NEW ENGLAND INSTITUTE OF TECHNOLOGY SAMI Advanced Manufacturing/CNC Operator Programmer Program

The SAMI Program has been very successful in producing excellent entry level machinists and connecting them to manufacturers in need of skilled workers. This training curriculum places strong emphasis on learning manual machine processes and gradually builds skills to expose participants to CNC operations based on each student's skills and abilities.

The Prime Component

This 300 hour curriculum was developed and its machine labs exercises were designed to replicate real world work experiences. SAMI focuses on work readiness skills in the delivery of the training curriculum and each participant receives an OSHA-10 certification. Our training emphasis is on safety and worker accountability. SAMI's goal is to produce skilled, reliable, production workers.

Work activities in machine shop involve applying knowledge of machine capabilities, the properties of materials, and shop practices to set-up and operate various machines. The skills needed to position work pieces, adjust machines, and verify the accuracy of machine functions and finished products are taught by classroom instructions, demonstration, and hands on experience. The machine training program will lead to employment opportunities in Advanced Manufacturing Careers.

SAMI instructors and staff work very closely with employers to make a quality match to the skill level and interests of our students within the employment needs of each employer. We incorporate post placement feedback from our employers to continually improve our program and to ensure our training is responsive to current industry needs.

Prime Component (300 hours)

CURRICULUM HIGHLIGHTS

Contextualized Math for Machine Technologies Blue Print Reading Precision Measurement Tools Manufacturing Materials and Cutting Tool Technology

- Metal Characteristics
 - Cutting Speeds and Feeds

Bench Work Activities

- Work Piece Layout
- Deburring Tools and Techniques

Drill Press Operation

Lathe/Turning Process

- Set-Up/Chucks & Collets/Indicating Work Pieces
- Cutting Tool Design & Positioning
- Turning Operations: Facing/OD/Shoulders/Drilling/Boring/Angles

Vertical Milling Process

- Work Holding Devices/Set-Up
- Cutting Tool Speed Feed
- Machining: Squaring/Drilling/Boring/Angles

Surface Grinding Process

- Grinding Wheel Technology
- Surface Finish Process
- Squaring & Parallel Grinding to Dimensions

CNC Process (Introduction)

- Set-Up and Tool Offset Positions
- Operation
- Program Monitoring and Adjustment

OSHA-10 Certification

Job Preparation Workshops

MACHINE TOOL TECHNOLOGY PRIME COMPONENT Total 300 hours

1ST PHASE – TWO WEEKS

Hours per Week
1
3
3
3
5
5
10

2 nd PHASE – TWO WEEKS	
COURSES	Hours per Week
Safety in the Work Environment	2
Math for Manufacturing	3
Blueprint Reading/AutoCAD	5
Basic Machine Technology – Cut Off Saw & Drill Press Process	20

3 rd PHASE – SIX WEEKS	
COURSES	Hours per Week
Safety in the Work Environment	1
Math for Manufacturing	1
Advanced Metrology	3
Quality Procedures and Concepts	5
Machine Technology – Turning/Milling/Grinding	18
Introduction to CNC Machining	2

COURSE DISCRIPTIONS

BENCHWORK:

When you complete this lesson you will be able to identify the basic hand tools required and hand work methods used to manufacture replacement or repair parts used in various types of equipment:

- Describe tools and methods for work piece layout, bluing, measuring, scribing lines, and marking hole centers.
- Describe tools and methods for hand cutting material with a hacksaw, including hacksaw parts description, blade types, cutting edge alloys, and tooth pitch.
- Describe the different types of files methods for filing and draw filing.
- Describe the types of hand reamers and methods for precision sizing of holes, including the use of hand reamers, hand chucks, and drivers.
- Describe the different types of deburring tools and techniques for the deburring of parts with hand tools.
- Describe the various types of taps and dies and the proper hand use of hand taps and dies.

METROLOGY:

When you complete this lesson you will be able to identify common micrometer types, identify their components, and correctly take readings using English, metric and Vernier micrometers.

- Identify common types of micrometers.
- List the major components of micrometers.
- Demonstrate how to take an accurate reading with an outside micrometer
- Explain how to properly read the scale on an English scale micrometer, a metric scale micrometer, and a Vernier micrometer.
- Demonstrate how to take an accurate reading with an inside micrometer.
- Demonstrate how to take an accurate reading with a depth micrometer.

You will be able to describe the various types of fixed gauges commonly used by maintenance and machining technicians. You will also be able to explain the purpose of the various fixed gauges.

- Identify and describe the purpose of each of the following types of fixed gauges:
 - Go NoGo gauge
 - o Plug gauge
 - Thickness gauge
 - o Screw Pitch gauge
 - o Radius gauge
 - Small hole gauge

You will be able to list the major components of dial indicators and demonstrate how to use the instrument to take an accurate reading. You will also be able to describe how to use a dial indicator to measure the run out of a rotating part, and how to align two shafts using a dial indicator:

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- List the main components of a dial indicator.
- Explain how to properly read a dial indicator.
- Describe how to measure run out.
- Demonstrate how to align rotating components.
- Describe various types of indicators.

CUT OFF SAW:

When you complete this lesson, you will be able to describe the design and operation of a band saw. In addition, you'll be able to explain how to use a bandsaw to produce various cuts.

- List the major components of a vertical band saw.
- Describe different types of available band saw cutting blades.
- Explain how to manufacture a band saw blade using the shearing, welding, grinding, and annealing attachments.

DRILL PRESS:

When you complete this lesson, you will be able to describe the design, function, and safe operation of a drill press and its major components and attachments.

- Explain safety precautions taken when operating a drill press.
- Describe various drill press components and attachments.
- List various types of drill presses and describe their operations.
- Describe how cutting speeds and feed rates affect drill press operations.

TURNING:

When you complete this lesson, you will be able to identify engine lathe control systems and machining methods, and explain the basic methods to manufacture replacement or repair parts for various types of equipment.

- Describe basic engine lathe parts and operational controls.
- Identify types of chucks and discuss procedures for installing and removing chucks and faceplates on cam lock spindles.
- Explain the operation and use of the four jaw chuck.
- Describe tail stock parts and operations.
- Describe the following types of cutting tools and discuss their uses:
 - Carbide and alloy turning tools and drills
 - o Drill bits
 - Turning tools
 - Facing tools
 - Boring bars and tools
 - Threading and Specialty tools
- Identify factors that determine suitable speeds and feeds for different cutting tools, operations, and work piece materials.
- Describe the basic methods used for:
 - Turning operations
 - o Shaft work
 - Thread cutting

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- Boring bars and tools
- Threading and Specialty tools
- Identify factors that determine suitable speeds and feeds for different cutting tools.

MILLING:

When you complete this lesson, you will be able to identify the basic control systems and machining methods used on a vertical milling machine and explain the basic operations necessary to manufacture replacement or repair parts used in various types of equipment.

- Identify the function of the vertical milling machine's operational controls.
- Explain how workpieces and cutting tools may be precision located through coordinate measuring.
- Explain how to square a work piece on a vertical milling machine.
- Describe the use of the holding and clamping tools.
 - Explain how to determine suitable speeds and feeds for various:
 - o Cutting tools
 - o Operations
 - Work piece materials
- Describe the use of each of the following cutting tools:
 - o End mills
 - Woodruff cutters

GRINDING:

When you complete this lesson, you will be able to describe surface grinder control systems and explain basic machining methods used to manufacture replacement parts used to repair various types of equipment.

- Identify surface grinder components and identify their functions.
- Discuss techniques and components related to workpiece clamping.
- Identify types of grinding wheels and compare their uses.
- Explain the basic steps for dressing a grinding wheel and profile-shaping a grinding wheel.
- Describe the two basic techniques for grinding part.
- Identify safety equipment and best practices for safe grinder operation.
- Outline the technique for grinding a workpiece parallel and to a specific size.

CNC Process Introduction

- Set-Up and Tool Offset Positions
- Operation
- Program Monitoring and Adjustment

OSHA – 10 hour Certification

Job Preparation Workshops

CNC MACHININE OPERATOR / PROGRAMMER

Advanced Component <u>100 hours</u>

The SAMI students chosen for this portion of the training will have illustrated competencies in machinist math, drawing interpretation, manual machining, blueprint reading and SolidWorks portion of the SAMI Prime Component manual machinist program (300 hrs.) The Prime Component will be the prerequisite for students moving on to this Advanced Component 100 hour block of training.

Objectives/Learning Goals:

By the end of this 100 hour course of instruction, students will:

- Experience programming, machining and tooling setup tasks using various CNC machines.
- Show ability to trouble shoot any errors in their CNC program and make necessary corrections.
- The student will experience 40 hours of Blueprint, SolidWorks and Mastercam allowing the student to develop and run a simulation of the product, insuring that data they have a programmed is correct prior to the actual CNC production operation.

Learning Resources:

The students will be give two HAAS CNC programming workbooks based on the VF/EC Series milling machines and the TL/ST Series Lathes. These formal resources will be used in the classroom portion of the class. The student will also be given hands on/lab based industrial type assignments.

The primary training (approx. 30 hrs.) will be on HAAS machines. The student will also experience assignments on the SIEMENS controller, on a MTAB milling machine, the OKUMA Lathe, and MAZAK simulator.

Simultaneously, the student will receive training in Blueprint Reading, SolidWorks and Mastercam providing the skills to create CAD drawings and then to produce a finished machined product on a CNC machine. The student will also learn how to apply their knowledge of SolidWorks and Mastercam as a stand-alone tool, which will allow them to apply this knowledge and machining skills in the development of CNC code, then move that new information from the CAM program to various CNC machines to perform various manufacturing operations.

CNC Training Topics:

- How to operate hydraulic centering chucks and setting up soft jaws.
- Explanation of International Organization for standardization "ISO" and how it applies to the students.
- Explanation of Shop Operating Procedures or "SOP's" and how it applies to manufacturing and shop safety and why they need to know these rules.
- Exposure to additional machines used by manufacturing partners and the various differences in the way code varies between machine manufacturers.
- Explanation of calibration standards and how to maintain machine coolant.

<u>Blueprint / SolidWorks / Mastercam Program</u> <u>Topical Outline</u>

Blueprint Reading outline:

Topics:

- Terminology related to Blueprints
- The Breakdown of sections within a Blueprint / Layout
- Sheet sizes
- Primary Views (Six)
- Line convention (AMSE)
- ANSI Standards (symbols)
- Reading a Blueprint related to the view / features / dimensions
- Orthographic Projection / Third angle projection

Exercises in this section include finding missing dimensions / Locating information within the Title block – Notes - Drawing - Dimensions / recognizing features that are missing in different views / completing a few simple parts by hand to help solidify how everything lines up and where and how features need to be depicted.

- Geometric Terminology
- Terminology related to Section and Auxiliary views
- Section Views
- Auxiliary Views

Exercises in this section include recognition of the different type of section and auxiliary views / where features are located on each view.

Each Blueprint reading exercise gets increasingly more challenging in the way of detail and the questions.

SolidWorks outline:

This is an introductory program where the students are shown the below topics / features within the program (but not limited to the list below) the students then have a number of exercises to work on related to those topics covered.

Topics:

- Terminology related to SolidWorks
- Cartesian Coordinate System
- Plotting points
- User Interface of SolidWorks
- Commands within the Feature and Sketch tabs
- Feature Manager Tree
- Incorporating the Blueprint concepts learned earlier in the program into creating a SolidWorks Drawing.
- View / getting around within a drawing
- Additional Blueprint reading Exercises
- Tolerances
- Hole Wizard
- Multiple hands on tutorials / drawing exercises working their way from easy to more difficult concepts.
- Editing / modifying a part
- Creating a PART, ASSEMBLY and a DRAWING.

Mastercam outline:

This is an introductory program where the students are shown the below topics / features within the program. They then have a number of exercises to work on related to those topics covered.

Topics covered:

- Terminology related to Mastercam
- Mastercam File Types / Native Files
- Translation Problems
- Quick reference guide to some commands
- Starting Mastercam
- GUI Graphical User Interface
- Status Bar / Setting Attributes
- Ribbon Bars
- Toolpath Manager / Loading a Workspace 2D Toolpaths
- Configuration Dialog Box Define a GRID
- How to navigate within Mastercam (Example Line command)
- AutoCursor
- Sketcher Tools
- Xform Tools
- Letters
- Wire Frame Geometry

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- Toolpath configurations for Mill & Lathe
- Working with Solids / created in SolidWorks
- Solid Modeling
- Solids tools
- Solid Model Prep tools

For those students that excel within any portion of the program, additional instruction will be offered to bring them further along.

The approach in the class room is an instructor led building block approach - then hands on for the students to apply what they have been shown.

Evaluations Process:

The students in the CNC program will be evaluated by the instructor(s) on a bi-weekly bases. The evaluations will be both written and/or performance based.

When the student illustrates, to the instructor's satisfaction, the ability to program the CNC simulators and utilizing the reference materials, they will be placed on the actual CNC machines and begin the process of operating them under real industrial conditions.

This workforce product was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The product was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The U.S. Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership.