

# WELDING FABRICATION



## PURPOSE

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

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

## ELIGIBILITY (TEAM OF THREE)

Open to active SkillsUSA members enrolled in programs with welding as the occupational objective. This is a team event. Each team will be comprised of three student members from the same school and training program.

## CLOTHING REQUIREMENTS

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

**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 and materials.
  - b. For all drawings and procedure, please refer to: [updates.skillsusa.org/](http://updates.skillsusa.org/).

- c. Power tools needed for the competition.
- d. Some tools will be provided; please see updated list on the SkillsUSA website prior to the competition.
2. Supplied by the contestant team:
  - a. Hearing and/or ear protection.
  - b. Welding helmet with appropriate filter plate/lens and protective cover plate/lens in a flip or slide front. Auto darkening shields are permissible.
  - c. Spare spatter and filter lenses/plates for arc welding helmet and oxyacetylene goggles.
  - d. Pocket calculator.
  - e. Lead pencil and/or ballpoint pen.
  - f. Soap stone with holder.
  - g. Scribe with magnet.
  - h. Combination square set.
  - i. Fillet weld gauge.
  - j. Center punch.
  - k. Chipping hammer with or without wire brush.
  - l. Stainless steel wire brush.
  - m. 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/>.

Project drawings will be posted ahead of time for students, also at: <http://updates.skillsusa.org/>.

## SCOPE OF THE CONTEST

The scope of the contest is defined by industry standards as identified by the following companies: American Welding Society Inc., Harris Products Group, Hobart Brothers Co., Lincoln Electric Co., Linweld Inc. and Miller Electric Manufacturing Co. All drawings, welding symbols and welding terms conform to the latest edition of the American Welding Society (AWS) standards.

## Knowledge Performance

The contest will include a written knowledge exam that assesses the practical knowledge of welding, including safety, measurement and blueprint reading. Other common fabrication operations will also be assessed such as saw operation, drilling, grinding and material handling.

## Skill Performance

The skill performance assessment includes the completion of a metal project and a demonstration of the ability to weld carbon steel, aluminum or stainless steel project in various positions using a variety of filler metals. Contestants will be involved in the completion of a metal project that involves various manufacturing methods.

## Contest Guidelines

1. Contestants must correctly use the welding equipment during the contest. The contest chairman and contest coordinator may stop contestants at any section of the contest if they deem a contestant's manner to be hazardous to either him- or herself or others. Such stoppage shall disqualify the participant for that section of the contest. If the contestant is warned a second time, he or she will be disqualified as a contest participant.
2. While the contest is in progress, there shall be no communication between the contestants or between other teams or anyone else, except as directed by a judge, contest coordinator or contest chair. It is expected that team members will communicate to each other.
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 operation instructions will be specified in drawings and procedure sheets provided to the contestants.
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 compatible with the metals being welded and will be detailed on the contest procedure sheet. Instructions to the contestants will define more specifically the filler metals that may be used.
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.

## Standards and Competencies

### WF 1.0 — Identify safety standards on a test in accordance to ANSI Z49.

- 1.1 Demonstrate proper use and inspection of equipment used for protection of personnel.
- 1.2 Model proper work area operation.
- 1.3 Demonstrate proper use and inspection of equipment used for ventilation.
- 1.4 Demonstrate proper Hot Zone operation.
- 1.5 Demonstrate proper procedures for working in confined spaces.
- 1.6 Understand precautionary labeling.
- 1.7 Model proper use and inspection of equipment used for each required welding or thermal cutting process.

### WF 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  $\frac{1}{64}$  of an inch.
- 2.3 Employ the components of a combination square set.
- 2.4 Use layout and marking tools as required

- 2.5 Determine wire feed speed as indicated on drawing.

**WF 3.0 — Read and interpret blueprints.**

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

**WF 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 and related welding equipment and do basic process and equipment troubleshooting.
- 4.3 Correctly identify base metal prior to welding.
- 4.4 Set up and shut down equipment for welding of carbon steel and/or stainless steel.
- 4.5 Select correct type of filler metal size of electrode based on carbon steel and/or stainless steel plate ( $\frac{1}{4}$ -inch to  $\frac{1}{2}$ -inch thickness).
- 4.6 Prepare carbon steel and/or stainless steel for welding.
- 4.7 Start, stop and restart stringer beads on carbon steel and/or stainless steel in the flat, horizontal, vertical up and down, and overhead positions.
- 4.8 Weld a pad with a multiple-pass weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down, and overhead positions.
- 4.9 Weld a lap joint with a single-pass, fillet weld on carbon steel and stainless steel sheet/plate in flat, horizontal, vertical up and down, and overhead positions.

- 4.10 Weld a lap joint with a multiple-pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down, and overhead positions.
- 4.11 Weld a T-joint with a single-pass, fillet weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and down, and overhead positions.
- 4.12 Weld a T-joint with a multiple-pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down, and overhead position.
- 4.13 Weld a butt joint with a single-pass, square groove weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and down, and overhead positions.
- 4.14 Weld a butt joint with a partial joint penetration, single pass, double V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down, and overhead positions.
- 4.15 Weld a butt joint with a multiple-pass, V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down, and overhead positions.
- 4.16 Weld a butt joint with complete joint penetration, multiple pass, double groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down, and overhead positions.
- 4.17 Weld 2- to 8-inch diameter, schedules 40 to 80 carbon steel and stainless steel pipe, single/multiple-pass V-groove weld in the 2G, 5G and 6G positions.
- 4.18 Lay out, weld, cut and prepare coupons for evaluation.
- 4.19 Test the prepared coupon.

**WF 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 and related welding equipment and do basic process and equipment troubleshooting.
- 5.3 Correctly identify base metal prior to welding.
- 5.4 Set up and shut down equipment for short circuiting, globular, spray and

- pulsed transfer welding of carbon steel, stainless steel and/or aluminum.
- 5.5 Select correct type of filler metal size of electrode, type of shielding gas, wire feed speed and voltage based on carbon steel, stainless steel and/or aluminum sheet and/or plate ( $\frac{1}{16}$ -inch to  $\frac{3}{8}$ -inch thickness).
  - 5.6 Prepare the carbon steel, stainless steel and/or aluminum for welding.
  - 5.7 Start, stop and restart stringer beads on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical up and down, and overhead positions.
  - 5.8 Weld a pad with a multiple-pass weld on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.9 Weld a lap joint with a single-pass, fillet weld on carbon steel, stainless steel and aluminum sheet/plate in flat, horizontal, vertical up and down and overhead positions.
  - 5.10 Weld a lap joint with a multiple-pass, fillet weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.11 Interrupt root pass at mid point and restart arc.
  - 5.12 Weld a T-joint with a single-pass, fillet weld on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.13 Weld a T-joint with a multiple-pass, fillet weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.14 Weld a butt joint with a single-pass, square groove weld on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.15 Weld a butt joint with a partial joint penetration; single-pass and double V-groove weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.16 Weld a butt joint with a multiple-pass, V-groove weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.17 Weld a butt joint with complete joint penetration; multiple-pass and double V-groove weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
  - 5.18 Weld 2- to 8-inch diameter, schedule 40 to 80 carbon steel, stainless steel and aluminum pipe, single/multiple pass V-groove weld in the 2G, 5G and 6G positions.
  - 5.19 Lay out, weld, cut and prepare coupons for evaluation.
  - 5.20 Test prepared coupons.
- WF 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 and related welding equipment and do basic process and equipment troubleshooting.
  - 6.3 Correctly identify base metal prior to welding.
  - 6.4 Set up and shut down equipment for welding of carbon steel and/or stainless steel.
  - 6.5 Select correct type of filler metal, size of electrode, type of shielding gas (if needed), wire feed speed and voltage based upon carbon steel and/or stainless steel sheet and/or plate ( $\frac{1}{16}$ -inch to  $\frac{3}{8}$ -inch thickness).
  - 6.6 Prepare carbon steel and/or stainless steel for welding.
  - 6.7 Start, stop and restart stringer beads on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.
  - 6.8 Weld a pad with a multiple-pass weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.
  - 6.9 Weld a lap joint with a single-pass, fillet weld on carbon steel and stainless steel sheet/plate in flat, horizontal, vertical up and overhead positions.

- 6.10 Weld a lap joint with a multiple-pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions. Stop and restart in the middle of the joint.
- 6.11 Weld a T-joint with a single-pass, fillet weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.
- 6.12 Weld a T-joint with a multiple-pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- 6.13 Weld a butt joint with a single-pass, square groove weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.
- 6.14 Weld a butt joint with a partial joint penetration, single pass, double V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- 6.15 Weld a butt joint with a multiple-pass, V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- 6.16 Weld a butt joint with complete joint penetration, multiple-pass, double V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- 6.17 Weld 2- to 8-inch diameter, schedules 40 to 80 carbon steel and stainless steel pipe, single/multiple pass V-groove weld in the 2G, 5G and 6G positions.
- 6.18 Lay out, cut and prepare coupons for evaluation.
- 6.19 Test prepared coupons.

**WF 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 and related welding equipment and do basic process and equipment troubleshooting.
- 7.3 Correctly identify base metal prior to welding.
- 7.4 Set up and shut down equipment for regular and pulsed welding of aluminum, stainless steel and/or carbon steel.
- 7.5 Select the correct size and type of tungsten and/or filler metal based on aluminum, stainless steel or carbon steel sheet and/or plate ( $\frac{1}{16}$ -inch to  $\frac{1}{4}$ -inch thickness).
- 7.6 Prepare aluminum, stainless steel and/or carbon steel for welding.
- 7.7 Start, stop and restart stringer beads on aluminum, stainless steel and carbon steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
- 7.8 Weld a pad with multiple-pass weld on aluminum, stainless steel and carbon steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
- 7.9 Weld a lap joint with a single-pass, fillet weld on aluminum, steel, stainless steel and carbon steel sheet/plate in flat, horizontal, vertical up and down and overhead positions.
- 7.10 Weld a lap joint with a multiple-pass, fillet weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal vertical up and down and overhead positions.
- 7.11 Weld a T-joint with a single-pass fillet weld on aluminum, stainless steel and carbon steel sheet/ plate in the flat, horizontal, vertical up and down and overhead positions.
- 7.12 Weld a T-joint with a multiple-pass, fillet weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal, vertical up and down and overhead positions.
- 7.13 Weld a butt joint with a single-pass, square groove weld on aluminum, stainless steel and carbon steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
- 7.14 Weld a butt joint with a partial joint penetration, single-pass, double V-groove weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal vertical up and down and overhead positions.
- 7.15 Weld a butt joint with a multiple-pass, V-groove weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal, vertical up and down and overhead positions.



- 7.16 Weld a butt joint with complete joint penetration, multiple-pass and double V-groove weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal, vertical up and down and overhead positions.
- 7.17 Weld 2- to 8-inches diameter, schedules 40 to 80 aluminum, stainless steel, carbon steel pipe, single/multiple pass V-groove weld in the 2G, 5G and 6G positions.
- 7.18 Lay out, weld, cut and prepare coupons for evaluation.
- 7.19 Test prepared coupons.

**WF 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.
- 8.3 Correctly identify base metal prior to cutting.
- 8.4 Set up and shut down equipment for cutting carbon steel plate.
- 8.5 Select correct tip size and gas pressure for severing carbon steel plate ( $\frac{1}{4}$ -inch to  $\frac{1}{2}$ -inch thickness).
- 8.6 Prepare carbon steel for cutting.
- 8.7 Cutting operations will be specified in drawings and procedure sheets provided to the contestants.
- 8.8 Properly light, adjust the flame on and shut down the oxygen fuel equipment.
- 8.9 Use a straight edge and soapstone laying out the prescribed pattern.
- 8.10 Make a square cut on carbon steel in flat, horizontal, vertical and overhead positions.
- 8.11 Make a bevel cut (45-degree angle) on carbon steel plate in the flat, horizontal, vertical and overhead positions.
- 8.12 Pierce a hole on carbon steel in the flat, horizontal, vertical and overhead position.
- 8.13 Make a pipe and tubing cut on carbon steel pipe in flat, horizontal, vertical and overhead positions.
- 8.14 Make a gouge and groove cut on carbon steel in flat, horizontal, vertical and overhead positions.
- 8.15 Lay out, weld, cut and prepare coupons for evaluation.

- 8.16 Test prepared coupon.

**WF 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 and related cutting equipment and do basic process and equipment troubleshooting.
- 9.3 Correctly identify base metal prior to cutting.
- 9.4 Set up and shut down equipment for cutting carbon steel, stainless steel and/or aluminum.
- 9.5 Select correct cutting head and gas pressure for severing carbon steel, stainless steel or aluminum plate and/or sheet ( $\frac{1}{16}$ -inch to  $\frac{1}{4}$ -inch thickness).
- 9.6 Prepare carbon steel, stainless steel and/or aluminum for cutting.
- 9.7 Cutting operations will be specified in drawings and procedure sheets provided to the contestants.
- 9.8 Properly adjust and use the plasma arc equipment.
- 9.9 Use a straight edge and soapstone laying out the prescribed pattern.
- 9.10 Make a square cut on carbon steel, stainless steel and aluminum sheet/plate in flat, horizontal, vertical and overhead positions.
- 9.11 Make a bevel cut (45-degree angle) on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical and overhead positions.
- 9.12 Pierce a hole on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical and overhead position.
- 9.13 Make a pipe and tubing cut on carbon steel, stainless steel and aluminum pipe in the horizontal position.
- 9.14 Make a gouge and groove cut on carbon steel, stainless steel and aluminum sheet/plate in the flat position.
- 9.15 Lay out, cut and prepare coupons for evaluation.
- 9.16 Test prepared coupon.

**WF 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.

### **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.
- 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).