

Welding Technology 1, 2, 3, and 4
Course Codes: 6340, 6341, 6342, 6343

PROGRAM DESCRIPTION: Welding is designed to provide students with the skills and knowledge to effectively perform cutting and welding applications used in the construction industry or in advanced manufacturing. Students will develop proficiency in fundamental safety practices in welding, interpreting drawings, creating computer aided drawings, identifying and using joint designs, efficiently laying out parts for fabrication. This program will provide the students with skills in basic Shielded metal arc welding (SMAW), gas metal arc welding (GMAW), Flux core arc welding (FCAW), Gas tungsten arc welding (GTAW), as well as quality control methods.

Provided a student takes Introduction to Construction and scores 70% on all assessments (00101-8-15), he or she does not have to repeat these modules in HVAC, Building Construction, Cabinetmaking, Carpentry, Electricity, Masonry, Mechatronics, Plumbing, and Welding.

OBJECTIVE: Given the necessary equipment, supplies, and facilities, the student will complete all of the following core standards successfully.

CREDITS: 1 (120 hours), 2 (240 hours)
3 units (360 hours)

PREREQUISITE(S): None

RECOMMENDED GRADE LEVEL: 9 - 12

COMPUTER ACCESS REQUIRED: 1 Computer per student with
Internet access

RECOMMENDED MAXIMUM ENROLLMENT: 20

RESOURCES: [MySCTextbooks](#)

PREREQUISITE: NCCER CONTREN CORE MODULES

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A. STUDENT ORGANIZATIONS

Effective professionals know the academic subject matter, including professional development, required for proficiency within their area. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Identify the purpose and goals of a Career and Technology Student Organization (CTSO).
2. Explain how CTSOs are integral parts of specific clusters, majors, and/or courses.

3. Explain the benefits and responsibilities of being a member of a CTSO.
4. List leadership opportunities that are available to students through participation in CTSO conferences, competitions, community service, philanthropy, and other activities.
5. Explain how participation in CTSOs can promote lifelong benefits in other professional and civic organizations.

B. TECHNOLOGY KNOWLEDGE

Effective professionals know the academic subject matter, including the ethical use of technology as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate proficiency and skills associated with the use of technologies that are common to a specific occupation.
2. Identify proper netiquette when using e-mail, social media, and other technologies for communication purposes.
3. Identify potential abuse and unethical uses of laptops, tablets, computers, and/or networks.
4. Explain the consequences of social, illegal, and unethical uses of technology (e.g., piracy; cyberbullying, illegal downloading; licensing infringement; inappropriate uses of software, hardware, and mobile devices in the work environment).
5. Discuss legal issues and the terms of use related to copyright laws, fair use laws, and ethics pertaining to downloading of images, photographs, documents, video, sounds, music, trademarks, and other elements for personal use.
6. Describe ethical and legal practices of safeguarding the confidentiality of business-related information.
7. Describe possible threats to a laptop, tablet, computer, and/or network and methods of avoiding attacks.

C. PERSONAL QUALITIES AND EMPLOYABILITY SKILLS

Effective professionals know the academic subject matter, including positive work practices and interpersonal skills, as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate punctuality.
2. Demonstrate self-representation.
3. Demonstrate work ethic.
4. Demonstrate respect.
5. Demonstrate time management.
6. Demonstrate integrity.
7. Demonstrate leadership.
8. Demonstrate teamwork and collaboration.
9. Demonstrate conflict resolution.
10. Demonstrate perseverance.

11. Demonstrate commitment.
12. Demonstrate a healthy view of competition.
13. Demonstrate a global perspective.
14. Demonstrate health and fitness.
15. Demonstrate self-direction.
16. Demonstrate lifelong learning.

D. PROFESSIONAL KNOWLEDGE

Effective professionals know the academic subject matter, including positive work practices and interpersonal skills, as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate effective speaking and listening skills.
2. Demonstrate effective reading and writing skills.
3. Demonstrate mathematical reasoning.
4. Demonstrate job-specific mathematics skills.
5. Demonstrate critical-thinking and problem-solving skills.
6. Demonstrate creativity and resourcefulness.
7. Demonstrate an understanding of business ethics.
8. Demonstrate confidentiality.
9. Demonstrate an understanding of workplace structures, organizations, systems, and climates.
10. Demonstrate diversity awareness.
11. Demonstrate job acquisition and advancement skills.
12. Demonstrate task management skills.
13. Demonstrate customer-service skills.

NCCER CONTREN CORE MODULES

Effective construction professionals demonstrate basic safety knowledge as needed in their role. The following accountability criteria are considered essential for students in all the construction programs of study.

1. Identify the responsibilities and personal characteristics of a professional craftsperson.
2. Describe the safe work requirements for elevated work.
3. Identify and explain how to avoid struck-by and caught-in-between hazards.
4. Explain the appropriate safety precautions around common job-site hazards.
5. Demonstrate the use and care of appropriate personal protective equipment (PPE).
6. Identify and describe other specific job-site safety hazards.
7. Follow safe procedures for lifting heavy objects.
8. Describe safe behavior on and around ladders and scaffolds.
9. Explain the importance of the Hazard Communication Standard (HazCom) requirement and Safety Data Sheets (SDS)
10. Describe fire prevention and firefighting techniques.
11. Define safe work procedures around electrical hazards.

12. Complete 10-hour OSHA course/assessment and receive card. (SDE Requirement)
13. Complete Performance Tasks

00102-15: BASIC MATH

Effective construction professionals demonstrate basic math skills as needed in their role. The following accountability criteria are considered essential for students in all the construction programs of study.

1. Add, subtract, multiply, and divide whole numbers, with and without a calculator.
2. Use a standard ruler and a metric ruler to measure.
3. Add, subtract, multiply, and divide fractions.
4. Add, subtract, multiply, and divide decimals, with and without a calculator.
5. Convert decimals to percent and percent to decimals.
6. Convert fractions to decimals and decimals to fractions.
7. Explain what the metric system is and how it is important in the construction trade.
8. Recognize and use metric units of length, weight, volume, and temperature.
9. Recognize some of the basic shapes used in the construction industry and apply basic geometry to measure them.

00103-15: INTRODUCTION TO HAND TOOLS

Effective construction professionals demonstrate how to safely use various hand tools as needed in their role. The following accountability criteria are considered essential for students in all the construction programs of study.

1. Recognize and identify various types of basic hand tools used in the construction trade.
2. Identify and describe how to use various types of measurement and layout tools.
3. Identify and explain how to use various types of cutting and shaping tools.
4. Use these tools safely.
5. Describe the basic procedures for taking care of these tools.
6. Complete Performance Tasks

00104-15: INTRODUCTION TO POWER TOOLS

Effective construction professionals demonstrate how to safely use power tools as needed in their role. The following accountability criteria are considered essential for students in all the construction programs of study.

1. Identify and explain how to use various types of power drills and impact wrenches used

in the construction trade.

2. Identify and explain how to use various types of power saws.
3. Identify and explain how to use various grinders and grinder attachments.
4. Identify and explain how to use miscellaneous power tools.
5. Use power tools safely.
6. Explain how to maintain power tools properly.
7. Complete Performance Tasks

00105-15: INTRODUCTION TO CONSTRUCTION DRAWINGS

Effective construction professionals demonstrate knowledge and the use of blueprints/construction drawings as needed in their role. The following accountability criteria are considered essential for students in the plumbing program of study.

1. Identify and describe various types of construction drawings, including their fundamental components and features.
2. Recognize and identify basic blueprint terms, components, and symbols.
3. Relate information on blueprints to actual locations on the print.
4. Recognize different classifications of drawings.
5. Interpret and use drawing dimensions.
6. Complete Performance Tasks

00106-15: BASIC RIGGING (Optional)

Effective construction professionals demonstrate how to use basic rigging as needed in their role. The following accountability criteria are considered essential for students in the plumbing program of study.

1. Explain how ropes, chains, hoists, loaders, and cranes are used to move material and equipment from one location to another on a job site.
2. Describe inspection techniques and load-handling safety practices.
3. Explain the American National Standards Institute (ANSI) hand signals.
4. Complete Performance Tasks

00107-15: BASIC COMMUNICATION SKILLS (SDE Requirement)

Effective construction professionals demonstrate appropriate communication skills as needed in their role. The following accountability criteria are considered essential for students in all of the construction programs of study.

1. Describe the communication, listening and speaking processes and their relationship to job performance.
2. Describe good reading and writing skills and their relationship to job performance
3. Demonstrate telephone and e-communication skills necessary in the workplace.
4. Complete Performance Tasks

00108-15: BASIC EMPLOYABILITY SKILLS (SDE Requirement)

Effective construction professionals demonstrate appropriate workplace behavior as needed in their role. The following accountability criteria are considered essential for students in all of the construction programs of study.

1. Describe the opportunities in the construction business and how an individual enters the construction workforce.
2. Explain the importance of critical thinking and how to solve problems in the workplace.
3. Explain the importance of social skills and identify ways good social skills are applied in the construction trade.
4. Describe computer systems and their industry applications.
5. Explain interpersonal relationship skills, self-presentation, and key workplace issues such as sexual harassment, stress, and substance abuse.

Welding Technology 1, 2, 3, and 4 Using NCCER Course Materials

Title:	Welding Level 1/2							
Edition:	5th							
Pub Date:	2015							
Add. Instructor Require.:								
Prerequisite:	Core							
Previous Edition	2020							
Book Module #	Old M	New Mod ID #	Equivalent Registr	Performance Test	Current Hou	New Hours	Mod Name	Comments
					72.5	72.5	Core	*For SENSE -only basic math from Core
1	29101-	29101-15	No	No	2.5	5	Welding Safety	
2	29102-	29102-15	No	Yes	17.5	17.5	Oxyfuel Cutting	Added task for SENSE
3	29103-	29103-15	No	Yes	7.5	7.5	Plasma Arc Cutting	Added task for SENSE
4	29104-	29104-15	No	Yes	12.5	10	Air Carbon Arc Cutting and	
5	29105-	29105-15	No	Yes	12.5	12.5	Base Metal Preparation	
6	29106-09	29106-15	No	Yes	10	10	Weld Quality	
7	29107-09	29107-15	No	Yes	5	5	SMAW - Equipment and Setup	
8	29108-09	29108-15	No	No	2.5	2.5	SMAW Electrodes	Formerly called Shielded Metal Arc Welding –
9	29109-	29109-15	No	Yes	120	100	SMAW - Beads and Fillet	
10	29110-	29110-15	No	Yes	5	5	Joint Fit-up and Alignment	

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11	29111-	29111-15	No	Yes	30	50	SMAW - Groove Welds with	
12	29112-09	29112-15	Yes	Yes	80	60	SMAW - Open Root Groove Welds - Plate	Formerly Open V-Groove
					Total	357.5		

Color Highlight		
	= Lock-Down	 = No performance Test
	= New Module	 = Equivalent Module
		 = Deleted
		 = Interim Credential

Definition

Lock-Down Module: A module adopted 'as is' from another craft or an earlier edition of the same curriculum.





Equivalent Module: A module whose learning and performance outcomes match those of the newer editions and is therefore

Title:	Welding Level 3/4							
Edition:	Fifth							
Pub Date:	2015							
Add. Instruc								
Prerequisite								
Previous Edition	2020							
Book Module #	Old Mo	New Mod ID	Equivalent	Performance	Current	New Hours	Mod Name	Comments
1	29201-09	29201-15	No	Yes	5	5	Welding Symbols	
2	29202-09	29202-15	No	Yes	10	10	Reading Welding Detail Drawings	
3	29203-09	29203-15	No	No	7.5	7.5	Physical Characteristics and Mechanical Properties	
4	29204-09	29204-15	No	Yes	5	5	Preheating and Post heating of Metals	
5	29205-09	29205-15	No	Yes	10	10	GMAW and FCAW - Equipment and Filler Metals	
6	29206-09	29209-15	No	Yes	80	60	GMAW - Plate	Split 29206-09 GMAW and FCAW - Plate
7	29206-09	29210-15	No	Yes	80	60	FCAW - Plate	Split 29206-09 GMAW and FCAW - Plate
8	29207-09	29207-15	No	Yes	10	10	GTAW - Equipment and Filler Metals	
9	29208-09	29208-15	No	Yes	60	60	GTAW – Plate	

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					Total Hours	227.5		
		Color Highlight Legend						

Color Highlight
 = Lock-Down
 = New Module

 = No performance Test
 = Equivalent Module
 = Deleted
 = Interim Credential

Definitions:

Lock-Down Module: A module adopted 'as is' from another craft or an earlier edition of the same curriculum.

Equivalent Module: A module whose learning and performance outcomes match those of the newer editions and is therefore

Welding Technology 1, 2, 3, and 4 Using Welding Principals and Applications Course Materials

A: WELDING SAFETY

Effective welders demonstrate appropriate safety skills. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify some common hazards in welding.
2. Explain and identify proper personal protection used in welding.
3. Demonstrate how to avoid welding fumes.
4. Explain some of the causes of accidents.
5. Identify and explain uses for material safety data sheets.
6. Demonstrate safety techniques for storing and handling cylinders.
7. Explain how to avoid electric shock when welding.
8. Demonstrate proper material handling methods.

B: OXYFUEL CUTTING

Effective welders demonstrate appropriate skills for oxyfuel cutting. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain the use of oxyfuel cutting equipment.
2. Set up oxyfuel equipment.
3. Light and adjust an oxyfuel torch.
4. Shut down oxyfuel cutting equipment.
5. Disassemble oxyfuel equipment.
6. Change empty cylinders.
7. Perform oxyfuel cutting:
 - Straight line and square shapes
 - Piercing and slot cutting
 - Bevels
 - Washing
 - Gouging
8. Operate a motorized, portable oxyfuel gas cutting machine.

C: BASE METAL PREPARATION

Effective welders demonstrate appropriate skills for base metal preparation. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Clean base metal for welding or cutting.
2. Identify and explain joint design.
3. Explain joint design considerations.
4. Using a nibbler, cutter, or grinder, mechanically prepare the edge of a mild steel plate ¼" to ¾" thick at 22½° (or 30° depending on equipment available).
5. Using a nibbler, cutter, or grinder, mechanically prepare the end of a pipe with a 30° or 37½° bevel (depending on equipment available) and a 3/32" land. Use 6", 8", or 10" Schedule 40 or Schedule 80 mild steel pipe.
6. Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.

D: SMAW – EQUIPMENT AND SETUP

Effective welders demonstrate appropriate skills using arc welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain shielded metal arc welding (SMAW) safety.
2. Identify and explain welding electrical current.
3. Identify and explain arc welding machines.
4. Explain setting up arc welding equipment.
5. Set up a machine for welding.
6. Identify and explain tools for weld cleaning.

E: SMAW – ELECTRODES AND SELECTION

Effective welders demonstrate knowledge and use of metals in welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify factors that affect electrode selection.
2. Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
3. Identify different types of filler metals.
4. Explain the storage and control of filler metals.
5. Explain filler metal traceability requirements and how to use applicable code requirements.
6. Identify and select the proper electrode for an identified welding task.

F: SMAW – BEADS AND FILLET WELDS

Effective welders demonstrate knowledge and use of metals in welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Set up shielded metal arc welding (SMAW) equipment.

2. Describe methods of striking an arc.
3. Properly strike and extinguish an arc.
4. Describe causes of arc blow and wander.
5. Make stringer, weave, and overlapping beads.
6. Make fillet welds in the:
 - Horizontal (2F) position
 - Vertical (3F) position
 - Overhead (4F) position

G: SMAW – GROOVE WELDS WITH BACKING

Effective welders demonstrate appropriate groove welding skills. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain groove welds.
2. Identify and explain groove welds with backing.
3. Set up shielded metal arc welding (SMAW) equipment for making V-groove welds.
4. Perform SMAW for V-groove welds with backing in the:
 - Flat (1G) position
 - Horizontal (2G) position
 - Vertical (3G) position
 - Overhead (4G) position

H: JOINT FIT-UP AND ALIGNMENT

Effective welders demonstrate appropriate joint fit-up and alignment skills in welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain job code specifications.
2. Use fit-up gauges and measuring devices to check joint fit-up.
3. Identify and explain distortion and how it is controlled.
4. Fit up joint using plate and pipe fit-up tools.
5. Check for joint misalignment and poor fit-up before and after welding.

I: WELDING SYMBOLS

Effective welders demonstrate knowledge and use of welding symbols. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain the various parts of a welding symbol.

2. Identify and explain fillet and groove weld symbols.
3. Read welding symbols on drawings, specifications, and welding procedure specifications.
4. Interpret welding symbols from a print.
5. Draw welding symbols based on the observation of actual welds.

J: READING WELDING DETAIL DRAWINGS

Effective welders demonstrate knowledge and skills for reading and interpreting welding detail drawings. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain a welding detail drawing.
2. Identify and explain lines, material fills, and sections.
3. Identify and explain object views.
4. Identify and explain dimensioning.
5. Identify and explain notes and bill of materials.
6. Interpret basic elements of a welding detail drawing.
7. Develop basic welding drawings.

K: PLASMA ARC CUTTING (PAC)

Effective welders demonstrate appropriate plasma arc cutting skills in welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and understand plasma arc cutting processes.
2. Identify plasma arc cutting equipment.
3. Prepare and set up plasma arc cutting equipment.
4. Use plasma arc cutting equipment to make various types of cuts.
5. Properly store equipment and clean the work area after use.

L: GMAW AND FCAW – EQUIPMENT AND FILLER METALS

Effective welders demonstrate appropriate knowledge and use of gas metal arc and flux cored arc welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Explain gas metal arc welding (GMAW) and flux cored arc welding (FCAW) safety.
2. Explain the characteristics of welding current and power sources.
3. Identify and explain the use of GMAW and FCAW equipment:
 - Spray transfer
 - Globular
 - Short circuiting

- Pulse
- 4. Identify and explain the use of GMAW and FCAW shielding gases and filler metals.
- 5. Set up GMAW and FCAW equipment and identify tools for weld cleaning

M: GMAW AND FCAW – PLATE

Effective welders demonstrate appropriate knowledge and skills for gas metal arc and flux cored arc welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Perform GMAW multiple-pass fillet welds on plate, using solid or composite wire and shielding gas in multiple positions.
2. Perform GMAW multiple-pass open-root V-groove welds on plate, using solid or composite wire and shielding gas, in multiple positions.
3. Perform GMAW spray fillet and open-root V-groove welds on plate, using solid or composite wire and shielding gas, in flat and horizontal positions.
4. Perform FCAW multiple-pass fillet welds on plate in multiple positions using flux cored wire and, if required, shielding gas.
5. Perform FCAW multiple-pass open-root V-groove welds on plate in multiple positions using flux cored wire and, if required, shielding gas.

WELDING – ADVANCED

For schools with more classroom instructional hours, choose from the list of advanced standards.

A: WELD QUALITY

Effective welders demonstrate knowledge of quality welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.

B: SMAW – OPEN V-GROOVE WELDS

Effective welders demonstrate appropriate knowledge and skills in using shielded metal arc welding for open V-groove welds. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove welds.
2. Perform open-root V-groove welds in the:
 - Flat (1G) position
 - Horizontal (2G) position
 - Vertical (3G) position
 - Overhead (4G) position

C: SMAW – OPEN-ROOT PIPE WELDS

Effective welders demonstrate appropriate knowledge and skills in using shielded metal arc welding for open-root pipe welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove pipe welds.
2. Identify and explain open-root V-groove pipe welds.
3. Perform SMAW for open-root welds in the:
 - Flat (1G-ROTATED) position
 - Horizontal (2G) position
 - Multiple (5G) position
 - Multiple inclined (6G) position

D: AIR CARBON ARC CUTTING AND GOUGING

Effective welders demonstrate appropriate knowledge and skills for air carbon arc cutting process and equipment. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain the air carbon arc cutting (CAC-A) process and equipment.
2. Select and install CAC-A electrodes.
3. Prepare the work area and CAC-A equipment for safe operation.
4. Use CAC-A equipment for washing and gouging activities.
5. Perform storage and housekeeping activities for CAC-A equipment.
6. Make minor repairs to CAC-A equipment.

E: GTAW – EQUIPMENT AND FILLER METALS

Effective welders demonstrate appropriate knowledge and skills for gas tungsten arc welding. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Explain gas tungsten arc welding (GTAW) safety.
2. Identify and explain the use of GTAW equipment.
3. Identify and explain the use of GTAW filler metals.
4. Identify and explain the use of GTAW shielding gases.
5. Set up GTAW equipment.

F: GTAW – PLATE

Effective welders demonstrate appropriate skills for creating multiple-pass open-root V-groove welds. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Build a pad in the flat position with stringer beads using GTAW and carbon steel filler metal.
2. Make multiple-pass open-root V-groove welds on carbon steel plate in the 1G (flat) position using GTAW and carbon steel filler metal.
3. Make multiple-pass open-root V-groove welds on carbon steel plate in the 2G (horizontal) position using GTAW and carbon steel filler metal.
4. Make multiple-pass open-root V-groove welds on carbon steel plate in the 3G (vertical) position using GTAW and carbon steel filler metal.
5. Make multiple-pass open-root V-groove welds on carbon steel plate in the 4G (overhead) position using GTAW and carbon steel filler metal.

G: GTAW – ALUMINUM PLATE

Effective welders demonstrate appropriate knowledge and skills in using gas tungsten arc welding using aluminum plate. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Identify and explain aluminum metallurgy.
2. Explain and identify characteristics of aluminum.
3. Explain GTAW and set up equipment to weld aluminum plate.
4. Explain and practice GTAW techniques for plate, including padding in the flat position with stringer beads, using aluminum filler metal.
5. Make fillet welds on aluminum plate in the following positions:
 - 1F (flat)
 - 2F (horizontal)
 - 3F (vertical)
 - 4F (overhead)
6. Make multiple-pass V-groove welds with backing on aluminum plate in the following positions:
 - 1G (flat)
 - 2G (horizontal)
 - 3G (vertical)

- 4G (overhead)

H: GAS TUNGSTEN ARC WELDING (GTAW) – CARBON STEEL PIPE

Effective welders demonstrate appropriate knowledge and skills in using gas tungsten arc welding using carbon steel pipe. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Set up GTAW equipment.
2. Identify and explain open-root V-groove pipe weld techniques.
3. Perform open-root V-groove pipe welds using GTAW in the following positions:
 - 1G-ROTATED
 - 2G
 - 5G
 - 6G

I: GAS TUNGSTEN ARC WELDING (GTAW) – LOW-ALLOY AND STAINLESS STEEL PIPE

Effective welders demonstrate appropriate knowledge and skills in using gas tungsten arc welding using low-alloy and stainless steel pipe. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in the Welding Technology program of study.

1. Set up GTAW equipment to perform stainless and/or low-alloy steel pipe welding.
2. Identify and explain open-root V-groove pipe weld techniques.
3. Perform open-root V-groove pipe welds using GTAW in the following positions:
 - 1G-ROTATED
 - 2G
 - 5G
 - 6G

Resources: [NCCER](#)
[AWS](#)
[Cengage](#)
[MySCTextbooks](#)