AUTOMATED MANUFACTURING TECHNOLOGY
VIRTUAL COMPETITION

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: http://updates.skillsusa.org.

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.

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:
  o Official Competition Clothing.
  o Trade Appropriate Clothing.
  o Professional Dress.
  o Business Casual.
- Clothing must meet industry safety standards.

Scoring deductions may only be given and/or disqualification of contestant if clothing safety standards are not met.

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

EQUIPMENT AND MATERIALS
1. Supplied by the technical committee:
   a. Part(s) design
   b. Competition packet
   c. Ren board material for machining
   d. 2 USB memory devices that will be sent to the judges. 1 to record activity that was done on the laptops. (CAD/CAM), and the other, to record activity next to the mill.
   e. Screen Capture software which will record the whole session of CAD/CAM operation. (on both laptops)

2. Supplied by the contestants:
   a. Covid 19 Protective equipment
   b. School's! (any) 3 axes VMC CNC machining center with:
      1. Machinist vise
      2. Hold-downs and clamps
      3. Tool holders

One small toolbox holding the following items:
1. Dial indicator that fits into tool holder.
2. One set of (multiple heights) parallels (complete set soft-jaw parallel pliers
3. One soft-face hammer
4. One six-inch dial, or digital Vernier calipers
5. One calculator
6. One 6” or 12” steel ruler
7. Safety glasses with clear lenses
9. Appropriately sized end mills (see Tools section.)
10. Pencils + erasers

c. computer:
   1. One laptop computer loaded with CAD
   2. One laptop computer with CAM software.

d. Video recording device (camera) with audio and video placed in a strategic place in the room showing as best you see fit, the machine and surrounding.

Note: The recording device can be moved during the session from place to place as needed to show various activities on the mill as necessary but NOT to be turned off, or edited in any way.
Tools:

(Description includes MSC numbers)

**End Mills**
- 3/8” end mill 01710243 3/8” * 3/8” * 9/32”
- 1/4” end mill 01710169 1/4” * 1/2” * 2 5/32”
- 1/4” end mill 01748011 1/4” * 1/2” * 3 1/16”
- 1/8” end mill 01710086 1/8” * 1/4” * 3/32” * 2 5/32”

**Ball Mills**
- 1/8” ball mill 01760081 1/8” * 1/32” * 3/32”

**Conical Tooling**
- 90 Degree Conical 00199364 1/4” * 2 1/2”
- 60 Degree Conical 01787084 1/8” * 1 1/2”

Edge finder

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

e. All competitors must create a one-page résumé and submit a software or hard copy to the technical committee chair at orientation. Failure to do so will result in a 10-point penalty.

**Timeline for virtual contest**

**Prior to contest** – Receive package with contest details and materials.
- **June 1** – Orientation meeting (Zoom)
- **June 2-3** – Questions and Clarifications
- **June 8** – Secondary School Competition.
- **June 9** – Post-secondary Competition.
- **June 10** – Makeup (optional) date
- **June 24** - Winner announced (By SkillsUSA)
**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 Intellitek Inc., MasterCam/CNC Software, CG Tech, Verisurf, Learning Labs Inc.

**Knowledge Performance**

The contest includes a written 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 shipped to the teams prior to competition orientation day.
2. Teams must confirm and provide detail of the equipment they have for the competition prior to the orientation session.
3. Technical committee will set up an online orientation session for all teams and schedule with the teams the time and location where they will perform the competition. Advisors must nominate a proctor to adjudicate the competition at the location and attest to the proper performance of the competition per these guidelines.
4. Teams must supply their computers and above-listed equipment.
5. Tampering with or removing any of the equipment provided during the competition is grounds for disqualification.
6. Advisors are recommended to assist with the competition setup but must not intervene during the competition.
7. The technical committee will be available remotely. Team members and advisors can request a debriefing session prior to the contest.
8. Teams must be comprised of three members.
9. Competition time is set for 4 hours. By then the part(s) must be produced.
10. An additional ½ hour will be given for written exercise + transferring the (unedited) recorded data to the USB memory cards by the advisors. (TBD – SkillsUSA may be able to offer video file upload service)
11. The teams will be presented with dimensioned drawing(s) of a part(s) to prototype during the contest.
12. 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.
13. 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.
14. All group members are responsible for double-checking each other’s work and quality control.
15. When the teams finish machining the prototype part(s), they will present it to the proctor who will seal it in a marked envelope. or, they will be presented with a second drawing(s) as either a change order or as an additional part(s).
16. 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.
17. All packets, forms and drawings must be returned to the proctor at the end of the competition.
18. Finished product(s) will be sealed in an envelope and placed in the packet together with the completed forms, and 2 USB memory devices, and sent to the judges by mail to be evaluated.
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

**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)
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

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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.