

CNC TECHNICIAN (TURNING AND MILLING)



**NOTE: NAME CHANGE COMING IN 2022.
CONTEST WILL BE RENAMED "CNC
PROGRAMMER" FOR THE 2022 COMPETITION
SEASON.**

PURPOSE

The purpose of this contest is to evaluate whether each contestant can independently plan and program jobs and provide instructions for 3-Axis Computer Numerical Control milling machine and turning center operators to execute. In addition, to recognize outstanding students for excellence and professionalism.

First, download and review the General Regulations at: <http://updates.skillsusa.org>.

ELIGIBILITY

Open to active SkillsUSA members enrolled in programs with precision machining automated manufacturing or CNC as the occupational objective.

CLOTHING REQUIREMENT

Class C: Contest Specific — Manufacturing/Construction Khaki Attire

- Official SkillsUSA khaki short-sleeve work shirt and pants.
- Black, brown or tan leather work shoes.

Note: Safety glasses must have side shields or goggles (prescription glasses may be used only if they are equipped with side shields. If not, they must be covered with goggles).

These regulations refer to clothing items that are pictured and described at: www.skillsusastore.org. If you have questions about clothing or other logo items, call 1-888-501-2183.

Note: Contestants must wear their official contest clothing to the contest orientation meeting.

EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
 - a. Computer with pre-installed CAD/Cam software
 - b. Scientific calculator
 - c. Pencils and paper
2. Supplied by the contestant:
 - a. Contestants who choose to use CAD/CAM software outside of what is supplied by the technical committee must bring their own computer and CAD/CAM software.
 - b. Machinery's Handbook (optional)
 - c. All competitors must create a one-page résumé and submit a hard copy to the technical committee chair at orientation. Failure to do so will result in a 10-point penalty.

Note: Check the Contest Guidelines and/or the updates page on the SkillsUSA website: <http://updates.skillsusa.org>.

SCOPE OF THE CONTEST

The contest will be based on and consistent with the National Institute for Metalworking Skills (NIMS), Duties and Standards for Machining Skills, Levels I and II. Information on how to obtain these skill standards may be obtained directly from NIMS by calling 703-352-4971, or on the web at: www.nims-skills.org. Competencies to be tested are determined by the SkillsUSA Championships technical committee.

Knowledge Performance

The contest will include a written test to evaluate a contestant's knowledge of Computer Numeric Control milling and turning programming in such areas as: safety, materials, measuring and test equipment, applied mathematics, engineering drawings, geometric dimensioning and tolerancing, machine technologies, controls navigation and maintenance, mechanical design, cutting tool and holder technology, computer operations and software technologies.

Skill Performance

The contest will assess the ability to write CNC milling and turning programs, interpret prints (including GDT), and measure/gauge parts.

Participants also will demonstrate theoretical knowledge of CNC machine configuration, setup and operations.

Contest Guidelines

1. Each contestant will be given dimensional drawings to program a part on a **CNC program**.
2. Programming
 - a. Write and verify CNC programs without the use of CAM software
 - b. Display complete knowledge of programming (G and M modes)
 - c. Apply the correct use of cutter compensation (G41/G42)
3. Perform mathematical calculations
 - a. Calculate CNC speeds and feeds
 - b. Calculate programming coordinates from the drawing
 - c. Calculate radius tangent points
4. Measuring
 - a. Measure sample parts within 0.005"
5. Communication
 - a. Read and interpret technical prints
 - b. Understand all symbols on technical prints, such as geometric controls, surface-finish symbols, corner-break symbols, etc.
6. Dimensions
This is a contest of programming skills. Contestant parts will only run on machine if programs run without violating safety standards or damaging machines.
7. An overview of a **CNC machine** will be available for orientation before the competition with technicians on hand to help competitors familiarize themselves with the interface.

Standards and Competencies

CNCTECH1.0 —Apply basic machining skills per industry standards as set forth by the SkillsUSA technical committee

- 1.1 Demonstrate the basic math skills essential for CNC turning and milling
- 1.2 Identify and use measuring tools that are basic to CNC turning and machining
- 1.3 Interpret and apply information from prints and drawings
- 1.4 Measure part to nearest +/- .001"
- 1.5 Demonstrate safe working practices on machines

- 1.6 Use various precision measuring tools (i.e., micrometers, calipers, radius gages)
- 1.7 Define and calculate speed and feed rates (SFPM, CCS, IPM, IPR)
- 1.8 Demonstrate knowledge of cutting tools, clamping devices and materials
- 1.9 Perform mathematical calculations that enable solving complex trigonometric, geometric and algebraic problems applicable to CNC machining processes

CNCTECH2.0 —Demonstrate knowledge of CNC programming per industry standards as set forth by the SkillsUSA technical committee

- 2.1 **Manually write and verify CNC programs with and** without the use of CAM software according to print specifications, dimensions and tolerances
- 2.2 Display complete knowledge of programming (G and M codes)
- 2.3 Apply the correct use of cutter compensation (G41/G42)
- 2.4 Demonstrate knowledge of incremental and absolute positioning
- 2.5 Demonstrate knowledge of coordinate system
- 2.6 Determine proper machining sequences from workpiece drawing

CNCM 3.0 — Demonstrate knowledge of CAM programming per industry standards as set forth by the technical committee.

NOTE: NEW for 2021. Demonstration Only. Will not be a scored component in the contest in 2021.

- 3.1 **Create and modify solid models according to print specifications, dimensions and tolerances.**
- 3.2 **Import, align, and position solid modules in CAM programming software environment.**
- 3.3. **Create and post process toolpaths using CAM software.**
- 3.4. **Simulate toolpaths, compare cut part against model and eliminate collisions and gouges using CAM software.**

CNCM 4.0 — Perform mathematical calculations as needed for calculating speeds, feeds, program coordinates, angles, radii and tangent points

- 4.1 Calculate CNC speeds and feeds
- 4.2 Calculate programming coordinates from the drawing
- 4.3 Calculate angles, radii and tangent points

CNCM 5.0 — Communicate and demonstrate an understanding of all symbols on a print

- 5.1 Read and interpret technical prints
- 5.2 Understand all symbols on technical prints, such as geometric tolerances, surface-finish symbols, corner-break symbols, etc.

CNCM 6.0 — Inspect work per industry standards as set forth by the technical committee

- 6.1 Inspect for conformity to print (shape and features of part to drawing)
- 6.2 Inspect for broken edges
- 6.3 Inspect for damage to part (clamp marks, scratches)

Committee Identified Academic Skills

The technical committee has identified that the following academic skills are embedded in this contest.

Math Skills

- Use fractions to solve practical problems.
- Simplify numerical expressions.
- Measure angles.
- Apply transformations (rotate or turn, reflect or flip, translate or slide and dilate or scale) to geometric figures.
- Apply Pythagorean Theorem.
- Solve problems using proportions, formulas and functions.
- Solve problems using trigonometry.
- Solve problems using Cartesian coordinate system.

Science Skills

None Identified

Language Arts Skills

None Identified

State-level academic curriculum specialists identified the following connections to national academic standards.

Math Standards

- Numbers and operations.
- Algebra.
- Geometry.
- Measurement.
- Data analysis and probability.
- Problem solving.
- Reasoning and proof.
- Communication.
- Connections.
- Representation.

Source: NCTM Principles and Standards for School Mathematics. For more information, visit: <http://www.nctm.org>.

Science Standards

- Understands the sources and properties of energy.
- Understands forces and motion.
- Understands the nature of scientific inquiry.

Source: McREL compendium of national science standards. To view and search the compendium, visit: www2.mcrel.org/compendium/browse.asp.

Language Arts Standards

- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information).

Source: IRA/NCTE Standards for the English Language Arts. To view the standards, visit: www.ncte.org/standards.

Connections to National Standards