PRECISION MACHINING TECHNOLOGY

Purpose

To evaluate each contestant's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of precision machining technology.

Clothing Requirements

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. 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 technology as the occupational objective.

Equipment & Materials

1. Supplied by the technical committee:
    - All necessary machines, work holding devices and work-piece materials
    - All necessary reference material, charts and work instructions to be used by contestants and/or judges
2. Required items supplied by the contestant:
    - Safety Glasses
    - Precision Measuring Tools (0-6" Calipers, 0-1" & 1-2" OD micormeters, etc.)
    - Dial Indicator with base
    - Edge finder
    - Small Container of tapping / cutting fluid
    - A set of Standard Allen Wrenches
    - A flat file or other suitable deburring tools
    - Calculators are not required, but are allowed.

Contestants 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: www.skillsusa.org/compete/updates.shtml

Scope of the Contest

The contest will be based on and consistent with the Machining and Manufacturing Technology Program Alignment Level 3 – Kansas Board of Regents – CIP 48.0501, 2022.

Knowledge Performance

The contest will include written knowledge assessments that require the understanding of precision machining technology-related knowledge (theory). Wherever the words "demonstrate knowledge of" are used in the contest standards and competencies, the technical committee could include any of that subject matter in the written theory test that is administered on the Wednesday morning prior to the hands-on skill competition

Skills Performance

The contest will include a hands-on skill competition. Each contestant in the SkillsUSA Championships is expected to demonstrate competency in manual machining performance skills. This includes: applying fundamental computational skills; interpreting engineering drawings, technical data and other graphics; applying physical science principles; setup and operation of manual metalworking machines; industrial safety and hygiene requirements.

Contest Guidelines

1. It should be understood that some of the standards and competencies beginning with the statement "demonstrate knowledge of" are also a normal part of the hands-on portion, such as reading engineering drawings, making calculations, etc.

2. Each year, the technical committee will conduct an interview with each contestant as part of the contest.

Standards and Competencies:

Safety

- Define and demonstrate an understanding of safety codes and rules used to safeguard self, other workers and the equipment and tooling
- Demonstrate safe work habits when performing any of the machining, bench work, material handling or measurement competencies listed for this precision machining competition
- Read, understand and follow a Material Safety Data Sheet (MSDS)

Professonalism & Industrial Knowledge

- Respond to general questions that typically would be part of an employment-type interview
- In an interview situation, explain a technical issue related to precision machining technology such as sequence of operations, one piece vs. production setups; related non-machining operations such as heat treating, deburring, material handling, etc.
- Analyze a specific machining-related problem and then make an oral report
- Demonstrate poise, confidence and knowledge of the subject, oral communication skills, and the ability to react to new situations and to make sound decisions in an interview situation
- Read, interpret, conceptualize and be able to report (orally, handwritten note or paper document) common manufacturing processes related to precision machining and relate them to features of a part or engineering drawing of a part
- Orally explain machining procedures and/or practices
- Describe the physical and/or metallurgical characteristics of cast irons, steels, nonferrous metals, composites, plastics and other materials that could be machined
- Discuss the effects of heat-treating and coating processes on materials used for work pieces and/or cutting tools
- Apply good hygiene in the use of cutting fluids typically used for machining
- Identify and discuss the application of various types of mills & lathes and the advantages of each
- Demonstrate knowledge of the general classes of fits
- Identify and explain the components that boost machine performance and cut costs
- Discuss the variables that could cause machining problems such as tool/work overhang, tool grade/geometry, machine condition/power, cutting fluid, shape of work, chip breakers, material hardness, etc.
- Demonstrate knowledge of cutter types, styles and materials
- Identify which manufacturing processes are capable of producing specific surface finishes economically
- Awareness of new or emerging precision machining technologies
- Discuss what chip shape and color can tell you about optimum cutting

Applied Mathematics:

- Apply basic arithmetic skills to solve problems
- Apply functional algebra, geometry, trigonometry to solve problems
- Use formulas, handbook tables, charts and technical reports to solve problems or make decisions

- Calculate speeds, feeds, depth of cuts for tooling & materials provided
- Calculate the correct amount of stock to be left on a part when doing roughing operations
- Calculate center offsets for taper turning and compound slide settings for angle turning

Blueprint Reading:

- Interpret single or multiple-page engineering drawings or sketches (inch or metric) to determine features to be machined
- Translate geometric tolerance symbols and other part specifications contained within feature control symbols used in machining and measurement (ASME Y14.5-1982)
- Demonstrate knowledge and understanding of projection theory and other engineering drawing principles
- Produce an appropriate freehand orthographic, oblique, isometric or perspective sketch of a part to be machined
- Using current industrial engineering drawings and work pieces, make precision measurements for specific features
- Select and use the proper measuring device (U.S. customary or metric) for the feature to be measured

Turning:

- Perform basic turning operations: work between centers, three- or four-jaw chuck work, collet work, center drilling, straight turning, shoulder and end facing, chamfering, radius turning, grooving, cutting off, drilling, boring, reaming, taper and angle turning, roughing (leaving grind stock) and finishing, knurling, filing and polishing, and internal and external thread chasing, etc.
- From the cutting tools available, select the best tool for the operation and mount properly
- Set up machine for single or multiple part production, which includes setting machine stops, proper speeds, feeds and depth of cuts for the material to be machined and the type of cutting tools available
- Demonstrate the ability to hold inch and/or metric dimensional, geometric and surface finish tolerance requirements
- Prepare machine and select proper RPM for the cutting tool being used
- Obtain and hold surface finish tolerances
- Make the appropriate calculations to set up the measuring device or to mathematically determine location of part features
- Deburr work pieces after machining or hand operations

Milling:

- Select the proper work-holding device and set it up correctly to withstand the cutting forces present
- Make table setups, using straps and clamps, vise setups, V-block setups and indexing devices
- Select the proper cutting tool holding device; mount it properly; determine correct direction of rotation; determine when a cutter is dull; be able to change inserts
- Perform basic milling operations that include plain, face, end, side, form, angle, grooving, keyway/key seat and cut- off
- Mount work piece in work-holding device
- Select the proper cutting tool for the job
- Perform drilling, countersinking, counter- boring, spot-facing, reaming and tapping operations
- Obtain and hold close inch or metric dimensional tolerances
- Make the appropriate calculations to set up the measuring device or to mathematically determine location of part features
- Deburr work pieces after machining or hand operations

Inspection & Metrology:

- Explain the reason for using calibrated measuring tools
- Be able to effectively use common precision machining measuring tools (U.S. customary or metric) such as steel rulers, combination square sets, depth gages, spring calipers, outside/inside/depth micrometers, venire/dial/digital calipers, venire/digital height gage, protractor, mechanical/electronic indicators, go/no-go gages; comparators; surface plates, angle plates, parallel blocks, inspection centers, sine bars/plates, and profilometer/surface finish comparison devices
- Physically measure for: parallelism; squareness; roundness; concentricity; axial run-out; flatness; hole location/size; angles; tapers; threads; lengths; depths, etc.
- Selection of the most suitable measuring tool for the tolerance specified
- Testing for and maintaining machine geometries to manufacturer specifications

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

- Simplify numerical expressions
- Measure angles
- Find surface area and perimeter of two- dimensional objects
- Apply transformations (rotate or turn, reflect or flip, translate or slide, and dilate or scale) to geometric figures
- Construct three-dimensional models
- Make comparisons, predictions and inferences using graphs and charts
- Find slope of a line
- Solve practical problems involving complementary, supplementary and congruent angles
- Solve problems involving symmetry and transformation
- Use measures of interior and exterior angles of polygons to solve problems
- Find arc length and the area of a sector

Science Skills

- Use knowledge of the particle theory of matter
- Describe and recognize solids, liquids and gases
- Describe characteristics of types of matter based on physical and chemical properties
- Use knowledge of physical properties (shape, density, solubility, odor, melting point, boiling point, color)
- Use knowledge of chemical properties (acidity, basicity, combustibility, reactivity)
- Use knowledge of classification of elements as metals, metalloids, and nonmetals
- Describe phases of matter
- Describe and identify physical changes to matter
- Predict chemical changes to matter (types of reactions, reactants, and products; and balanced equations)
- Use knowledge of potential and kinetic energy
- Use knowledge of mechanical, chemical and electrical energy
- Use knowledge of heat, light and sound energy
- Use knowledge of temperature scales, heat and heat transfer

Science Standards

- Understands the structure and properties of matter
- 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.

Language Arts Standards

- Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works
- 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 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 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 studies

Source: IRA/NCTE Standards for the English Language Arts. To view the standards, visit: www.ncte.org/standards.

PRECISION MACHINING TECHNOLOGY SCORECARD

ITEMS EVALUATED	POSSIBLE POINTS
Manual Engine Lathe Operation	250
Manual Milling Machine Operation	250

Process Control/Precision Measurement	250
Written Test	150
Professional Development Oral Interview	100
SkillsUSA Professional Assessment	25
Resume Penalty	0 or -10 only
Clothing Penalty	0 to -50
TOTAL POSSIBLE POINTS	1,025