2023-24 EDITION

SkillsUSA CHAMPIONSHIPS

WELDING FABRICATION

SkillsUSA Championships Technical Standards

PURPOSE

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

ELIGIBILITY (TEAM OF THREE)

Open to active SkillsUSA members enrolled in programs with welding as an occupational objective. This is a team event composed of three student members from the same school and training program. Each state may send one high school and one college/postsecondary team.

CLOTHING REQUIREMENTS

Class I: Competition Specific — Welding | Welding Fabrication

- Official SkillsUSA khaki long-sleeve work shirt (100% cotton as per OSHA regulations)
- Khaki pants (100% cotton as per OSHA regulations)
- Black, brown, or tan work shoes

Note: Safety glasses must have side shields or goggles meeting ANSI/ISEA Z87.1 2020. (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. If you have questions about clothing or other logo items, call 1-888-501-2183.

Note: Competitors must wear their official competition clothing to the competition orientation meeting.

EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
   a. All necessary welding equipment and materials.
   b. All drawings and procedures
   c. Power tools needed for the competition.
   d. Some tools will be provided; please review the updated list on the SkillsUSA website prior to the competition.
2. Supplied by the competitor 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 oxy acetylene goggles.
   d. Pocket calculator
   e. Lead pencil and/or ballpoint pen
   f. Soapstone 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. 4 ½ inch grinder
   n. All competitors must create a one-page resume. See "Resume Requirement" below for guidelines.

Note: Check the Competition Guidelines and/or the updates page on the state competition updates page.

RESUME REQUIREMENT

Competitors must create a one-page resume to submit online. SkillsUSA South Carolina competitors should submit their resume by the deadline published on the competition updates page of our website. Failure to submit a resume will result in a 10-point penalty.

Your resume must be saved as a PDF file type using file name format of "Last Name_First Name." For example, "Amanda Smith" would save her resume as Smith_Amanda. If you need assistance with saving your file as a PDF, visit the Adobe website for more information.

Note: Check the Competition Guidelines and/or the updates page on the state website.

PROHIBITED DEVICES

Cellphones, electronic watches and/or other electronic devices not approved by a competition's national technical committee are ***NOT*** allowed in the competition area. Please follow the

guidelines in each technical standard for approved exceptions. Technical committee members may also approve exceptions onsite during the SkillsUSA Championships if deemed appropriate.

Penalties for Prohibited Devices

If a competitor's electronic device makes noise or if the competitor is seen using it at any time during the competition, an official report will be documented for review by the Director of the SkillsUSA Championships. If confirmed that the competitor used the device in a manner which compromised the integrity of the competition, the competitor's scores may be removed.

SCOPE OF THE COMPETITION

The scope of the competition 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 competition will include a written knowledge exam that assesses the practical knowledge of welding, including, but not limited to, safety, measurement, and blueprint reading. Other common fabrication operations will also be assessed, such as saw operation, drilling, grinding, and material handling. Competitors are also required to take the SkillsUSA Professional Development Test.

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 a stainless-steel project in various positions using a variety of filler metals. Competitors will be involved in the completion of a metal project that involves various manufacturing methods.

COMPETITION GUIDELINES

1. Competitors must correctly use the welding equipment during the competition. The competition chair and competition coordinator may stop competitors at any section of the competition if they deem a competitor's manner to be hazardous to either him- or herself or others. Such stoppage shall disqualify the participant for that section of the competition. If the competitor is warned a second time, he or she will be disqualified as a competition participant.
2. While the competition is in progress, there shall be no communication between the competing teams or anyone else, except as directed by a judge, competition coordinator or competition chair. It is expected that team members will communicate with each other.
3. Time limits will be established on the competition 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 competitors.
6. Welding equipment used in the competition 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 competition procedure sheet. Instructions to the competitors 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 the correct type of filler metal size of electrode based on carbon steel and/or stainless-steel plate (¼-inch to ½-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 the 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 (1⁄16-inch to 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 steel 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 midpoint 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 the 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 (1⁄16-inch to 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 OAC 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 serving carbon steel plate (1⁄4-inch to 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 competitors.
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 a 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 (1/16-inch to 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 competitors.
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.

WF 11.0 — SkillsUSA Framework

The SkillsUSA Framework is used to pinpoint the Essential Elements found in Personal Skills, Workplace Skills and Technical Skills Grounded in Academics. Students will be expected to display or explain how they used some of these Essential Elements. Please reference the graphic, as you may be scored on specific elements applied to your project. For more, visit: [www.skillsusa.org/who-we-are/skillsusa-framework/.](www.skillsusa.org/who-we-are/skillsusa-framework/)

COMMITTEE IDENTIFIED ACADEMIC SKILLS

The technical committee has identified that the following academic skills are embedded in this competition.

Math Skills

- Use fractions to solve practical problems.
- Measure angles.
- Construct three-dimensional models.

Science Skills

- Describe and recognize solids, liquids and gasses.
- 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.*

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/.*

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.*