

# CNC TECHNICIAN (TURNING AND MILLING — VIRTUAL)



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

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## 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.

### Contest Clothing Notes (Apply ONLY to Virtual Competitions):

- Official SkillsUSA Competition Clothing recommended but NOT required.
- Contestant clothing options include the following:
  - Official Competition Clothing.
  - Trade Appropriate Clothing.
  - Professional Dress.
  - Business Casual.
- Clothing must meet industry safety standards.

- No identification of the contestant, school or state is allowed on clothing.
- No offensive, vulgar or inappropriate images or text are allowed on contestants clothing.
- No shorts or sleeveless shirts are allowed.
- Skirts must be at least knee-length.
- Proper Personal Protective Equipment (PPE) must be worn by contestant to meet all state, local and school requirements due to COVID-19.
- Scoring deductions may only be given and/or disqualification of contestant if clothing safety standards are not met.

**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.skillsusa.org](http://www.skillsusa.org). If you have questions about clothing or other logo items, call 1-888-501-2183.

## EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
  - a. Access to a virtual computer with CAM software
  - b. Access to NIMS Testing Center
2. Supplied by the contestant:
  - a. Computer with high-speed internet capability and camera to use applications such as Zoom, Teams, etc. The minimum recommended internet bandwidth speeds for joining Zoom meetings, accessing on-demand curriculum and other online operations is 2.0 Mbps up and down. You can test your current internet speeds by following this link: [www.speedtest.net](http://www.speedtest.net). Allow the page to load and click on GO.
  - b. A secondary camera(s) may be required to provide judges with the ability to view contestants from different angles. Additional camera requirements will be located on the SkillsUSA website at <http://updates.skillsusa.org>.
  - c. A contest Proctor will be required to be on site to assist judges. A local industry expert is preferred to serve as the Proctor and shall not be an individual that has been involved with the training of the contestant(s). The Proctor will serve as the onsite “hands and eyes” for the

judges. Proctor will follow instructions from the judges for safety and operations related to the competition. Proctor may be asked by judges to perform several tasks such as operating a portable camera to show specific components or steps, measure parts, or any task that will provide judges with information needed to assist in accurate scoring of the contestant's work or presentation. However, the Proctor shall not serve as a judge nor have any influence on contestant scores.

- d. The contestant's instructor or advisor shall be on site to observe all competition activities to ensure a safe and healthy competition experience for all participants. That instructor or advisor will not be allowed to interact or interfere with the competitor unless a safety issue arises that requires interaction. Any other support or interaction between the contestant and the instructor/advisor will result in disqualification.
- e. All competitors must create a one-page résumé and submit an electronic copy to the technical committee chair at least seven (7) days in advance of the competition. Failure to do so will result in a 10-point penalty. Instructions for submission of the electronic résumé copy will be provided on the SkillsUSA website at <http://updates.skillsusa.org>.
- f. **Computer with pre-installed CAD/CAM software**
- g. Scientific calculator
- h. Pencils and paper
- i. Machinery's Handbook (optional)

**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](http://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

**Note for Virtual Competitions:** Contestants may not be required to perform all the standards and competencies listed in this section. However, contestants should be prepared to perform components in all areas. Prior to the competition, the technical committee may determine which standards and competencies contestants will be perform for the virtual contests. The technical committee will determine if additional information is needed for contestants prior to the competition. These changes will be posted on the SkillsUSA Championships contest update website at: <http://updates.skillsusa.org>.

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

## 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.
- 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](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).