Overview</u></b> – This learning module illustrates the various sections of the Mazak lathe control panel as well as the steps for powering up, powering down, and homing the machine.	1.5	ToollingU-SME
<b><u>CNC Controls Practical</u></b> – This learning module will teach a worker how to use the machine and control panel functions to operate a CNC lathe and mill. This unit includes hands-on instruction covering concepts such as how to identify the operational modes on a CNC lathe or mill, accessing the manual control modes on a CNC lathe or mill, using a pulse handle and jog mode on a CNC machine, accessing MDI and single block mode, overriding, manual coolant operations, manual turret indexing, and manual operations for a chip conveyor.	12	Facility

#### Unit 3: CNC Machine Operation

The learning unit instructs the worker in the step by step procedures for operating a CNC machine.



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#### Learning Outcomes and Content

1. Understand CNC lathe offsets and how to use them.
2. Understand CNC mill offsets and how to use them.
3. Identify safety hazards which may occur during the setup or operation of CNC machines.
4. Demonstrate the ability to monitor the CNC machining process by interrupting machining, measuring or checking dimensions, and adjusting machine feeds, speeds, and offsets, so that the dimensions, shape, and tolerances of the machined workpiece are maintained during machining in conformance job specifications.

#### Learning Modules

Module	Hrs. of Instruction	Provider
<b>Offsets on the CNC Lathe</b> - This learning module will provide explanations of the concept, purpose, and use of offsets on a CNC lathe or turning center.	1.5	ToollingU-SME
<b>Offsets on the CNC Mill</b> - This learning module provides an explanation of the concept, purpose, and use of offsets on the CNC mill or machining center and details the movements and programming involved with each type of offset.	1.5	ToollingU-SME
<b>CNC Mill Operation Practical</b> - This hands-on learning module will teach a worker the step by step procedures for safe operation and monitoring of a CNC mill. This includes best practices in monitoring the CNC machining process and adjusting machine feeds, speeds, and offsets, so that the dimensions, shape, and tolerances of the machined workpiece are maintained during machining in conformance with job specifications. It also teaches a worker how to monitor CNC tool wear, interpret various CNC machine alarms cancel each alarm, and maintain the maximum quality and production of finished pieces. Final inspection procedures are also covered in this module.	40	Facility
<b>CNC Lathe Operation Practical</b> - This hands-on learning module will teach a worker the step by step procedures for safe operation and monitoring of a CNC Lathe. This includes best practices in monitoring the CNC machining process and adjusting machine feeds, speeds, and offsets, so that the dimensions, shape, and tolerances of the machined workpiece are maintained during machining in conformance with job specifications. It also teaches a worker how to monitor CNC tool wear, interpret various CNC machine alarms cancel each alarm, and maintain the maximum quality and production of finished pieces. Final inspection procedures are also covered in this module.	40	Facility

#### Unit 4: Advanced Metrology

The learning unit instructs the worker in advanced metrology and inspection of CNC machined parts using equipment such as optical comparators and CMMs.

#### Learning Outcomes and Content

1. Demonstrate how to use an Optical Comparator to inspect a part.
2. Demonstrate how to use a CMM to inspect a part.



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#### Learning Modules

Module	Hrs. of Instruction	Provider
<b><u>Inspecting with Optical Comparators</u></b> - This learning module provides an overview of the optical comparator, which uses optics to project an enlarged, two-dimensional shadow of a part onto a glass screen for measurement of its length, width, and surface.	1.5	ToollingU-SME
<b><u>Inspecting with CMMs</u></b> - This learning module provides a comprehensive overview of the functions and mechanics of the coordinate measuring machine, or CMM.	1.5	ToollingU-SME
<b><u>Calibration and Documentation</u></b> - This learning module details the calibration of measuring instruments and its necessary documentation.	1.5	ToollingU-SME
<b><u>In-Line Inspection Applications</u></b> - This learning module offers an in-depth look at the uses of in-line inspection, or error-proofing, in a production environment.	1.5	ToollingU-SME
<b><u>Advanced Metrology and Inspection Practical</u></b> - This hands-on learning module teaches a worker the step by step procedures for conducting advanced part inspections with tools such as optical comparators and CMMs.	15	ToollingU-SME