

# WELDING



## PURPOSE

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

First, download and review the General Regulations at: <http://updates.skillsusa.org>.

## ELIGIBILITY

Open to active SkillsUSA members enrolled in programs with welding as the occupational objective.

## CLOTHING REQUIREMENT

- Official SkillsUSA khaki work shirt and pants (both the shirt and pants must be 100-percent cotton).
- Black, brown or tan leather high-top work boots.

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

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

## EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
  - a. All necessary welding equipment, filler metals and base materials.
  - b. All instructions, Welding Procedure Specifications (WPS) and prints.
  - c. The technical committee will provide on the SkillsUSA website a preview of the current year's national contest

- a. consisting of cut lists and/or partial prints no later than April 15.
2. Supplied by the contestant:
    - a. Hearing and/or ear protection.
    - b. Welding gloves — full length (gauntlet) for SMAW, GMAW and FCAW.
    - c. Welding gloves — appropriate for GTAW.
    - d. Welding cap/beanie.
    - e. Welding helmet with appropriate filter plate/lens and protective cover lens for tacking and welding; auto darkening filter plate/lens permissible. Spare filter plate and cover lens.
    - f. Cutting goggles — with shade 5 lens/cover lens for OFC/PAC; helmet with shade 5 capability permissible; faceshield head gear with shade 5 permissible. Spare filter and cover lens.
    - g. Pocket calculator.
    - h. Fillet weld gauge — standard set.
    - i. Lead pencil and/or ballpoint pen.
    - j. Soap stone with or without holder.
    - k. Scribe without magnet.
    - l. Compass.
    - m. Protractor.
    - n. Combination square set.
    - o. 10-foot (3.1 meters) minimum steel tape measure.
    - p. 16-ounce (.45 kilogram) ball peen hammer.
    - q. Center punch.
    - r. Cold chisel.
    - s. 11R or 10-inch (254 millimeters) vise grips.
    - t. 6-inch (152 millimeters) side cutting pliers or diagonal cutting pliers.
    - u. 6-inch (152 millimeters) needle nose pliers – welpers permissible.
    - v. Chipping hammer.
    - w. Carbon steel wire brush.
    - x. Stainless steel wire brush.
    - y. Friction lighter (striker) and tip cleaner
    - z. 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 <http://updates.skillsusa.org/>.

## SCOPE OF THE CONTEST

The scope of the contest is defined by industry standards as identified by the American Welding Society, Emmert Welding and Manufacturing Co. Inc., Honeywell Engines and Systems, ITW Hobart Brothers Co., The Lincoln Electric Co., Matheson Tri-Gas Inc., Miller Electric Co. Inc. and the International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers. All drawings, welding symbols and welding terms conform to the latest edition of the American Welding Society (AWS) standards.

### Knowledge Performance

The contest includes a written knowledge exam that assesses welding and associated topics including safety, math for welders and print reading. It also includes a brief oral interview comprised of several questions before a group of technical committee members.

### Skill Performance

The skill performance assessment may include: steel project(s), aluminum project(s), stainless steel project(s) in various positions using a variety of filler metals. Contestants will be involved in a series of stations testing various aspects of welding.

### Contest Guidelines

1. Contestants must correctly use the welding equipment during the contest. The contest chairman and/or any technical committee member may stop a contestant at any section of the contest if they deem a contestant's manner to be hazardous to either themselves or others. Such stoppage shall be documented as a warning. If the contestant is warned a second time, he or she will be disqualified for that section of the contest.
2. As soon as the contestants enter the contest area — as defined by the surrounding tables — no communication shall occur between the contestants or between the contestants and anyone else, except as directed by the contest chair, technical committee members or judges. Any such communication will result in the contestant being disqualified from that section of the contest. If any taped lines on the floor

within the contest area are present, all contestants shall stay within the taped lines. Failure to stay within the taped lines, except for being escorted to the restroom, will result in penalties as follows: First violation, disqualification of the nearest segment of the contest. Second violation, disqualification as a contest participant.

3. Time limits will be established on the contest procedure sheets for all segments of the test.
4. Evaluation of the completed project will be judged visually. Nondestructive and/or destructive tests may be used to complete the project evaluation.
5. Welding and cutting instructions will be provided to the contestants and specified on the Welding Procedure Specifications (WPS) and prints provided in the welding booths and near cutting stations.
6. Welding equipment used in the contest may be obtained from a variety of manufacturers and may include transformers, rectifiers and/or inverters.
7. Filler metals will be detailed on the Welding Procedure Specification (WPS) and/or the prints.
8. Welds will be evaluated visually using a rating system as established by the SkillsUSA technical committee. Nondestructive and/or destructive tests may be used to complete the project evaluation.
9. Final judging of the welded projects will be evaluated according to the difficulty of the assigned task and by using the following visual inspection criteria: dimensional accuracy, including distortion; conformity to drawing requirements, including determination of whether all welds have been completed and whether the finished welds conform to the required size and contour; and visual examination of the welds for cracks, undercut, overlap, crater fill, spatter, arc strikes, porosity, convexity and reinforcement.
10. Print assembly tolerance will be  $\pm 1/16$ " unless otherwise noted.
11. If no print assembly dimensions are given to orient any project part, the part is to be approximately located based on the print's isometric view.

## Standards and Competencies

### W 1.0 — Identify safety standards and demonstrate safety and health practices of welders in accordance to ANSI Z49.

- 1.1 Demonstrate proper use of equipment used for protection of personnel.
- 1.2 Demonstrate proper use and inspection of equipment used for ventilation.
- 1.3 Demonstrate Hot Work operation.
- 1.4 Demonstrate working in confined spaces properly.
- 1.5 Understand precautionary labeling.

### W 2.0 — Demonstrate an understanding of practical measurement.

- 2.1 Identify basic metal-working tools used in measuring.
- 2.2 Use visual measuring tools to accuracy of  $\frac{1}{32}$ ".
- 2.3 Employ the components of a combination square set.
- 2.4 Use layout and marking tools as required.

### W 3.0 — Read and interpret prints.

- 3.1 Apply information found in the information block of the drawing.
- 3.2 Identify the basic views used on prints including assembly, detail and fit-up drawings.
- 3.3 Identify common types of lines, abbreviations and symbols in accordance with national drawing standards (ANSI).
- 3.4 Identify basic welding symbols and components of a symbol (such as arrow, reference line, tail, size, length and location) in accordance with the current national welding symbol standard AWS A 2.4, current edition.

### W 4.0 — Produce welds using a Shielded Metal Arc Welding (SMAW) process to AWS QC10 standards.

- 4.1 Demonstrate safety procedures for SMAW.
- 4.2 Demonstrate ability to correctly set up SMAW power sources, related welding equipment and do basic process and equipment troubleshooting for welding of carbon steel and/or stainless steel.
- 4.3 Select correct type of electrode based on carbon steel and/or stainless steel plate ( $\frac{1}{4}$ " to  $\frac{1}{2}$ " thickness).

- 4.4 Prepare carbon steel and/or stainless steel for welding.

### W 5.0 — Produce welds using a Gas Metal Arc Welding (GMAW) process to AWS QC10 standards.

- 5.1 Demonstrate correct safety procedures for GMAW.
- 5.2 Demonstrate ability to correctly set up GMAW power sources, related welding equipment and do basic process and equipment troubleshooting.
- 5.3 Identify short circuiting, globular, spray and pulsed transfer welding of carbon steel, stainless steel and/or aluminum.
- 5.4 Select correct type of filler metal, type of shielding gas, amperage and voltage based on carbon steel, stainless steel and/or aluminum sheet and/or plate ( $\frac{1}{16}$ " to  $\frac{3}{8}$ " thickness).
- 5.5 Prepare the carbon steel, stainless steel and/or aluminum for welding.

### W 6.0 — Produce welds using a Fluxed Cored Arc Welding (FCAW) process to AWS QC10 standards.

- 6.1 Demonstrate correct safety procedures for FCAW.
- 6.2 Demonstrate ability to correctly set up FCAW power sources, related welding equipment and do basic process and equipment troubleshooting.
- 6.3 Select correct type of filler metal, type of shielding gas, amperage and voltage based upon carbon steel and/or stainless steel sheet and/or plate ( $\frac{1}{4}$ " to  $\frac{3}{8}$ " thickness).
- 6.4 Prepare stainless steel and/or carbon steel for welding.

### W 7.0 — Produce welds using a Gas Tungsten Arc Welding (GTAW) process to AWS QC10 standards.

- 7.1 Demonstrate safety procedures for GTAW.
- 7.2 Demonstrate ability to correctly set up GTAW power sources, related welding equipment and do basic process and equipment troubleshooting for regular and pulsed welding of aluminum, stainless steel and/or carbon steel.
- 7.3 Select the correct type of tungsten and/or filler metal based on aluminum, stainless steel or carbon steel sheet and/or plate ( $\frac{1}{16}$ " to  $\frac{1}{4}$ " thickness).

- 7.4 Prepare aluminum, stainless steel and/or carbon steel for welding.

**W 8.0 — Produce cut materials using an Oxygen Fuel Cutting (OFC) process to AWS QC10 standards.**

- 8.1 Demonstrate safety procedures for OFC.  
8.2 Demonstrate ability to correctly set up the OFC equipment for cutting and do basic process troubleshooting.

**W 9.0 — Produce cut materials using a Plasma Arc Cutting (PAC) process to AWS QC10 standards.**

- 9.1 Demonstrate safety procedures for PAC.  
9.2 Demonstrate ability to correctly set up the PAC power sources, related cutting equipment and do basic process and equipment troubleshooting.  
9.3 Set up and shut down equipment for cutting carbon steel, stainless steel and/or aluminum.

**W 10.0 — Demonstrate knowledge of visual inspection.**

- 10.1 Examine and measure undercut.  
10.2 Examine and measure porosity.  
10.3 Measure fillet size.  
10.4 Examine and measure weld reinforcement.  
10.5 Determine acceptability of welded samples in accordance with provided acceptance criteria.

**W 11.0 — Demonstrate knowledge of welding positions and terminology.**

- 11.1 Start, stop and restart stringer beads in the flat, horizontal, vertical up and down, and overhead positions.  
11.2 Weld a pad with a multiple pass weld in the flat, horizontal, vertical up and down, and overhead positions.  
11.3 Weld a lap joint with a single pass, fillet weld in flat, horizontal, vertical up and down, and overhead positions.  
11.4 Weld a lap joint with a multiple pass, fillet weld in the flat, horizontal, vertical up and down, and overhead positions.  
11.5 Weld a T-joint with a single pass, fillet weld in the flat, horizontal, vertical up and down, and overhead positions.  
11.6 Weld a T-joint with a multiple pass, fillet weld in the flat, horizontal, vertical up and down, and overhead positions.

- 11.7 Weld a butt joint with a single pass square groove weld in the flat, horizontal, vertical up and down, and overhead positions.  
11.8 Weld a butt joint with a partial joint penetration, single pass, double V-groove weld in the flat, horizontal, vertical up and down, and overhead positions.  
11.9 Weld a butt joint with a multiple pass V-groove weld in the flat, horizontal, vertical up and down, and overhead positions.  
11.10 Weld a butt joint with complete joint penetration, multiple pass, double groove weld in the flat, horizontal, vertical up and down, and overhead positions.  
11.11 Weld a 2" to 8" diameter, schedules 40 to 80 pipe, single/multiple pass V-groove weld in the 2G, 5G and 6G positions.  
11.12 Lay out, weld, cut and prepare coupons for evaluation.

**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.
- Convert fractions to decimals and vice versa.
- Measure angles.
- Construct three-dimensional models.

**Science Skills**

- Describe and recognize solids, liquids and gases.
- Use knowledge of principles of electricity and magnetism.

**Language Arts Skills**

- Provide information in oral presentations.

**Connections to National Standards**

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

**Math Standards**

- Geometry.

- Measurement.
- Problem solving.
- Communication.
- Connections.
- Representation.

**Source:** NCTM Principles and Standards for School Mathematics. For more information, visit: [www.nctm.org](http://www.nctm.org).

### **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: [www2.mcrel.org/compendium/browse.asp](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).

**Source:** IRA/NCTE Standards for the English Language Arts. To view the standards, visit: [www.ncte.org/standards](http://www.ncte.org/standards).