# PRECISION MACHINING, 48.0500.30

An Industry Standards Validation Committee developed and approved these standards on November 12, 2015. They align with the NIMS (National Institute for Metalworking Skills, Inc.) credentialing process designed to meet entry-level requirements for Level I and Level II Machinists. The Arizona Career and Technical Education Quality Commission, the validating authority for the Arizona Skills Standards Assessment System and the end-of-program assessments, certificates, and transcripts, endorsed these standards on May 12, 2016. The first testing date for the end-of-program assessment for Precision Machining using the new standards is Fall 2016.

**STANDARD 1.0 ANALYZE THE EVOLUTION OF PRECISION MACHINING**

1.1 Explain the machining process
1.2 Discuss the history of machining
1.3 Identify the significance of machining in society
1.4 Discuss types of machine tools (e.g., sawing machines, drill press, lathe, milling)
1.5 Discuss types of machining operations (e.g., abrasive, electrical discharge, laser, water jet)

**STANDARD 2.0 APPLY INDUSTRY SAFETY STANDARDS FOR PRECISION MACHINING**

2.1 Explain the purpose of the Occupational Safety and Health Administration (OSHA)
2.2 Identify Personal Protective Equipment (PPE) appropriate for working in a machining environment
2.3 Interpret basic Safety Data Sheet (SDS) information

**STANDARD 3.0 IMPLEMENT PRECISION AND SEMI-PRECISION MEASUREMENT**

3.1 Perform machine tool math (e.g., fractional operations, fractional/decimal conversion, ratios and proportions, English/metric conversions, basic geometry, angles, Cartesian coordinates, basic trigonometry)
3.2 Use semi-precision measurement tools (e.g., machinist's rule, combination sets, protractors, scales)
3.3 Use precision measurement tools (e.g., gage blocks, dial calipers, sine tools, micrometers, optical comparators)
3.4 Explain the purpose of quality assurance, process planning, and quality control systems in the machining industry [e.g., SPC (statistical process control), ISO (International Organization for Standardization]

**STANDARD 4.0 DISTINGUISH AMONG TYPES OF MATERIALS AND ROUTINE MAINTENANCE REQUIREMENTS**

4.1 Differentiate between ferrous and nonferrous materials
4.2 Identify national standards of materials classifications [e.g., AISI (American Iron and Steel Institute), SAE (Society of Automotive Engineers), ASTM (American Society for Testing and Materials), UNS (Unified Numbering System)]
4.3 Explain common heat treatment processes
4.4 Assess the importance of a routine maintenance program (e.g., lubrication methods, inspection points, cutting fluids)

**STANDARD 5.0 DESIGN A JOB PROCESS PLAN INCLUDING BENCHWORK AND LAYOUT**

5.1 Identify components of two-dimensional (2D) drawings [e.g., title block, views, line types, symbols and notation, classes of fit, GD&T (geometric dimensioning and tolerance)]
5.2 Perform basic layout procedures and mathematical calculations using semi-precision and precision layout tools
5.3 Demonstrate proper hand tool use and related safety precautions
5.4 Demonstrate safe operation of saws and cutoff machines
5.5 Explain the uses of offhand grinding and related safety precautions
5.6 Demonstrate drilling, reaming, threading, and tapping operations

**STANDARD 6.0 PERFORM BASIC DRILL PRESS OPERATIONS**

6.1 Identify major components of a drill press and their functions
6.2 Explain safe operation of a drill press
6.3 Apply proper tooling (e.g., tools, toolholding, workholding)
6.4 Demonstrate drill press safety precautions (e.g., safety glasses, securing workpieces, shutting off spindle, cleaning, good housekeeping rules)

**STANDARD 7.0 PERFORM BASIC TURNING OPERATIONS**

7.1 Identify major components of a lathe and their functions

7.2 Explain safe operation of a lathe

7.3 Apply proper tooling (e.g., tools, toolholding, workholding)

7.4 Demonstrate safe operation of a lathe [e.g., cutting threads and tapers, OD (outside diameter), ID (inside diameter), chucking, between centers, facing, grooving)]

**STANDARD 8.0 PERFORM BASIC MILLING OPERATIONS**

8.1 Identify major components of a vertical milling machine and their functions

8.2 Explain safe operation of a mill

8.3 Apply proper tooling (e.g., tools, toolholding, workholding)

8.4 Explain use of accessories to increase efficiency when operating a mill (e.g., rotary table, right angle heads, sine plates)

8.5 Demonstrate safe operation of a mill (e.g., squaring blocks, pocket milling, boring holes)

**STANDARD 9.0 EXPLAIN BASIC PRECISION GRINDING OPERATIONS**

9.1 Differentiate among types of precision grinding machines (e.g., surface grinders, cylindrical grinders)

9.2 Identify major components of a grinder and their functions

9.3 Identify types and characteristics of grinding wheels

9.4 Describe precision grinder safety guidelines (e.g., safety glasses, work shoes and clothing, machine guards and covers, locks and tags, wheels and workpieces)

**STANDARD 10.0 DESCRIBE BASIC OPERATIONS OF A CNC MACHINE**

10.1 Compare and contrast Cartesian and polar coordinate systems in CNC programming

10.2 Describe absolute and incremental positioning systems

10.3 Describe the purpose of codes and commands (e.g., G-codes, M-codes, S-commands, F-commands)

10.4 Identify types of machine controls

**STANDARD 11.0 PERFORM BASIC CNC TURNING OPERATIONS**

11.1 Identify parts of CNC turning machines

11.2 Describe the X- and Z-axes used for turning

11.3 Apply turning programming codes

11.4 Apply CNC-specific turning operations and canned cycles

11.5 Perform basic set-up procedures (e.g., workholding, partholding, offsets, toolholders)

11.6 Demonstrate program prove-out procedures

**STANDARD 12.0 PERFORM BASIC CNC MILLING OPERATIONS**

12.1 Identify parts of CNC milling machines

12.2 Describe the X-, Y-, and Z-axes used for milling

12.3 Apply milling programming codes

12.4 Apply CNC-specific milling operations and canned cycles

12.5 Perform basic set-up procedures (e.g., workholding, partholding, offsets, toolholders)

12.6 Demonstrate program prove-out procedures

**STANDARD 13.0 ASSESS ADVANTAGES OF USING COMPUTER AIDED-DESIGN (CAD) AND COMPUTER-AIDED MANUFACTURING (CAM) SOFTWARE**

13.1 Describe basic applications of CAD and CAM

13.2 Explain the use of drawings (e.g., wireframe, solid model, surface)

13.3 Describe the process of toolpath creation and toolpath types

13.4 Explain basic principles of post-processing