

# **SkillsUSA**

## **2011 Contest Projects**

### **CNC Milling**

Click the “Print this Section” button above to automatically print the specifications for this contest. Make sure your printer is turned on before pressing the button.



## **CNC MILLING TECHNOLOGY**

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Buses will begin loading for Metropolitan Community College, Lobby 1500, Tuesday, 8:15 a.m. All buses will leave at 8:30 a.m. (Contestants and Advisors Only)

Orientation: Tuesday, 9 a.m.—11:30 a.m., Metropolitan Community College - Business and Technology Campus, 1775 Universal Ave. Kansas City, MO 64120

Instructors' Tutorial: Tuesday, 9 a.m.—11:30 a.m., Metropolitan Community College - Business and Technology Campus, 1775 Universal Ave. Kansas City, MO 64120

Lunch: Tuesday, 11:30 p.m.—12:30 p.m., Metropolitan Community College - Business and Technology Campus, 1775 Universal Ave. Kansas City, MO 64120

Meeting: Tuesday, 12:30 p.m. - 2:30 p.m., Metropolitan Community College - Business and Technology Campus, 1775 Universal Ave. Kansas City, MO 64120

Contest: Wednesday, 8 a.m. - Noon, Contest Area, Bartle Hall

Debriefing: immediately following competition, Contest Area, Bartle Hall

# CNC MILLING



## PURPOSE

To evaluate each contestant's preparation for employment in Computer Numeric Control Milling and to recognize outstanding students for excellence and professionalism in the CNC milling field.

First, refer to General Regulations, Page 9.

## CLOTHING REQUIREMENT

Official SkillsUSA khaki work shirt and pants, black or brown leather work shoes, and safety glasses with side shields or goggles. (Prescription glasses can 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 800-401-1560 or 703-956-3723.

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

## ELIGIBILITY

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

## EQUIPMENT AND MATERIALS:

1. Supplied by the technical committee:
  - a. Haas Programmable Controllers
2. Supplied by the contestant:
  - a. Nonprogrammable calculator
  - b. Pencils and paper
  - c. Machinery's Handbook (optional)
  - d. All competitors must create a one-page résumé using a word processor and submit the résumé electronically at: [www.skillsusa.net/newresume](http://www.skillsusa.net/newresume). Check the Web site for further instructions.

**Note:** Your contest may also require a hard copy of your résumé as part of the actual contest. Check the Contest Guidelines and/or the updates page on the SkillsUSA Web site: [www.skillsusa.org/compete/updates.shtml](http://www.skillsusa.org/compete/updates.shtml)

## SCOPE OF THE CONTEST

### Knowledge Performance

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

### Skill Performance

The contest will assess the ability to write the CNC program for a part drawing and materials, determine tool offsets, setting up the machine and producing a part.

### Contest Guidelines

1. Each contestant will be given a dimensional drawing and materials to produce a part on a CNC mill.
2. Programming
  - a. Write and verify CNC program without the use of CAM software (competitor has the opportunity to correct any program errors on the machine)
  - b. Display complete knowledge of DIN/ISO programming (G and M codes)
  - c. Apply the correct use of cutter compensation (G41/G42)
  - d. Adjust speeds and feeds as needed
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 test part to the nearest 0.001"
5. Communication
  - a. Read and interpret technical blueprints
  - b. Understand all symbols on technical blueprints, such as geometric

tolerances, surface-finish symbols, corner-break symbols, etc.

6. Dimensions

This is an objective scoring. Scores will only be granted if dimension is in compliance with the print. The score for each dimension will either be full points or zero points.

7. The CNC will be available for orientation before the competition with technicians on hand to help competitors and their advisors familiarize themselves with the equipment.

## **Standards and Competencies**

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

- 1.1 Demonstrate the basic math skills essential to CNC machining
- 1.2 Identify and use measuring tools that are basic to CNC machining
- 1.3 Interpret and apply information from prints and drawings
- 1.4 Measure part to nearest  $\pm .001$ "
- 1.5 Demonstrate safe working practices on machines
- 1.6 Use various precision measuring tools (i.e., micrometers, calipers, radius gages)
- 1.7 Use correct filling techniques and appropriate terminology
- 1.8 Define and calculate speed and feed rates (SFPM, CCS, IPM, IPR)
- 1.9 Demonstrate knowledge of cutting tools, clamping devices and materials
- 1.10 Perform mathematical calculations that enable the solving of 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 SkillsUSA technical committee**

- 2.1 Manually write and verify the CNC program 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 DIN/ISO 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 work piece drawing
- 2.7 Adjust speeds and feed as needed

### **CNCM 3.0 — Perform mathematical calculations as needed for calculating speeds, feeds, program coordinates, angles, radii and tangent points**

- 3.1 Calculate CNC speeds and feeds

- 3.2 Calculate programming coordinates from the drawing
- 3.3 Calculate angles, radii and tangent points

**CNCM 4.0 — Communicate and demonstrate an understanding of all symbols on a blueprint**

- 4.1 Read and interpret technical blueprints
- 4.2 Understand all symbols on technical blueprints, such as geometric tolerances, surface-finish symbols, corner-break symbols, etc.

**CNCM 5.0 — Inspect work per industry standards as set forth by the SkillsUSA technical committee**

- 5.1 Inspect for conformity to print (shape and features of part to drawing)
- 5.2 Inspect for broken edges
- 5.3 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**

- Use knowledge of speed, velocity and acceleration

**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. To view high school standards, visit: [standards.nctm.org/document/chapter7/index.htm](http://standards.nctm.org/document/chapter7/index.htm). Select "Standards" from menu.

**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: [www.mcrel.org/standards-benchmarks/](http://www.mcrel.org/standards-benchmarks/).

**Language Arts Standards**

- Students apply a wide range of strategies to comprehend, interpret, evaluate and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics)
- 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 employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes
- Students conduct research on issues and interests by generating ideas and questions and by posing problems. They gather, evaluate and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience
- 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).

## **CNC TURNING TECHNOLOGY**

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Meeting: Tuesday, 12:30 p.m. - 5 p.m., Metropolitan Community College - Business and Technology Campus, 1775 Universal Ave. Kansas City, MO 64120

Contest: Wednesday, 12:30 p.m., Contest Area, Bartle Hall

Debriefing: immediately following competition, Contest Area, Bartle Hall



# CNC TURNING



## PURPOSE

To evaluate each contestant's preparation for employment in Computer Numeric Control Turning and to recognize outstanding students for excellence and professionalism in the CNC turning field.

First, refer to General Regulations, Page 9.

## CLOTHING REQUIREMENT

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### Skill Performance

The contest will assess the ability to write the CNC program for a part drawing and materials, determine tool offsets, setting up the machine and producing a part.

### Contest Guidelines

1. Each contestant will be given a dimensional drawing and materials to produce a part on a CNC lathe.
2. Programming
  - a. Write and verify CNC program without the use of CAM software (competitor has the opportunity to correct any program errors on the machine)
  - b. Display complete knowledge of DIN/ISO programming (G and M codes)
  - c. Apply the correct use of cutter compensation (G41/G42)
  - d. Adjust speeds and feeds as needed
3. Perform mathematical calculations
  - a. Calculate CNC speeds and feeds
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- 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
- 2.7 Adjust speeds and feed as needed

### **CNCT 3.0 — Perform mathematical calculations as needed for calculating speeds, feeds, program coordinates, angles, radii and tangent points**

- 3.1 Calculate CNC speeds and feeds

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**Committee Identified Academic Skills**

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**Science Skills**

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**Language Arts Skills**

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**Connections to National Standards**

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**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: [www.mcrel.org/standards-benchmarks/](http://www.mcrel.org/standards-benchmarks/).

**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
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- 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.  
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**Haas Automation, Inc.**

**Skills USA  
CNC Milling 2011**

**CNC Milling Part Score Sheet**

**Contestant Number** \_\_\_\_\_

	<b>Points Poss.</b>	<b>Points Earned</b>
1. Face mill top of part .....	20 pts .....	_____
2. 2.5 Square Feature .....	40 pts .....	_____
3. .400 Wide Slots (4) .....	50 pts .....	_____
4. .400" x 2.200" Slot .....	50 pts .....	_____
5. .031 x 45 deg (2) .....	20 pts .....	_____
6. ¼"-20 x .425" (4) .....	30 pts .....	_____
7. ¼"-20 x .300" (4) .....	30 pts .....	_____
8. .201" Hole Thru with .250" x .500" C'Bore(4) ..	40 pts .....	_____
9. Spindle on .....	20 pts .....	_____
10. Rotation correct .....	20 pts .....	_____
11. Speeds and feeds .....	30 pts .....	_____
12. Following instructions.....	30 pts .....	_____
13. Tool changes .....	20 pts .....	_____

**Total Points Available: 400 points**

**Total Points Earned:** \_\_\_\_\_

**Scored by:** \_\_\_\_\_

**Run on Mill by:** \_\_\_\_\_