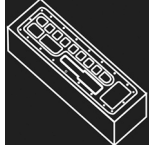


# AUTOMATED MANUFACTURING TECHNOLOGY



## PURPOSE

To evaluate each contestant's preparation for employment in automated manufacturing and the team approach to problem-solving work environment. To recognize outstanding students for excellence and professionalism in the field of automated manufacturing technology.

First, download and review the General Regulations at: [updates.skillsusa.org](http://updates.skillsusa.org).

## CLOTHING REQUIREMENT

Official khaki work shirt and pants; black, brown or tan leather work shoes; and safety glasses, clear lenses 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 a team of three active SkillsUSA members enrolled in programs with precision machining, automated manufacturing, or CAD/CAM or CNC as the occupational objective.

## EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
  - a. CNC machining center with:
    1. Machinist vise
    2. Hold-downs and clamps
    3. Tool holders
    4. End mills

- b. Part(s) design
  - c. Competition packet
  - d. Pencils
  - e. Blank diskettes or USB thumb drives
  - f. Material for machining
2. Supplied by the contestants:
    - a. 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:** 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 website at [updates.skillsusa.org](http://updates.skillsusa.org).

- b. Two computers:
  1. One computer loaded with CAD software for CAD program
  2. One computer loaded with software for CAM program. This computer *must* have an open LAN Port (Ethernet connection) and Windows XP SP3/Vista/7-32 or 64bit. (Must have administrator privilege to the computer to configure the address of the LAN Port.)
- c. Licensed versions of the above CAD and CAM software *must* be available at start of the orientation/practice session on Tuesday for loading onto the technical committee's computer(s).
- d. One 6" dial or digital vernier caliper
- e. One dial indicator. Dial indicator must have  $\frac{3}{8}$ " holding shank to fit into tool holder supplied by the technical committee.
- f. One calculator
- g. One pair of  $\frac{3}{4}$ " and/or 1" parallels (complete set suggested)
- h. One soft-face hammer
- i. One 6" or 12" steel rule
- j. Safety glasses with clear lenses
- k. Each team must provide a USB memory device
- l. Each team must provide a machinist handbook
- m. Each team can provide appropriate sized end mills

**Note:** Only the above listed items will be allowed in the contest area during the competition.

## SCOPE OF THE CONTEST

The contest will test the ability to perform, exhibit and compile skills and knowledge from the following list of competencies determined by the SkillsUSA Automated Manufacturing Technology technical committee. Committee membership includes intelitek Inc., MasterCam/CNC Software, CG Tech, Verisurf, Learning Labs Inc.

### Knowledge Performance

The contest includes a written knowledge test assessing general knowledge related to automated manufacturing technology. Written portions may also exist during the skills portion of the contest. The exam is an evaluation that measures ability to solve various solutions to the process that is involved in quoting a job in a rapid prototyping environment.

### Skill Performance

The contest includes a team skill performance for three students and evaluates teams for employment in integrated manufacturing technology fields of computer-aided drafting/design (CAD), computer-aided manufacturing (CAM) and computer numerical controlled machining (CNC).

### Contest Guidelines

1. All equipment provided by the technical committee will be in place and set up on the Monday before the competition begins. On Tuesday all teams assemble to compete in a full virtual contest. Full contest points available in CAD/CAM/CNC. Teams must bring their computers and above-listed equipment on Tuesday. Tampering with or removing *any* of the equipment provided during the days of the competition is grounds for disqualification.
2. Virtual contest results will determine the top 10 secondary and the 10 post-secondary teams to compete with a new challenge using the hardware. A short practice period will take place on Wednesday and Thursday morning before the competition. Advisors are

recommended to stay for the practice period but must leave during the competition.

3. All team members and advisors are required to attend a debriefing session on Friday morning.
4. Teams must be comprised of three members.
5. The teams will be presented with dimensioned drawing(s) of a part(s) to prototype during the contest.
6. The CAD operators construct the part geometry; the CAM operator generates the tool paths; and the CNC operator sets up and machines the part. When a team member has spare time, he or she will help others in the group.
7. One person should not dominate a team by doing the CAD drawing and the CAM toolpath and running the CNC machine while using the other members simply as support. The contest is designed to promote creativity in organization of production responsibility.
8. All group members are responsible for double-checking each other's work and quality control.
9. When the teams finish machining the prototype part(s), they will present it to the client (judges). At this time, they will be presented with a second drawing(s) as either a change order or as an additional part(s).
10. Each team will be issued a contest guideline packet. Included in the packet will be all the necessary information and forms to complete the project. These forms will not be highly specific but will coach the teams.
11. All packets, forms and drawings must be turned in to the judges at the end of the competition.

## Standards and Competencies

### **MFG 1.0 — Perform mathematical and measurement calculations used in automated manufacturing situations**

- 1.1 Measure work pieces to the nearest .001 inch
- 1.2 Calculate CNC speed and feeds
- 1.3 Calculate stock utilization and setup
- 1.4 Calculate tolerances
- 1.5 Calculate various variables to estimate costs and material usage written evaluation

### **MFG 2.0 — Design, sketch and plan machine work to U.S. National CAD Standards**

- 2.1 Transfer information from provided drawing to CAD drawing
- 2.2 Create CAD file for manufacturing using standard CAD terminology and standard practice
- 2.3 Initiate manufacturing documentation process
- 2.4 Generate a process plan
- 2.5 Plot a CAD file
- 2.6 Export a CAD file
- 2.7 Process Engineering Change Orders (ECO)
- 2.8 Repeat steps as necessary to accommodate ECO

### **MFG 3.0 — Create a toolpath (CAM file) and the CNC code to related duty tasks of the National Institute for Metalworking Skills (NIMS) Duties and Standards for Machining Skills, Level I**

- 3.1 Create process plan (job plan)
- 3.2 Read-in CAD export file
- 3.3 Create toolpath
- 3.4 Verify toolpath
- 3.5 Create CNC code
- 3.6 Send CNC code to machine tool
- 3.7 Process Engineering Change Orders (ECO)
- 3.8 Repeat steps as necessary to accommodate ECO

### **MFG 4.0 — Perform CNC machining functions given a scenario to the related duty tasks of the National Institute for Metalworking Skills (NIMS) Duties and Standards for Machining Skills, Level I**

- 4.1 Verify CNC file existence
- 4.2 Verify toolpath

- 4.3 Set up fixture(s) and tooling on machine
- 4.4 Set up part(s) on mill
- 4.5 Set all offsets and tooling
- 4.6 Adjust machine speeds and feeds as needed
- 4.7 Complete an in-process quality assurance process
- 4.8 Perform tool changes
- 4.9 Perform multiple machining operations in one setup
- 4.10 Demonstrate proficiency in using a CNC machine tool and produce part(s)
- 4.11 Use Total Quality Management practices to verify process and part
- 4.12 Process Engineering Change Orders (ECO)
- 4.13 Repeat steps as necessary to accommodate ECO

### **MFG 5.0 — Perform and inspect part(s) using a Total Quality Management process**

- 5.1 Verify part(s) to provided standards
- 5.2 Verify part(s) to ECO standards
- 5.3 Document process of verification and inspection

### **MFG 6.0 — Demonstrate safety practices in a working situation to the related duty tasks of the National Institute for Metalworking Skills (NIMS) Duties and Standards for Machining Skills-Level I**

- 6.1 Carry out assigned responsibilities while adhering to safe practices in accordance with OSHA requirements and guidelines
- 6.2 Document safety activities as required
- 6.3 Demonstrate safety procedures in running and programming a CNC machine tool

### **MFG 7.0 — Provide an accurate quotation given an automated manufacturing technology simulated scenario**

- 7.1 Solve various solutions to the process that are involved in quoting a job in a rapid prototyping environment

## 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
- Use proportions and ratios to solve practical problems
- Use scientific notation
- Solve single variable algebraic expressions
- Solve multiple variable algebraic expressions
- Measure angles
- Find surface area and perimeter of two-dimensional objects
- Find volume and surface area of three-dimensional objects
- Construct three-dimensional models
- Apply Pythagorean Theorem
- Solve problems using proportions, formulas and functions
- Find slope of a line
- Solve practical problems involving complementary, supplementary and congruent angles
- Solve problems involving symmetry and transformation

### Science Skills

- Use knowledge of physical properties (shape, density, solubility, odor, melting point, boiling point, color)

### Language Arts Skills

- Provide information in conversations and in group discussions
- Demonstrate comprehension of a variety of informational texts
- Organize and synthesize information for use in written and oral presentations
- Demonstrate knowledge of appropriate reference materials

## Connections to National Standards

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

### Math Standards

- Numbers and operations
- Geometry
- Measurement
- Data Analysis and probability
- Problem solving
- Communication
- Connections
- Representation

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

### Science Standards

- Understands the structure and properties of matter
- Understands the sources and properties of energy
- Understands the nature of scientific inquiry

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

### 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 apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language and genre to create, critique, and discuss print and nonprint texts

- 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 participate as knowledgeable, reflective, creative and critical members of a variety of literacy communities
- 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).