

# CNC MILLING SPECIALIST



**NOTE: NAME CHANGE COMING IN 2022. CONTEST WILL BE RENAMED "CNC 3-AXIS MILLING PROGRAMMER" FOR THE 2022 COMPETITION SEASON.**

## PURPOSE

The purpose of this contest is to evaluate each contestant's preparation for employment in Computer Numeric Control Milling. 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 REQUIREMENTS

### 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](http://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

### Knowledge Performance

The contest will include a written test to evaluate a contestant's knowledge of Computer Numeric Control milling in such areas as: basic milling skills, knowledge of CNC programming, performing mathematical calculations related to CNC, communication and inspection.

### Skill Performance

This contest will assess the ability to write CNC milling 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 text application**.
2. Programming
  - a. Write and verify CNC programs without the use of CAM software
  - b. Display complete knowledge of programming (G and M codes)
  - 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

CNCM 1.0 — Apply basic machining skills per industry standards as set forth by the technical committee

- 1.1 Demonstrate the basic math skills essential for CNC milling
- 1.2 Identify and use measuring tools that are basic to CNC milling
- 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

CNCM 2.0 — Demonstrate knowledge of CNC programming per industry standards as set forth by the 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 (competitor has

the opportunity to edit any program errors on the machine)

- 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

## Connections to National Standards

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

### Math Standards

- Numbers and operations.
- Algebra.
- Geometry.
- Measurement.
- 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](http://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](http://www.ncte.org/standards).