

Minnesota Dual-Training Pipeline

Competency Model for Advanced Manufacturing

Occupation: Machinist/CNC Operator

Employer-Specific Requirements

Occupation-Specific Competencies

General Housekeeping & Maintenance	
Preventative Maintenance/ Tooling Maintenance	
Benchwork and Hand Tools	
Level 1	Level 2
Manual Milling	Adv. Manual Milling
Turning Operations	Adv. Turning
Grinding Skills	Adv. Grinding Skills
CNC Turning	Adv. CNC Turning
CNC Milling	Adv. CNC Milling
Inspection Practices	EDM - Wire/Plunge
	Adv. Inspection

Industry-Sector Technical Competencies

Machining Introduction	Blueprint Reading	Shop Math and Measurement	CNC Turning	CNC Milling	CNC Setup and Programming Basics	Machine Tool Theory	Molding — Metallurgy — Inspection
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Industry-Wide Technical Competencies

Manuf. Process Design & Development	Production	Maintenance, Installation and Repair	Supply Chain Logistics	Quality Assurance, Continuous Improvement	Sustainable and Green Manuf.	Safety, Health Security and Environment	Root Cause Analysis	CAD Intro
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Workplace Competencies

Business Basics	Teamwork	Adaptability and Flexibility	Technical Work Instructions	Planning and Organizing	Problem Solving, Decision Making	Working with Tools, Technology	Checking, Examining and Recording	Sustainable Practices
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Academic Competencies

Science	Basic Computer Skills	Mathematics	Reading and Writing	Communication: Listening & Speaking	Critical & Analytic Thinking	Information Literacy
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Personal Effectiveness Competencies

Interpersonal Skills	Integrity	Professionalism	Initiative	Dependability and Reliability	Lifelong Learning
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Based on: Advanced Manufacturing Competency Model Employment and Training Administration, United States Department of Labor, April 2010.

* Pipeline recommends the Industry-Sector Technical Competencies as formal training opportunities (provided through related instruction) and the Occupation-Specific Competencies as on-the-job training opportunities.



Machinist/ Computer Numerical Control (CNC) Operator -

A machinist/CNC Operator oversees the CNC machines that shape parts from metal or plastic. They must interpret blueprints, part manuals and other work instructions. They also study sample parts to determine dimensions of finished work pieces and equipment setup requirements. They set the machine and load it with the correct cutting tools. Machinists inspect work pieces throughout a production run. In addition, machinists measure and mark dimensions and reference points on material or work pieces as a guide for subsequent machining. Machinists additionally clean and perform basic preventative maintenance functions on machines, tooling equipment and parts. They must work safely to prevent on-the-job injuries, which includes wearing personal protective equipment such as safety glasses. They also inspect cutting tools for sharpness and usability. These professionals additionally detect malfunctions using precision measuring instruments such as micrometers, dial calipers, depth gages, machine indicators and scales.

Industry-Sector Technical Competencies

- Machining Introduction – Learn basic machining operations including safety, MSDS, measuring tools and use of drill presses and band saws.
- Blueprint Reading – Knowledge in reading and understanding industrial prints.
- Shop Math and Measurement – Training in basic math including linear measurement, metrics and beginning algebra.
- CNC Turning – Training in how to operate a lathe including types of chucks, cutting tools, speeds and feeds, tool care, threads, part production and general inspection.
- CNC Milling – Learn mill operation including clamping, tools and holders, speeds and feeds, cutting depths/width along with direction.
- CNC Setup and Programming Basics – Exposure to manual programming of Computer Numerical Control (CNC) machine tools. Learn types of CNC controls, machinery, programming formats and basic terminology.
- Machine Tool Theory – Learn to complete the processes required for manufacturing a precision part, use standard shop safety practices, set-up and operate standard manufacturing machines, complete accurate lay-outs, explain applications of hand tools and use correctly and use basic measuring tools.
- Molding – Understand the fundamentals of injection molding technology.
- Metallurgy – Know the basic principles of metals, the behavior of metals and the processes which affect them, as well as the most common metals used in industrial processes.
- Inspection – Know the proper methods and instruments used to effectively inspect parts in the shop, including using instruments such as the caliper, micrometer, and CMM.

Occupation-Specific Competencies

- General Housekeeping and Maintenance – Demonstrate the ability to maintain tools and machinery with basic cleaning and maintenance procedures.
- Preventative Maintenance / Tooling Maintenance – Practice industry approved procedures for conducting preventative maintenance on machines and tools.
- Benchwork and Hand Tools – Knowledge of the various tools, methods, and procedures for common machine shop benchwork and hand tool work.

Level 1 Machinist

- Manual Milling – Display basic operation of the vertical and horizontal milling machines and the ability to use cutting tools and holders, setups, spindles and arbors, work holding methods.
- Turning Operations – Demonstrate basic lathe applications such as understanding turning safety, calculating speeds and feeds, using various tools and tool holders, identifying basic tool geometry, and the use of common lathe spindle tooling.
- Grinding Skills – Use surface grinders with proper set up techniques and grinding processes.
- CNC Turning – Demonstrate CNC lathe operations, control functions, the letter address system, the program format, and machine setup.
- CNC Milling – Demonstrates the fundamentals of CNC machining processes with skills in work holding, speeds and feeds for various materials and functions and understanding of capabilities of CNC machining tools.
- Inspection Practices – Demonstrate the proper methods and instruments used to effectively inspect parts in the shop, including using instruments such as the caliper, micrometer, and CMM.

Level 2 Machinist

- Advanced Manual Milling – Use mill for advanced techniques such as squaring a block, perform angle layouts with various methods including a sign bar. Perform simple keyset and slotting operations.
- Advanced Turning – Ability to operate lathe for advanced processes such as form radius, single-point isometric threads, turn spherical radius, use a radius gauge, as well as advanced taper techniques and work support devices.
- Advanced Grinding Skills – Demonstrate advanced techniques of grinding including use of sine bars and chucks, sine bars, gage blocks, wheel balancers, various grinding wheels and diamond dressers.
- Advanced CNC Turning – Able to perform advanced techniques of CNC lathe including turning with an offset talk stock and boring functions.
- Advanced CNC Milling – Use advanced techniques of setting-up and operating CNC milling machines including principles of clamping and locating work piece, selection of

cutting tools and holders along with use of rotary tables. Demonstrate pocketing slotting and key seat techniques as well as edging techniques.

- EDM – Wire/Plunge – Know how to prepare, operate, and maintain the wire EDM machine. Create basic G-code without the use of CAM software.
- Advanced Inspection – Able to use measuring instruments relating to state-of-the-art manufacturing environments, such as coordinate measuring machine and calibration. Understanding of Quality Control, TQM, and SPC processes as they relate to manufacturing environments.

Machinist/CNC Operator Occupational Competency Training Plan

Related Instruction means an organized and systematic form of instruction designed to provide the apprentice with the knowledge of the theoretical and technical subjects related to the apprentice's trade of occupation, or industrial courses or, when of equivalent value, by correspondence, electronic media, or other forms or self-study approved by the commissioner.

	Course	Course Description	Credit/Non-Credit	Hours Spent on Competency
	Machining Introduction			
	Blueprint Reading			
	Shop Math and Measurement			
	CNC Turning			
	CNC Milling			
	CNC Setup and Programming Basics			
	Machine Tool Theory			
	Molding			
	Metallurgy			

Inspection				
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On-The-Job Training is the work experience and instruction. Training experience need not be in the exact order as listed below.

	Trainer/Instructor	Name of person responsible for verifying competency mastery	Hours spent on competency
General Housekeeping & Maintenance			
Preventative Maintenance / Tooling Maintenance			
Benchwork and Hand Tools			
Level 1			
Manual Milling			
Turning Operations			
Grinding Skills			
CNC Turning			
CNC Milling			
Inspection Practices			
Level 2			
Advanced Manual Milling			
Advanced Turning			
Advanced Grinding Skills			
Advanced CNC Turning			
Advanced CNC Milling			

EDM – Wire/Plunge			
Advanced Inspection			