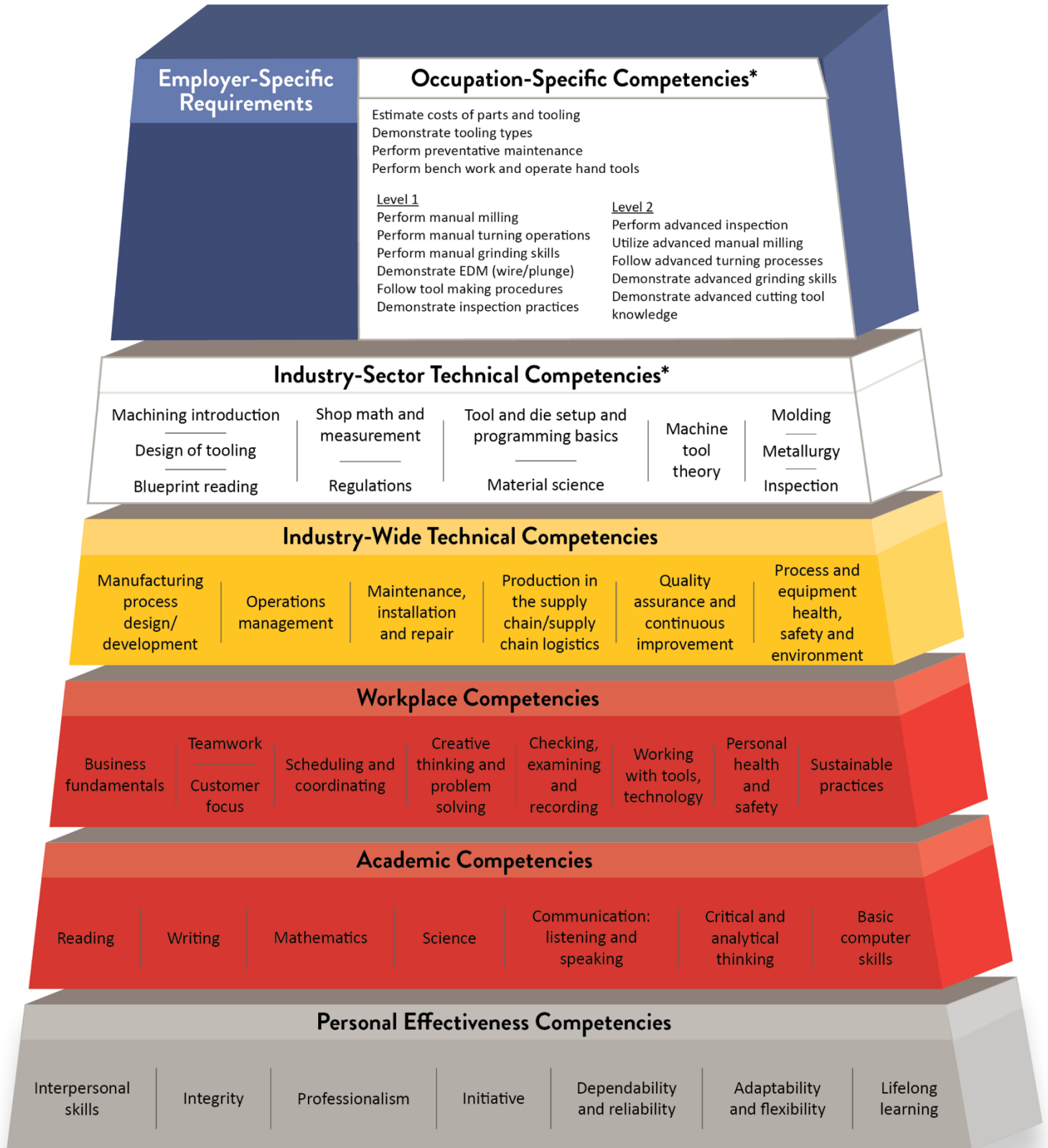


Minnesota Dual-Training Pipeline

Competency Model for Advanced Manufacturing

Occupation: Machinist/Tool and Die Maker



Based on: Advanced Manufacturing Competency Model, Employment and Training Administration, United States Department of Labor, February 2025. For more detailed information about competency model creation and sources, visit dli.mn.gov/business/workforce/advanced-manufacturing.

Competency Model for Machinist/Tool and Die Maker

Machinist/tool and die maker – A skilled craftsperson who makes, repairs, and modifies custom made, prototype or special tools, dies, jigs, fixtures and gauges to very specific and precise dimensions. The work involves the operation of lathes, grinders, milling and boring machines. They must read and interpret blueprints, manuals, and other work instructions of tools, dies, prototypes or models. They compute and verify dimensions, sizes, shapes, and tolerances of workpieces. Machinists operate a variety of computer-controlled and mechanically controlled machine tools. They must plan the sequence of operations from set-up to finished product, making sure that machined parts conform to specifications by using precision measuring instruments. They must work safely to prevent on-the-job injuries, which includes wearing personal protective equipment. These professionals identify any flaws in the finish or operation of machined parts and take corrective action while working independently or as a member of a team on a variety of different projects and tasks.

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

Industry-Sector Technical Competencies

Related Instruction for dual training means the organized and systematic form of education resulting in the enhancement of skills and competencies related to the dual trainee's current or intended occupation.

- **Machining introduction** – Learn basic machining operations including safety, material safety data sheets (MSDS), measuring tools and use of drill presses and band saws.
- **Design of tooling** – Understand how to design tools that account for the time it will take for a job to run and know how to develop tools that correlate with a part blank allowance for drawing and bending.
- **Blueprint reading** – Knowledge in reading and understanding industrial prints such as geometric dimensioning and tolerance (GD&T).
- **Shop math and measurement** – Training in basic math including linear measurement, metrics and beginning algebra, as well as statistical process controls (SPC) used for data collection.

- **Regulations** – Understanding of industry regulations (such as (International Society of Automation (ISA), Good Manufacturing Practices (GMP), etc.) and how to interpret work instructions, standard operating procedures and work instructions based on regulations.
- **Tool and die setup and programming basics** – Exposure to manual programming of tools. Learn types of tool and die controls, machinery, programming formats and basic terminology.
- **Material science** – Basic understanding of material science or plastics and/or metallurgy.
- **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 layouts, explain applications of hand tools and use correctly and use basic measuring tools.
- **Molding** – Demonstrated knowledge of the process used in manufacturing to shape materials.
- **Metallurgy** – Understanding of the physical and chemical behavior of metallic elements, their inter-metallic compounds, and their mixtures (alloys). Includes: Materials stamped and selection of tool steels for tooling.
- **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

On-the-Job Training is hands-on instruction completed at work to learn the core competencies necessary to succeed in an occupation. Common types of OJT include job shadowing, mentorship, cohort-based training, assignment-based project evaluation and discussion-based training.

- **Estimate costs of parts and tooling** – Demonstrate the ability to obtain or provide quotes of costs for parts and tooling
- **Demonstrate tooling types** – Demonstrate knowledge of the different types of tooling such as forming, support, production and specialized tools including tools like draw dies, coining, blanking, progressive, etc.
- **Perform preventative maintenance** – Practice industry approved procedures for preventative maintenance on machines and tools.
- **Perform bench work and operate hand tools** – Knowledge of the various tools, methods, and procedures for common machine shop bench work and hand tool work.

Level 1

- **Perform 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.
- **Perform manual turning operations** – Demonstrate 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.
- **Perform manual grinding skills** – Use surface grinders with proper set up techniques and grinding processes.
- **Demonstrate Electrical Discharge Machining (EDM) (Wire/Plunge)** – Demonstrate basic understanding of Electrical Discharge Machining which is the process of utilizing electrical discharges to shape and form materials
- **Follow tool making procedures** – Demonstrated ability to perform advanced turning and advanced manual milling.
- **Demonstrate 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

- **Perform 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, Total Quality Management (TQM), and Standard Process Control (SPC) processes as they relate to manufacturing environments.
- **Utilize advanced manual milling methods** – Use mill for advanced techniques such as squaring a block, perform angle layouts with various methods including a sign bar. Perform simple key seat and slotting operations.
- **Follow advanced turning processes** – 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.
- **Demonstrate 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.

- **Demonstrate advanced cutting tool knowledge** – Demonstrated ability to perform advanced operations of a drill press, vertical milling machine, engine lathe, surface grinder and saws.

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