

**Guide
for the Training of
Welding Personnel:
Level I—Entry
Welder**



American Welding Society

Guide for the Training of Welding Personnel: Level I— Entry Welder

**Supersedes EG2.0-95
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Prepared by the
American Welding Society (AWS) Committee on SENSE
AWS Committee on Education

Approved by the
AWS Board of Directors

Abstract

This guide contains information to assist education and training organizations in the development and administration of a modular, competency-based training that leads to the qualification and certification of a trainee in accordance with the requirements of AWS QC10, Specification for Qualification and Certification of Level I—Entry Welder.



American Welding Society

550 N.W. LeJeune Road, Miami, FL 33126

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Foreword

This foreword is not a part of AWS EG2.0-2006 *Guide for the Training of Welding Personnel: Level I—Entry Welder*, but is included for informational purposes only.

The American Welding Society (AWS), recognizing the need for competent welders, through a grant by the U.S. Department of Education, formed the Education Grant Committee in 1992 and assigned them the task of preparing the initial guide.

Welding has become a very sophisticated and technical science, requiring not only mental application but also hands-on abilities. The future need for competent welders should prompt the establishment of a greater number of educational programs. Thus, it becomes imperative that training adequately prepares individuals for industrial assignments at various levels of skill development.

To this end the Level I—Entry Welder needs to enter the workforce possessing a prerequisite amount of knowledge, attitude, skills and habits required to perform routine, predictable, repetitive, and procedural tasks involving motor skills, and limited theoretical knowledge while working under close supervision.

As the name implies, it is the intent of this Guide to establish, expand, or enhance a private or public training program for Level I—Entry Welder. The guidelines contained in this document are based on AWS QC10: *Specification for the Qualification and Certification of Level I—Entry Welder*. AWS QC10 and EG2.0 were developed according to the DACUM method, and are based on the results of a national survey to identify requisite entry welder skills and knowledge. Survey participants included individuals from a wide range of business, industrial and educational areas.

Therefore, this document represents the AWS Education Grant Committee's consensus on the minimum requirements for a Level I—Entry Welder as specified by industry, and establishes the guidelines necessary to standardize the training and qualification of Level I—Entry Welder on a national basis.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to: The American Welding Society, Attention: Managing Director of Education, 550 N.W. LeJeune Road, Miami, FL 33126.

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1. General Provisions

1.1 Scope. EG2.0 establishes a skill standard by defining the recommended minimum welder training requirements for a Level I—Entry Welder in accordance with AWS QC10: *Specification for Qualification and Certification of Level I—Entry Welder*.

This guide is intended to specify a credible path for training organizations to implement new welding programs or to enhance existing programs to administer Level I—Entry Welder training.

Use of this Guide is voluntary. Training organizations desiring to register a trainee as an AWS SENSE certified Level I—Entry Welder, or to record completion of modules or units, shall consider these guidelines as the minimum specified under AWS QC10.

1.2 Objectives

1.2.1 Provide training organizations with an industrial awareness of the occupational description, conditions, task listing, and profile that encompasses the job classification of Level I—Entry Welder.

1.2.2 Establish a national consensus guidelines, based on an industry-wide survey of skills needed in industry, detailing the minimum acceptable skill requirements for the training of a Level I—Entry Welder.

1.2.3 Provide training organizations with a list of *Key Indicators Objectives*, and *Modular Instructional Activities* necessary to accomplish Level I—Entry Welder training.

1.2.4 Provide training organizations with a national consensus guideline with which to compare their own curriculum, evaluate third party curricula, or develop a new curriculum that is aligned with this national consensus modular SENSE guidelines.

1.2.5 Provide training organizations with AWS documents and standards to be used as a basis for evaluating or developing training materials.

1.2.6 Provide training organizations participating in SENSE with information related to the administration of Level I—Entry Welder testing necessary to meet the requirements of AWS QC10.

1.3 Implementation

1.3.1 Curriculum Comparison. Each training organization's course of study should reflect the objectives and key indicators of this guide as outline in 3.2 *Modular Competency Based Program Outline* and detailed in 3.3 *Learning Modules*.

1.3.2 Teaching Sequence. The program sequence as outlined in 3.2 *Recommended Modular Competency Based Program Outline* and detailed in 3.3 *Recommended Modular Guidelines for Level I—Entry Welder Training* is a suggested or recommended sequence. It is not mandatory to teach a course of study following the sequence of AWS QC10, Table 1 *Level I—Entry Welder Program Structure*. The teaching sequence for each training organization's course of study should be that which the instructor, the organization or the state educational authority specifies or has found to be most suited to the capabilities of the trainees and meets the needs of the industry.

1.3.3 Continuation of Trainees in Entry Welders Registration. AWS QC10: Section 11 the *Registration of Entry Welders* indicates that trainees who have a record of completed arc welding process competency(s) they have three (3) years to complete the program after the registration of their last completed arc welding process competency.

1.3.4 Budget. Adequate financial resources should be provided to maintain and enhance the welding program. Primary funding is for all necessary equipment (power sources, filler materials, gases, power equipment, hand tools, etc.). Additional monies should be available to provide the materials necessary for adequate welding instruction. Budget resources should also be available for staff and faculty technical and professional development.

2. Industrial Awareness

2.1 Scope. Training organizations should understand the needs of industry and provide welder training programs that prepare students to fill these needs. This is difficult because of the diverse nature of the welding function, along with the fact that it varies from industry-to-industry and from company-to-company.

Recognizing this diversity, AWS conducted an industry-wide survey, covering a broad base of businesses, job classifications, and educational institutions, to gather and analyze data concerning the skills and knowledge that a Level I—Entry Welder should possess. From a needs assessment and analysis, a profile of the Level I—Entry Welder was developed. This profile identifies skill and knowledge areas common to all Level I—Entry Welders, regardless of their unique situation in industry. A copy of the Level—I Entry Welder Profile may be obtained by contacting AWS Education Services, 550 N.W. LeJeune Road, Miami, FL 33126.

The second step used to understand the function of a welder in industry, was to prepare a task analysis based on the Level I—Entry Welder profile. The results of this analysis included a definition (see 2.2), an occupational description (see 2.3), the occupational conditions (see 2.4) and a task listing sheet (see 2.5). The resulting information is considered common to all Level I—Entry Welders.

Upon completion of the task analysis, technical information topics, materials, equipment, and tools were identified. This information was then converted from occupational data to a guide with key indicators, objectives, evaluation criteria and instructional activities. The following sections include portions of the occupational data collected during the needs and task analysis phases of this project to help institutions increase their awareness of industry needs.

2.2 Level I Entry Welder Definition. An individual employed in this position is considered to possess a prerequisite amount of knowledge, attitude, skills and habits required to perform routine, predictable, repetitive, and procedural tasks involving motor skills, and limited theoretical knowledge while working under close supervision.

2.3 Level I—Entry Welder Occupational Description. The Level I—Entry Welder position is comprised of the following areas:

2.3.1 Common Work Assignments (Occupational Orientation)

1. Follows detailed verbal or written instructions given by an immediate supervisor to set up and carry out specific job assignments.

2. Performs general housekeeping duties to maintain workspace, equipment, and tool cleanliness.
3. Fills out, maintains, and submits a time card, or work assignment card, and other records as required by the employer or institution.
4. Follows safe practices in the performance of daily duties.

2.3.2 Safety and Health of Welders

1. Wears applicable Personal Protective Equipment (PPE) while conducting, or in the vicinity of welding and cutting activities.
2. Follows procedures established using the concepts and requirements from NFPA and OSHA for “Hot Zone” management to ensure the safety of the work area and the general public.
3. Is aware of the dangers associated with welding and brazing fumes, and uses the best possible means of ventilation available for the capture of welding and brazing fumes as close to the source as possible.
4. Follows established procedures and policies for implementing of emergency action plans and for the use of safety equipment.
5. Performs fire safety inspections of the work area.
6. Follows established procedures and policies for working in confined areas.
7. Follows written instructions and precautions provided on applicable documentation for materials used in support of welding and cutting activities.
8. Is aware of the purpose of precautionary labels and Material Safety Data Sheets (MSDSs) and refers to them for materials used in support of welding and cutting activities.

2.3.3 Drawing and Welding Symbol Interpretation

1. Prepares an applicable bill of materials.
2. Performs conversions of standard inch and metric measurements.
3. Prepares parts from simple sketches or drawings.
4. Prepares weld joints and performs welding operations using welding symbol information.

2.3.4 Shielded Metal Arc Welding (SMAW). Performs minor external repairs to equipment and accessories, and sets up and performs SMAW operations, making fillet and groove welds in all positions within a limited thickness range on carbon steel.

2.3.5 Gas Metal Arc Welding (GMAW). Performs minor external repairs to equipment and accessories, and sets up and performs:

1. Gas metal arc welding (short circuit transfer) operations, making fillet and groove welds in all positions within a limited thickness range on carbon steel.
2. Gas metal arc welding (spray transfer) operations, making fillet and groove welds in limited positions within a limited thickness range on carbon steel.

2.3.6 Flux Cored Arc Welding (FCAW). Performs minor external repairs to equipment and accessories, and sets up and performs FCAW (both gas shielded and self-shielded) operations, making fillet and groove welds in all positions within a limited thickness range on carbon steel.

2.3.7 Gas Tungsten Arc Welding (GTAW). Performs minor external repairs to equipment and accessories, and sets up and performs gas tungsten arc welding operations, making fillet and groove welds in all positions within a limited thickness range on carbon steel, and in limited positions within a limited thickness range of austenitic stainless steel and aluminum.

2.3.8 Thermal Cutting Processes. Performs minor external repairs to equipment and accessories, and sets up and performs:

1. Manual oxyfuel gas cutting and gouging operations, making straight, bevel and shape cuts, and base and weld metal removal in limited positions within a limited thickness on carbon steel.
2. Mechanized oxyfuel gas cutting (e.g., track burner) operations, making straight and bevel cuts in limited positions within a limited thickness range on carbon steel.
3. Manual plasma arc cutting operations, making straight, bevel, and shape cuts, and base and weld metal removal in limited positions within a limited thickness range on carbon steel, stainless steel, and aluminum.
4. Manual air carbon arc cutting and gouging operations, making straight, bevel and shape cuts, and base and weld metal removal in limited positions within a limited thickness range on carbon steel.

2.3.9 Welding Inspection and Testing. Visually examines all work for discontinuities and defects:

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers and completed welds.

2.4 Level I—Entry Welder Occupational Conditions

2.4.1 Work Environment. Level I—Entry Welders are employed in a wide range of industries that use welding and welding-related tasks during the course of daily operations. This range of industries includes small, medium, and large facilities.

2.4.2 Occupational Hazards. As is the case in most metalworking industries, the potential for bodily harm and hazardous situations exists. Therefore, the welder shall take safety precautions and be safety conscious at all times. High electrical currents and voltages are used to operate machinery and welding equipment. Machinery for shearing, forming, and punching various materials is used. Flammable and other compressed gases are used during flame cutting and welding operations. The welder may be in direct contact with heavy sections during lifting and positioning operations. The welder may work in enclosed, restricted spaces, at high elevations, and in awkward positions. Excessive and prolonged noise levels are sometimes generated during production.

2.4.3 Level I—Entry Welder Profile. This position involves concentration, hand-eye coordination, limited decision-making and physical tasks. Additionally, they shall possess the following capabilities and character traits:

2.4.3.1 Physical Requirements. The Level I—Entry Welder shall meet the physical requirements established by the employer.

2.4.3.2 Employability. The Level I—Entry Welder should exhibit accurate written, oral, and listening skills, and basic problem solving and decision-making skills. This individual should show sound judgment, be dependable, and interact well with others.

2.4.3.3 Education. The Level I—Entry Welder training is accomplished through secondary, post-secondary, vocational-technical schools, junior colleges, universities, apprenticeship and employer-based welder training programs. Sufficient foundation skills such as reading, writing, math, science, communication and employability, are required to complete prerequisite welding related knowledge and skills training.

3. Guidelines

3.1 General Guidelines. It is the sole intent of this document to provide guidelines for a “modular,” competency-based welding curriculum for the Level I—Entry Welder. Thus, the training organizations shall provide an adequate curriculum to achieve Level I—Entry Welder welding skills and knowledge requirements.

In addition, it is the responsibility of the training organization to establish any prerequisites and guidelines for use during training related to basic skills (i.e., reading, writing, mathematics and listening/oral communications). Training activities should consistently reinforce the use of these basic skills, as well as employability skills.

3.1.1 Placement Assessment. Industry wants a Level I—Entry Welder with reading, writing, mathematics and listening/oral communication skills that are adequate for successful job performance. They shall also possess the aptitude to develop Level I—Entry Welder welding skills. Also, the recommendations made in this guide require that the trainee have sufficient basic skills to carry out and complete the training. Therefore, it is strongly recommended that a prospective trainee undergo a placement assessment of basic skills upon entering the welding program or ideally, if allowed by the training organization’s rules of operation, prior to entry into the welding program.

3.1.2 Guidelines Implementation. The Level I—Entry Welder guidelines can be implemented in two ways:

1. As a comprehensive program covering SMAW, GMAW, FCAW, and GTAW, along with occupational orientation, safety, drawing and welding symbol interpretation, cutting processes, and welding inspection.

or

2. As modular program covering selected welding processes (SMAW, GMAW, FCAW, or GTAW) along with occupational orientation, safety, drawing and welding symbol interpretation, cutting processes, and welding inspection.

NOTE: The Learning Modules in this guide contain sufficient information for instructors to develop or acquire a suitable curriculum, and to evaluate a trainee’s performance (see 3.3 Learning Modules).

3.2 Recommended Modular Competency-Based Outline—Based on Program Structure QC10, Table 1.

3.2.1 Program: LEVEL I—ENTRY WELDER TRAINING

3.2.1.1 MODULE 1: OCCUPATIONAL ORIENTATION

KEY INDICATORS

1. Prepares time or job cards, reports or records.
2. Performs housekeeping duties.
3. Follows verbal instructions to complete work assignments.
4. Follows written instructions to complete work assignments.

3.2.1.2 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATORS

1. Demonstrates proper use and inspection of personal protection equipment (PPE).
2. Demonstrates proper safe operation practices in the work area.
3. Demonstrates proper use and inspection of ventilation equipment.
4. Demonstrates proper Hot Zone operation.
5. Demonstrates proper work actions for working in confined spaces.
6. Demonstrates proper use of precautionary labeling and MSDS information.
7. Demonstrates proper inspection and operation of equipment used for each welding and thermal cutting process. (This is best done as part of the process module/unit for each of the required welding and thermal cutting processes.)

3.2.1.3 MODULE 3: DRAWING AND WELDING SYMBOL INTERPRETATION

KEY INDICATORS

1. Interprets basic elements of a drawing or sketch.
2. Interprets welding symbol information.
3. Fabricates parts from a drawing or sketch.

3.2.1.4 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATORS

1. Performs safety inspections of SMAW equipment and accessories.
2. Makes minor external repairs to SMAW equipment and accessories.
3. Sets up for SMAW operations on carbon steel.
4. Operates SMAW equipment on carbon steel.
5. Makes fillet weld in all positions on carbon steel.

6. Makes groove welds, in all positions, on carbon steel.
7. Passes SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel.

3.2.1.5 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATORS

1. Performs safety inspections of GMAW equipment and accessories.
2. Makes minor external repairs to GMAW equipment and accessories.

Short Circuiting Transfer

3. Sets up for GMAW-S operations on carbon steel.
4. Operates GMAW-S equipment on carbon steel.
5. Makes fillet welds in all positions on carbon steel.
6. Makes groove welds in all positions on carbon steel.
7. Passes GMAW-S welder performance qualification test on carbon steel.

Spray Transfer

8. Sets up for GMAW (spray) operations on carbon steel.
9. Operates GMAW (spray) equipment on carbon steel.
10. Makes fillet welds in the 1F and 2F positions on carbon steel.
11. Makes groove welds in the 1G position on carbon steel.
12. Passes GMAW (spray) welder performance qualification test on carbon steel.

3.2.1.6 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATORS

1. Performs safety inspections of FCAW equipment and accessories.
2. Makes minor external repairs to FCAW equipment and accessories.

Gas Shielded

3. Sets up for FCAW-G/GM operations on carbon steel.
4. Operates FCAW-G/GM equipment on carbon steel.
5. Makes fillet welds in all positions on carbon steel.
6. Makes groove welds in all positions on carbon steel.
7. Passes FCAW-G/GM welder performance qualification test on carbon steel.

Self-Shielded

8. Sets up for FCAW-S operations on carbon steel.
9. Operates FCAW-S equipment on carbon steel.
10. Makes fillet welds in all positions on carbon steel.
11. Makes groove welds in all positions on carbon steel.
12. Passes FCAW-S welder performance qualification test on carbon steel.

3.2.1.7 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATORS

1. Performs safety inspections of GTAW equipment and accessories.
2. Makes minor external repairs to GTAW equipment and accessories.

Carbon Steel

3. Sets up for GTAW operations on carbon steel.
4. Operates GTAW equipment on carbon steel.
5. Makes fillet welds in all positions on carbon steel.
6. Makes groove welds in all positions on carbon steel.
7. Passes GTAW welder performance qualification test on carbon steel.

Austenitic Stainless Steel

8. Sets up for GTAW operations on austenitic stainless steel.
9. Operates GTAW equipment on austenitic stainless steel.
10. Makes fillet welds in the 1F, 2F, and 3F positions, on austenitic stainless steel.
11. Makes groove welds in the 1G and 2G positions, on austenitic stainless steel.
12. Passes GTAW welder performance qualification test on austenitic stainless steel.

Aluminum

13. Sets up for GTAW operations on aluminum.
14. Operates GTAW equipment on aluminum.
15. Makes fillet welds in the 1F and 2F positions, on aluminum.
16. Makes groove welds in the 1G position, on aluminum.
17. Passes GTAW welder performance qualification test on aluminum.

3.2.1.8 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATORS

1. Performs safety inspections of manual OFC equipment and accessories.
2. Makes minor external repairs to manual OFC equipment and accessories.
3. Sets up for manual OFC operations on carbon steel.
4. Operates manual OFC equipment on carbon steel.
5. Performs straight, square edge cutting operations, in the flat position, on carbon steel.
6. Performs shape, square edge cutting operations, in the flat position, on carbon steel.
7. Performs straight, bevel edge cutting operations, in the flat position, on carbon steel.
8. Performs scarfing and gouging operations to remove base and weld metal, in the flat and horizontal positions, on carbon steel.

UNIT 2: MECHANIZED OXYFUEL GAS CUTTING (OFC) [e.g., TRACK BURNER]

KEY INDICATORS

1. Performs safety inspections of mechanized OFC equipment and accessories.
2. Makes minor external repairs to mechanized OFC equipment and accessories.
3. Sets up for mechanized OFC operations on carbon steel.
4. Operates mechanized OFC equipment on carbon steel.
5. Performs straight, square edge cutting operations in the flat position, on carbon steel.
6. Performs straight, bevel edge cutting operations in the flat position, on carbon steel.

UNIT 3: MANUAL PLASMA ARC CUTTING (PAC)

KEY INDICATORS

1. Performs safety inspections of manual PAC equipment and accessories.
2. Makes minor external repairs to manual PAC equipment and accessories.
3. Sets up for manual PAC operations on carbon steel, austenitic stainless steel, and aluminum.
4. Operates manual PAC equipment on carbon steel, austenitic stainless steel, and aluminum.
5. Performs straight, square edge cutting operations, in the flat position, on carbon steel, austenitic stainless steel, and aluminum.

6. Performs shape, square edge cutting operations, in the flat position, on carbon steel, austenitic stainless steel and aluminum.

UNIT 4: MANUAL AIR CARBON ARC CUTTING (CAC-A)

KEY INDICATORS

1. Performs safety inspections of manual CAC-A equipment and accessories.
2. Makes minor external repairs to manual CAC-A equipment and accessories.
3. Sets up for manual CAC-A scarfing and gouging operations on carbon steel.
4. Operates manual CAC-A equipment on carbon steel.
5. Performs scarfing and gouging operations to remove base and weld metal, in the flat and horizontal positions, on carbon steel.

3.2.1.9 MODULE 9: WELDING INSPECTION AND TESTING

KEY INDICATORS

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 1: OCCUPATIONAL ORIENTATION

KEY INDICATOR 1: Prepares time or job cards, reports or records.

OBJECTIVE: Provided with a period of instruction and demonstration, a time record, and job or work assignment number, the trainee records personal training and job assignment information.

EVALUATION CRITERIA: The trainee's time records are completed in accordance with the institution's standard operating procedures. The trainee performs the task on a continuous basis over the length of the program. The trainee's completed record is compared against the instructor's master record for accuracy.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Develop a Training Achievement Record (TAR) (see Annex E).
2. Develop a trainee time record.
3. Demonstrate procedures for completion of training achievement records and time cards.
4. Provide instruction related to time and job recording methods related to the welding industry.
5. Provide training exercises related to trainee maintenance of a TAR.
6. Provide training exercises related to trainee maintenance of a time card.
7. Observe each trainee's ability to carry out training exercises.
8. Monitor individual training achievement records and time cards.
9. Keep training records reflecting trainee achievement and attendance.

3.3.1 MODULE 1: OCCUPATIONAL ORIENTATION

KEY INDICATOR 2: Performs housekeeping duties.

OBJECTIVE: Provided with a period of orientation, housekeeping equipment or tools, and given a housekeeping assignment in the work area, the trainee will carry out housekeeping activities.

EVALUATION CRITERIA: The trainee's completed assignments show evidence of good housekeeping and safety practices. The assignment is completed in accordance with the institution's standard operating procedure. The task is completed in a timely manner. The trainee's workmanship is observed by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Outline common housekeeping activities shared by all trainees.
2. Outline individual housekeeping responsibilities.
3. Provide housekeeping activities for all trainees.
4. Monitor and inspect completed individual and shared housekeeping assignments.
5. Keep training records reflecting trainee housekeeping habits.
6. Observe each trainee's ability to carry out training exercises.

3.3.1 MODULE 1: OCCUPATIONAL ORIENTATION

KEY INDICATOR 3: Follows verbal instructions to complete work assignments.

OBJECTIVE: Given verbal work assignment instructions and the required materials, equipment and tools, the trainee will carry out a job assignment.

EVALUATION CRITERIA: The trainee's work assignment is completed according to verbal instructions. The instructor observes the trainee selecting the necessary materials, equipment and tools to meet service conditions for the job requirements. The trainee sets up and completes assignments in a timely manner. Verbal instructions are carried out on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Develop training exercises that require a trainee to follow verbal instructions.
2. Observe each trainee selecting the required material, equipment and tools for each exercise.
3. Observe each trainee's ability to carry out training exercises.
4. Keep training records reflecting each trainee's listening skills.

3.3.1 MODULE 1: OCCUPATIONAL ORIENTATION

KEY INDICATOR 4: Follows written instructions to complete work assignment.

OBJECTIVE: Given written work assignment instructions and the required materials, equipment and tools, the trainee will carry out a job assignment.

EVALUATION CRITERIA: The trainee's work assignment is completed according to written instructions. The trainee is observed by the instructor selecting the necessary materials, equipment and tools to meet service conditions for the job requirements. The trainee sets up and completes the assignment in a timely manner. Written instructions are carried out on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Develop training exercises that require a trainee to follow written instructions.
2. Observe each trainee selecting the required materials, equipment and tools for each exercise.
3. Keep training records reflecting each trainee's ability to follow written instructions.
4. Observe each trainee's ability to carry out training exercises.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATOR 1: Demonstrates proper use and inspection of personal protection equipment (PPE).

OBJECTIVE: Provided with a period of instruction, orientation and demonstration about general welding safety, and given the necessary personal protective clothing and equipment, the trainee demonstrates proper use and inspection of personal protective equipment (PPE).

EVALUATION CRITERIA: The trainee inspects and wears proper personal protective clothing and equipment while conducting, or in the vicinity of welding and cutting activities; follows established procedures to ensure the safety of the work area and the general public; and achieves a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide an orientation to Personal Protective Equipment (PPE) required for welding.
2. Provide demonstrations related to ANSI Z49.1, Section 4, *Protection of Personnel and the General Area*.
3. Keep records reflecting successful completion of safe practice training.
4. Observe each trainee's ability to carry out training exercises.

NOTES:

1. A safety test based on ANSI Z49.1 shall be administered prior to skill training. Trainees shall achieve a minimum score of 90% on the safety test before proceeding with skill training.
2. Proper safety procedures should be reinforced and observed in all modules and units.

3.3.1 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATOR 2: Demonstrates proper safe operation practices in the work area.

OBJECTIVE: Provided with a period of instruction, orientation and demonstration about general welding safety, and given the necessary personal protective clothing and equipment, the trainee demonstrates safe practices in the work area.

EVALUATION CRITERIA: The trainee: wears proper personal protective clothing and equipment while conducting, or in the vicinity of welding and cutting activities; follows established procedures to ensure the safety of the work area and the general public; and achieves a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation of the institution's welding work area.
2. Provide demonstrations related to ANSI Z49.1, Section 4, *Protection of Personnel and the General Area*.
3. Provide demonstrations related to ANSI Z49.1, Part I—*General Aspects*.
4. Keep records reflecting successful completion of safe practice training.
5. Observe each trainee's ability to carry out training exercises.

NOTES:

1. A safety test based on ANSI Z49.1 shall be administered prior to skill training. Trainees shall achieve a minimum score of 90% on the safety test before proceeding with skill training.
2. Proper safety procedures should be reinforced and observed in all modules and units.

3.3.1 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATOR 3: Demonstrates proper use and inspection of ventilation equipment.

OBJECTIVE: Provided with a period of instruction, orientation and demonstration about the operation, inspection and positioning of ventilation equipment, the trainee demonstrates the proper use and inspection of ventilation equipment.

EVALUATION CRITERIA: The trainee: conducts a proper inspection of ventilation equipment; uses the best possible means of ventilation available for the capture of welding and brazing fumes as close to the source as possible; and achieves a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations related to ANSI Z49.1, Section 5, *Ventilation*.
2. Keep records reflecting successful completion of safe practice training.
3. Observe each trainee's ability to carry out training exercises.

NOTES:

1. A safety test based on ANSI Z49.1 shall be administered prior to skill training. Trainees shall achieve a minimum score of 90% on the safety test before proceeding with skill training.
2. Proper safety procedures should be reinforced and observed in all modules and units.

3.3.1 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATOR 4: Demonstrates proper Hot Zone operation.

OBJECTIVE: Provided with a period of instruction, orientation and demonstration about safety in the Hot Zone, the trainee demonstrates safe practices in the Hot Zone.

EVALUATION CRITERIA: The trainee: follows established procedures to ensure the safety of the work area and the general public; follows established procedures and policies regarding emergency action plans and for the use of safety equipment; performs fire safety inspections of the work area; demonstrates proper safety procedures in the Hot Zone; and achieves a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation of the institution's Hot Zone areas.
2. Explain the concepts and use of Hot Zone permits.
3. Provide demonstrations related to ANSI Z49.1, Section 4, *Protection of Personnel and the General Area*.
4. Provide demonstrations related to ANSI Z49.1, Section 6, *Fire Prevention and Protection*.
5. Keep records reflecting successful completion of safe practice training.
6. Observe each trainee's ability to carry out training exercises.

NOTES:

1. A safety test based on ANSI Z49.1 shall be administered prior to skill training. Trainees shall achieve a minimum score of 90% on the safety test before proceeding with skill training.
2. Proper safety procedures should be reinforced and observed in all modules and units.

3.3.1 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATOR 5: Demonstrates proper work actions for working in confined spaces.

OBJECTIVE: Provided with a period of instruction, orientation and demonstration about safety precautions for working in confined spaces, the trainee demonstrates safe practices related to working in confined spaces.

EVALUATION CRITERIA: The trainee: follows established procedures to ensure the safety of the work area; uses the best possible means of ventilation available for the capture of welding and brazing fumes as close to the source as possible; follows established procedures and policies regarding emergency action plans for working in confined spaces; performs fire safety inspections of the work area; follows established procedures and policies for working in confined areas; and achieves a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations related to ANSI Z49.1, Section 7, *Confined Spaces*.
2. Provide demonstrations related to ANSI Z49.1, Section 5, *Ventilation*.
3. Provide demonstrations related to ANSI Z49.1, Section 6, *Fire Prevention and Protection*.
4. Provide demonstrations related to ANSI Z49.1, Section 9, *Precautionary Information*.
5. Keep records reflecting successful completion of safe practice training.
6. Observe each trainee's ability to carry out training exercises.

NOTES:

1. A safety test based on ANSI Z49.1 shall be administered prior to skill training. Trainees shall achieve a minimum score of 90% on the safety test before proceeding with skill training.
2. Proper safety procedures should be reinforced and observed in all modules and units.

3.3.1 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATOR 6: Demonstrates proper use of precautionary labeling and MSDS information.

OBJECTIVE: Provided with a period of instruction, orientation and demonstration about the purpose and design of material labels and Material Safety Data Sheets (MSDS), and other written materials used in support of welding and cutting activities, the trainee can demonstrate the proper use of label and MSDS information to identify proper safety procedures for work related materials and solvents.

EVALUATION CRITERIA: The trainee: wears proper personal protective clothing and equipment while conducting, or in the vicinity of welding and cutting activities; follows established procedures to ensure the safety of the work area and the general public; identifies proper safety procedures for work related materials and solvents based on label and MSDS information; follows written instructions and precautions (including Material Safety Data Sheets) for materials used in support of welding and cutting activities; and achieves a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations related to ANSI Z49.1, Section 9, *Precautionary Information*.
2. Provide demonstrations related to ANSI Z49.1, Section 4, *Protection of Personnel and the General Area*.
3. Provide demonstrations related to ANSI Z49.1, Section 5, *Ventilation*.
4. Provide demonstrations related to ANSI Z49.1, Section 6, *Fire Prevention and Protection*.
5. Keep records reflecting successful completion of safe practice training.
6. Observe each trainee's ability to carry out training exercises.

NOTES:

1. A safety test based on ANSI Z49.1 shall be administered prior to skill training. Trainees shall achieve a minimum score of 90% on the safety test before proceeding with skill training.
2. Proper safety procedures should be reinforced and observed in all modules and units.

3.3.1 MODULE 2: SAFETY AND HEALTH OF WELDERS

KEY INDICATOR 7: Demonstrates proper inspection and operation of equipment used for each welding and thermal cutting process.

OBJECTIVE: Provided with a period of instruction, orientation and demonstration about the safe inspection and use of welding and thermal cutting equipment, and given the necessary personal protective clothing and equipment, the trainee demonstrates proper inspection and operation of equipment for each welding and thermal cutting process used.

EVALUATION CRITERIA: The trainee: follows correct procedures for the inspection of welding and cutting equipment; uses the best possible means of ventilation available for the capture of welding and brazing fumes as close to the source as possible; follows correct procedures for the operation of welding and cutting equipment; and achieves a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations related to ANSI Z49.1, Section 11, *Arc Welding and Cutting Equipment Safety*.
2. Provide demonstrations related to ANSI Z49.1, Section 10, *Oxyfuel Gas Welding and Cutting Safety*.
3. Provide demonstrations related to ANSI Z49.1, Section 4, *Ventilation*.
4. Keep records reflecting successful completion of safe practice training.
4. Observe each trainee's ability to carry out training exercises.

NOTES:

1. A safety test based on ANSI Z49.1 shall be administered prior to skill training. Trainees shall achieve a minimum score of 90% on the safety test before proceeding with skill training.
2. Proper safety procedures should be reinforced and observed in all modules and units.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 3: DRAWING AND WELDING SYMBOL INTERPRETATION

KEY INDICATOR 1: Interprets basic elements of a drawing or sketch.

OBJECTIVE: Provided with a period of instruction and demonstration, a drawing, and base material, the trainee will layout the individual parts of a welded assembly.

EVALUATION CRITERIA: The trainee identifies the fabrication requirements according to drawings or sketch specifications on a routine basis. The instructor observes the trainee preparing to layout according to fabrication requirements. Workmanship sample information is correctly interpreted during workmanship and performance qualification testing and verified by the test supervisor. In accordance with the requirements of AWS QC10, the trainee shall pass the drawing fundamentals element of a written examination.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide an introduction to drawing or sketch reading.
2. Provide instruction in drawing view interpretation.
3. Provide instruction in title block interpretation.
4. Provide instruction in drawing notes interpretation.
5. Provide instruction in version control system for drawings.
6. Provide instruction in drawing list of materials and parts list interpretation.
7. Provide instruction in drawing dimensions and tolerance for both U.S. customary and SI metric units.
8. Demonstrate drawing element interpretation.
9. Introduce related terms and definitions.
10. Provide training exercises related to drawing and sketch interpretation.
11. Develop and administer formative (diagnostic) tests relevant to drawing fundamentals.
12. Prepare trainee for the drawing fundamentals element of a written examination.
13. Keep training records reflecting results of drawing element interpretation.

3.3.1 MODULE 3: DRAWING AND WELDING SYMBOL INTERPRETATION

KEY INDICATOR 2: Interprets welding symbol information.

OBJECTIVE: Provided with instruction and demonstration, drawings or sketches with welding symbols and supplementary data, the trainee locates and determines welding requirements.

EVALUATION CRITERIA: The trainee identifies welding requirements according to welding symbol information on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall pass the welding symbol element of a written examination based on the related sections of AWS A2.4, *Standard Symbols for Welding, Brazing and Nondestructive Examination*, and AWS A3.0, *Standard Welding Terms and Definitions*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction in welding symbol interpretation.
2. Demonstrate welding symbol interpretation.
3. Provide training exercises related to welding symbol interpretation.
4. Introduce related terms and definitions.
5. Observe trainee carrying out welding requirements from welding symbol information.
6. Develop and administer formative (diagnostic) tests relative to welding symbol information.
7. Prepare trainee for the welding symbol element of a written examination based on the related sections of AWS A2.4 and A3.0.
8. Keep training records reflecting results of welding symbol interpretation requirements.

3.3.1 MODULE 3: DRAWING AND WELDING SYMBOL INTERPRETATION

KEY INDICATOR 3: Fabricates parts from a drawing or sketch.

OBJECTIVE: Provided with a drawing or sketch, layout tools, measuring devices, a handheld calculator, fabrication and welding equipment, and base metals, the trainee fabricates a weldment from parts.

EVALUATION CRITERIA: The trainee prepares, assembles, and tack welds parts according to drawings or sketch specifications on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall pass the fabrication and weld symbol interpretation elements of workmanship qualification.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation to fabrication tools and equipment.
2. Provide instruction in fabrication tools and equipment safe practices.
3. Provide instruction in the care and use of fabrication tools and equipment.
4. Provide instruction in base metal identification and shapes.
5. Provide instruction in welded joint geometry.
6. Demonstrate the selection and use of fabrication tools and equipment.
7. Demonstrate fabrication techniques.
8. Demonstrate the preparation of welded joints.
9. Provide written fabrication exercises with U.S. (customary) elements for welding practices.
10. Provide written fabrication exercises with SI (metric) elements for welding practices.
11. Observe trainee selecting fabrication tools and equipment.
12. Observe trainee selecting base metals.
13. Observe trainee performance during various stages of fabrication.
14. Observe trainee following safe practices.
15. Develop and administer formative (diagnostic) tests relevant to fabrication and weld symbol interpretation.
16. Prepare trainee for the fabrication and weld symbol interpretation elements of performance qualification tests. (See drawings AWS EDU-1 through AWS EDU-6.)
17. Prepare trainee for the fabrication fundamentals element of a written examination.
18. Keep training records reflecting results of fabrication from drawing or sketch requirements.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATOR 1: Performs safety inspections of SMAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, and SMAW equipment and accessories, the trainee performs safety inspections of protective equipment and clothing, hand tools, SMAW equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective equipment and clothing, hand tools, SMAW equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of SMAW operations. In the course of daily operations, the trainee is observed following safe SMAW practices on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation to SMAW equipment and accessories.
2. Provide demonstrations on ANSI Z49.1, Section 11, *Arc Welding and Cutting Equipment Safety*.
3. Provide demonstrations on routine safety inspections of protective equipment and clothing, hand tools, SMAW equipment and accessories, and work area.
4. Provide instruction on ANSI Z49.1, Section 11.
5. Reinforce previous instruction from ANSI Z49.1, Part I—*General Aspects*.
6. Introduce relevant terms and definitions and observe trainee using proper SMAW terms and definitions.
7. Observe trainee conducting safety inspections for SMAW.
8. Observe trainee following safe SMAW practices.
9. Develop and administer formative or diagnostic tests on safe SMAW practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep records reflecting each trainee's successful completion of training in SMAW safe practices.

3.3.1 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATOR 2: Makes minor external repairs to SMAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on repair materials, equipment and tools, the trainee will make minor external repairs to SMAW equipment and accessories.

EVALUATION CRITERIA: The trainee's repairs to SMAW equipment and accessories are made in accordance with the manufacturer's recommendations and the institution's repair policy. The correct repair materials, equipment, and tools are selected. The assignment is completed in a timely manner. The objective is performed as required during the SMAW portion of the program

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on SMAW equipment and accessories identification.
2. Provide instruction and demonstrations on minor external repairs on SMAW equipment and accessories.
3. Introduce relevant terms and definitions and observe trainee using proper SMAW terms and definitions.
4. Provide training exercises on making minor external repairs on SMAW equipment and accessories.
5. Observe each trainee's ability to carry out training exercises on making minor external repairs on SMAW equipment and accessories.
6. Observe trainee following safe practices for SMAW while making repairs.
7. Develop and administer formative or diagnostic tests on SMAW equipment and accessories identification and making minor external repairs.
8. Prepare trainee for the SMAW equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume One, Welding Technology; Volume Two, Welding Processes—Part 1*.
9. Keep records reflecting each trainee's successful completion of training in SMAW equipment and accessories identification, and making minor external repairs.

3.3.1 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATOR 3: Sets up for SMAW operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, SMAW equipment and accessories, hand tools, carbon steel base metal and E6010 or E6011, and E7018 electrodes, the trainee will set up and prepare to perform SMAW operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, and electrodes are selected. SMAW equipment and accessories are set up and adjusted for the proper current and polarity. Parts are assembled according to job requirements. The objective is performed on a routine basis during the SMAW portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction on AC and DC welding principles.
2. Provide demonstrations on SMAW equipment and accessory set up on carbon steel.
3. Provide instruction on SMAW principles of operations on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on SMAW filler metal identification and selection for carbon steel.
6. Introduce relevant terms and definitions and observe trainee using proper SMAW terms and definitions.
7. Provide trainee with practice setting up SMAW equipment and accessories for carbon steel.
8. Observe trainee setting up SMAW equipment and accessories for carbon steel.
9. Observe trainee following safe SMAW practices.
10. Develop and administer formative or diagnostic tests on SMAW equipment set up, principles of operation, and carbon steel base and filler metal identification and selection.
11. Prepare trainees for the SMAW principles of operation, and carbon steel base and filler metal identification and selection portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume Two, Welding Processes—Part 1*.
12. Keep training records reflecting each trainee's successful completion of training in SMAW equipment set up, principles of operation, carbon steel base and filler metal identification and selection.

3.3.1 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATOR 4: Operates SMAW equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration verbal or written instructions, protective clothing and equipment, SMAW equipment and accessories, hand tools, carbon steel base metal and E6010 or E6011, and E7018 electrodes, the trainee will perform SMAW operations on carbon steel.

EVALUATION CRITERIA: The trainee's SMAW is completed as required by the welding assignment. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on SMAW equipment operations on carbon steel.
2. Provide instruction on SMAW principles of operation on carbon steel.
3. Provide instruction on essential process variables for SMAW on carbon steel.
4. Provide training exercises on SMAW equipment operation on carbon steel.
5. Provide training exercises on starting and maintaining an arc SMAW, using E6010 or E6011, and E7018 electrodes, on carbon steel.
6. Provide training exercises on making 1G, single layer, multiple pass, SMAW stringer bead welds, using E6010 or E6011, and E7018 electrodes, on carbon steel.
7. Provide training exercises on making 1G, multiple layer, multiple pass, SMAW stringer bead welds using E6010 or E6011 and E7018 electrodes, on carbon steel.
8. Observe trainee operating SMAW equipment on carbon steel.
9. Observe trainee following safe SMAW practices.
10. Visually inspect trainee's SMAW stringer bead welds.
11. Develop and administer formative or diagnostic tests on SMAW principles of operation and essential process variables.
12. Prepare trainee for the SMAW principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume Two, Welding Processes—Part 1*.
13. Keep training records reflecting each trainee's successful completion of training in SMAW principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATOR 5: Makes fillet welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, SMAW equipment and accessories, hand tools, carbon steel base metal and E6010 or E6011, and E7018 electrodes, the trainee will make SMAW fillet welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound SMAW fillet welds in all positions on carbon steel. During and after each operation, welds are visually examined by the welder and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on SMAW fillet welding, in all position, on carbon steel.
2. Provide instruction on visual examination of SMAW fillet welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for SMAW fillet welding, in all positions, on carbon steel.
4. Provide training exercises on making 1F, single and multiple pass SMAW fillet welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
5. Provide training exercises on making 2F, single and multiple pass SMAW fillet welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
6. Provide training exercises on making 3F, uphill, single and multiple pass SMAW fillet welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
7. Provide training exercises on making 4F, single and multiple pass SMAW fillet welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
8. Observe trainee operating SMAW equipment on carbon steel.
9. Observe trainee following safe SMAW practices.
10. Visually inspect trainee's SMAW fillet welds.
11. Develop and administer formative or diagnostic tests on SMAW fillet welding principles of operation and essential process variables.
12. Prepare trainee for the SMAW principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume Two, Welding Processes—Part 1*.
13. Keep training records reflecting each trainee's successful completion of making fillet welds in all positions on carbon steel.

3.3.1 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATOR 6: Makes groove weld in all positions on carbon steel.

OBJECTIVE: Provided with a period of demonstration, protective clothing and equipment, SMAW equipment and accessories, E6010 or E6011, and E7018 electrodes, carbon steel base metal, hand tools, and a welding assignment, the trainee will make SMAW groove welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound groove welds in all positions on carbon steel. During and after each operation, welds are visually examined by the welder and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on SMAW groove welding, in all position, on carbon steel.
2. Provide instruction on visual examination of SMAW groove welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for SMAW groove welding, in all positions, on carbon steel.
3. Provide training exercises on making 1G, single and multiple pass SMAW groove welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
4. Provide training exercises on making 2G, single and multiple pass SMAW groove welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
5. Provide training exercises on making 3G, uphill, single and multiple pass SMAW groove welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
6. Provide training exercises on making 4G, single and multiple pass SMAW groove welds, using E6010, or E6011, and E7018 electrodes, on carbon steel.
7. Observe trainee operating SMAW equipment on carbon steel.
8. Observe trainee following safe SMAW practices.
9. Visually inspect trainee's SMAW groove welds.
10. Develop and administer formative or diagnostic tests on SMAW groove welding principles of operation and essential process variables.
11. Prepare trainee for the SMAW principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume Two, Welding Processes—Part 1*.
12. Keep training records reflecting each trainee's successful completion of making groove welds in all positions on carbon steel.

3.3.1 MODULE 4: SHIELDED METAL ARC WELDING (SMAW)

KEY INDICATOR 7: Passes SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, SMAW equipment, accessories, E7018 electrodes, 3/8 in. thick carbon steel base metal, 1/4 in. to 3/8 in. thick carbon steel backing material, Welding Procedure Specifications AWS EDU SMAW-01 and AWS EDU SMAW-02, and drawing number AWS EDU-6, the trainee will perform SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound SMAW groove welds in the 2G, and 3G, uphill positions on carbon steel. Test assemblies are prepared according to drawing specifications and approved by the instructor. In accordance with the requirements of AWS QC10, WPS AWS EDU SMAW-01 and WPS AWS EDU SMAW-02, and drawing number AWS EDU-6, the trainee passes the fabrication, weld symbol interpretation and welding elements of SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and 2G and 3G, uphill, SMAW groove welding elements of SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel.
2. Administer SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel, upon completion of SMAW on carbon steel training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting each trainee's successful completion of the SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for the Safety and Health of Welders, Drawing and Welding Symbol Interpretation, SMAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel, may be reported to AWS to obtain Level I—Entry Welder certification in SMAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 1: Performs safety inspections of GMAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, GMAW equipment and accessories, and GMAW shielding gas supply system equipment and accessories, the trainee performs safety inspections of protective clothing, hand tools, GMAW equipment and accessories, GMAW shielding gas supply system equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective clothing and equipment, hand tools, GMAW equipment and accessories, GMAW shielding gas supply system equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of GMAW operations. In the course of daily operations, the trainee is observed following safe GMAW practices on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation to GMAW equipment and accessories, and GMAW shielding gas supply system equipment and accessories.
2. Provide demonstrations on ANSI Z49.1, Section 11, *Arc Welding and Cutting Equipment Safety*.
3. Provide demonstration on routine safety inspections of protective equipment and clothing, hand tools, GMAW equipment and accessories, shielding gas supply system equipment and accessories, and work area.
4. Provide Instruction on ANSI Z49.1, Section 11.
5. Reinforce previous instruction from ANSI Z49.1, Part I—*General Aspects*.
6. Introduce relevant terms and definitions and observe trainee using proper GMAW terms and definitions.
7. Observe trainee conducting safety inspections for GMAW.
8. Observe trainee following safe GMAW practices.
9. Develop and administer formative or diagnostic tests on safe GMAW practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep training records reflecting each trainee's successful completion of training in GMAW safe practices.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 2: Makes minor external repairs to GMAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on repair materials, equipment and tools, the trainee will make minor external repairs to GMAW equipment and accessories, and GMAW shielding gas supply system equipment and accessories.

EVALUATION CRITERIA: The trainee makes minor repairs to GMAW equipment and accessories, and GMAW shielding gas supply system equipment and accessories as required, in accordance with the manufacturer's recommendations and the institution's repair policy. The correct materials, equipment and tools are selected. The assignment is completed in a timely manner. The objective is performed as required during the GMAW portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on GMAW equipment and accessories identification.
2. Provide instruction and demonstrations on GMAW shielding gas supply system equipment and accessories identification.
3. Provide instruction and demonstrations on minor external repairs on GMAW equipment and accessories.
4. Provide instruction and demonstrations on minor external repairs on GMAW shielding gas supply system equipment and accessories.
5. Introduce relevant terms and definitions and observe trainee using proper GMAW terms and definitions.
6. Provide training exercises on making minor external repairs on GMAW equipment and accessories.
7. Observe each trainee's ability to carry out training exercises on making minor external repairs on GMAW equipment and accessories.
8. Observe trainee following safe practices for GMAW while making repairs.
9. Develop and administer formative or diagnostic tests on GMAW equipment and accessories, and GMAW shielding gas equipment and accessories identification and making minor external repairs.
10. Prepare trainee for the GMAW component and accessories, and GMAW shielding gas equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of AWS C5.6.
11. Keep records reflecting each trainee's successful completion of training in GMAW component and accessories, GMAW shielding gas equipment and accessories identification, and making minor external repairs.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 3: Sets up for GMAW-S operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW-S equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.035 in. or 0.045 in. E70S-X electrodes, and carbon steel base metal, the trainee will set up and prepare to perform GMAW-S operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, shielding gas, and filler metals are selected. GMAW-S equipment and accessories are set up and adjusted for proper voltage, polarity and wire feed speed. GMAW-S shielding gas supply system equipment and accessories are set up and adjusted to the proper flow rate. Parts are assembled according to job requirements. The objective is performed on a routine basis during the GMAW-S portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW-S equipment and accessories set up for carbon steel.
2. Provide demonstrations on GMAW-S shielding gas supply system equipment and accessories set up for carbon steel.
3. Provide instruction on GMAW-S principles of operation on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on shielding gases for GMAW-S on carbon steel.
6. Provide instruction on GMAW-S filler metal identification and selection for carbon steel.
7. Introduce relevant terms and definitions and observe trainee using proper GMAW-S terms and definitions.
8. Provide trainee with practice setting up GMAW-S equipment and accessories for carbon steel.
9. Provide trainee with practice setting up GMAW-S shielding gas supply system equipment and accessories for carbon steel.
10. Observe trainee setting up GMAW-S equipment and accessories for carbon steel.
11. Observe trainee setting up GMAW-S shielding gas supply system equipment and accessories for carbon steel.
12. Observe trainee following safe GMAW-S practices.
13. Develop and administer formative or diagnostic tests on GMAW-S equipment set up, principles of operation, and carbon steel base and filler metal identification and selection.
14. Prepare trainee for the GMAW-S equipment set up, principles of operation, and carbon steel base and filler metal identification and selection portion of a written examination from the relevant sections of AWS C5.6.
15. Keep training records reflecting each trainee's successful completion of training in GMAW-S equipment set up, principles of operation, and carbon steel base and filler metal identification and selection.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 4: Operates GMAW-S equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW-S equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.035 in. or 0.045 in. E70S-X electrodes, carbon steel base metal, and a welding assignment, the trainee will perform GMAW-S operations on carbon steel.

EVALUATION CRITERIA: The trainee's GMAW-S welding is completed as required by the welding assignment on a routine basis. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW-S equipment operation on carbon steel.
2. Provide instruction on GMAW-S principles of operation on carbon steel.
3. Provide instruction on essential process variables for GMAW-S on carbon steel.
4. Provide training exercises on GMAW-S equipment operation on carbon steel.
5. Provide training exercises on starting and maintaining a GMAW-S arc on carbon steel.
6. Provide training exercises on making 1G, single layer, multiple pass, GMAW-S stringer bead welds, using 0.035 in. or 0.045 in. diameter E70S-X electrodes and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
7. Provide training exercises on making 1G, multiple layer, multiple pass, GMAW-S stringer bead welds, using 0.035 in. or 0.045 in. diameter E70S-X electrodes and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
8. Observe trainee operating GMAW-S equipment on carbon steel.
9. Observe trainee following safe GMAW-S practices.
10. Visually inspect trainee's GMAW-S stringer bead welds.
11. Develop and administer formative or diagnostic tests on GMAW-S principles of operation and essential process variables.
12. Prepare trainee for the GMAW-S principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.6.
13. Keep training records reflecting each trainee's successful completion of training in GMAW-S principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 5: Makes fillet welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW-S equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.035 or 0.045 diameter E70S-X electrodes, carbon steel base metal, and a welding assignment, the trainee will make GMAW-S fillet welds on carbon steel in all positions.

EVALUATION CRITERIA: The trainee produces sound GMAW-S fillet welds in all position on carbon steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW-S fillet welding, in all positions, on carbon steel.
2. Provide instruction on visual examination of GMAW-S fillet welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for GMAW-S fillet welding, in all positions, on carbon steel.
4. Provide training exercises on making 1F single and multiple pass GMAW-S fillet welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
5. Provide training exercises on making 2F single and multiple pass GMAW-S fillet welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
6. Provide training exercises on making 3F single and multiple pass GMAW-S fillet welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
7. Provide training exercises on making 4F single and multiple pass GMAW-S fillet welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
8. Observe trainee operating GMAW-S equipment on carbon steel.
9. Observe trainee following safe GMAW-S practices.
10. Visually inspect trainee's GMAW-S fillet welds.
11. Develop and administer formative or diagnostic tests on GMAW-S fillet welding principles of operation and essential process variables.
12. Prepare trainee for the GMAW-S principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.6.
13. Keep training records reflecting each trainee's successful completion of making fillet welds in all positions on carbon steel.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 6: Makes groove welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW-S equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.035 in. or 0.045 in. diameter E70S-X electrodes, carbon steel base metal, and a welding assignment, the trainee will make GMAW-S groove welds on carbon steel in all positions.

EVALUATION CRITERIA: The trainee produces sound GMAW-S groove welds in all position on carbon steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW-S groove welding, in all positions, on carbon steel.
2. Provide instruction on visual examination of GMAW-S groove welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for GMAW-S groove welding, in all positions, on carbon steel.
4. Provide training exercises on making 1G, single and multiple pass GMAW-S groove welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
5. Provide training exercises on making 2G, single and multiple pass GMAW-S groove welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
6. Provide training exercises on making 3G, uphill, single and multiple pass GMAW-S groove welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
7. Provide training exercises on making 4G, single and multiple pass GMAW-S groove welds, using 0.035 or 0.045 diameter E70S-X electrodes, and CO₂ or 75% Ar/25% CO₂ shielding gas, on carbon steel.
8. Observe trainee operating GMAW-S equipment on carbon steel.
9. Observe trainee following safe GMAW-S practices.
10. Visually inspect trainee's GMAW-S groove welds.
11. Develop and administer formative or diagnostic tests on GMAW-S fillet welding principles of operation and essential process variables.
12. Prepare trainee for the GMAW-S principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.6.
13. Keep training records reflecting each trainee's successful completion of making groove welds in all positions on carbon steel.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 7: Passes GMAW-S welder performance qualification test on carbon steel.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, GMAW-S equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.035 in. or 0.045 in. diameter E70S-X electrodes, 10-14 gauge carbon steel base metal, Welding Procedure Specification AWS EDU GMAW-01, and drawing number AWS EDU-3, the trainee will perform GMAW-S welder performance qualification test on carbon steel with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound GMAW-S fillet and groove welds on carbon steel. Test assembly is prepared according to drawing specifications. In accordance with the requirements of AWS QC10, WPS AWS EDU GMAW-01, and drawing number AWS EDU-3, the trainee passes the fabrication, weld symbol interpretation and welding elements of GMAWS welder performance qualification test on carbon steel.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and GMAW-S fillet and groove welding elements of GMAW-S welder performance qualification test on carbon steel.
2. Administer GMAW-S welder performance qualification test on carbon steel upon completion of GMAW-S on carbon steel training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting each trainee's successful completion of GMAW-S welder performance qualification test on carbon steel.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for Safety and Health of Welders, Drawing and Welding Symbol Interpretation, GMAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the GMAW-S and GMAW (spray) performance qualification tests on carbon steel, may be reported to AWS to obtain Level I—Entry Welder certification in GMAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 8: Sets up for GMAW (spray) operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW (spray) equipment and accessories, 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer) with supply system equipment and accessories, 0.035 in. or 0.045 in. diameter E70S-X electrodes, and carbon steel base metal, the trainee will set up and prepare to perform GMAW (spray) operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, shielding gas, and filler metals are selected. GMAW (spray) equipment and accessories are set up and adjusted for proper voltage, polarity and wire feed speed. GMAW (spray) shielding gas supply system equipment and accessories are set up and adjusted to the proper flow rate. Parts are assembled according to job requirements. The objective is performed on a routine basis during the GMAW (spray) portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW (spray) equipment and accessory set up for carbon steel.
2. Provide demonstrations on GMAW (spray) shielding gas supply system equipment and accessories set up for carbon steel.
3. Provide instruction on GMAW (spray) principles of operation on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on shielding gases for GMAW (spray) on carbon steel.
6. Provide instruction on GMAW (spray) filler metal identification and selection for carbon steel.
7. Introduce relevant terms and definitions and observe trainee using proper GMAW (spray) terms and definitions.
8. Provide trainee with practice setting up GMAW (spray) equipment and accessories for carbon steel.
9. Provide trainee with practice setting up GMAW (spray) shielding gas supply system equipment and accessories for carbon steel.
10. Observe trainee setting up GMAW (spray) equipment and accessories for carbon steel.
11. Observe trainee setting up GMAW (spray) shielding gas supply system equipment and accessories for carbon steel.
12. Observe trainee following safe GMAW (spray) practices.
13. Develop and administer formative or diagnostic tests on GMAW (spray) principles of operation and essential process variables.
14. Prepare trainee for the GMAW (spray) principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.6.
15. Keep training records reflecting each trainee's successful completion of training in GMAW (spray) equipment set up, principles of operation, and carbon steel base and filler metal identification and selection.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 9: Operates GMAW (spray) equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW (spray) equipment and accessories, 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), 0.035 in. or 0.045 in. E70S-X electrodes, carbon steel base metal, and a welding assignment, the trainee will perform GMAW (spray) operations on carbon steel.

EVALUATION CRITERIA: The trainee's GMAW (spray) welding is completed as required by the welding assignment on a routine basis. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW (spray) equipment operation on carbon steel.
2. Provide instruction on GMAW (spray) principles of operation on carbon steel.
3. Provide instruction on essential process variables for GMAW (spray) on carbon steel.
4. Provide training exercises on GMAW (spray) equipment operation on carbon steel.
5. Provide training exercises on starting and maintaining a GMAW (spray) arc on carbon steel.
6. Provide training exercises on making 1G, single layer, multiple pass, GMAW (spray) stringer bead welds, using 0.035 in. or 0.045 in. diameter E70S-X electrodes, and 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), on carbon steel.
7. Provide training exercises on making 1G, multiple layer, multiple pass, GMAW (spray) stringer bead welds, using 0.035 in. or 0.045 in. diameter E70S-X electrodes, and 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), on carbon steel.
8. Observe trainee operating GMAW (spray) equipment on carbon steel.
9. Observe trainee following safe GMAW (spray) practices.
10. Visually inspect trainee's GMAW (spray) stringer bead welds.
11. Develop and administer formative or diagnostic tests on GMAW (spray) principles of operation and essential process variables.
12. Prepare trainee for the GMAW (spray) principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.6.
13. Keep training records reflecting each trainee's successful completion of training in GMAW (spray) equipment principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 10: Makes fillet welds in the 1F and 2F positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW (spray) equipment and accessories, 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), 0.035 in. or 0.045 in. diameter E70S-X electrodes, carbon steel base metals, and a welding assignment, the trainee will make GMAW (spray) fillet welds on carbon steel in the 1F and 2F positions.

EVALUATION CRITERIA: The trainee produces sound GMAW (spray) fillet welds in the 1F and 2F positions, on carbon steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW (spray) fillet welding, in 1F and 2F positions, on carbon steel.
2. Provide instruction on visual examination of GMAW (spray) fillet welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for GMAW (spray) fillet welding, in 1F and 2F positions, on carbon steel.
4. Provide training exercises on making 1F, single and multiple pass GMAW (spray) fillet welds, using 0.035 in. or 0.045 in. diameter E70S-X electrodes, and 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), on carbon steel.
5. Provide training exercises on making 2F, single and multiple pass GMAW (spray) fillet welds, using 0.035 in. or 0.045 in. diameter E70S-X electrodes, and 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), on carbon steel.
6. Observe trainee operating GMAW (spray) equipment on carbon steel.
7. Observe trainee following safe GMAW (spray) practices.
8. Visually inspect trainee's GMAW (spray) fillet welds.
9. Develop and administer formative or diagnostic tests on GMAW (spray) fillet welding principles of operation and essential process variables.
10. Prepare trainee for the GMAW (spray) principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.6.
11. Keep training records reflecting each trainee's successful completion of making fillet welds in the 1F and 2F positions on carbon steel.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW (spray transfer))

KEY INDICATOR 11: Makes groove welds in the 1G position on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GMAW (spray) equipment and accessories, 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), 0.035 in. or 0.045 in. diameter E70S-X electrodes, carbon steel base metal, and a welding assignment, the trainee will make GMAW (spray) groove welds on carbon steel in the 1G position.

EVALUATION CRITERIA: The trainee produces sound GMAW (spray) groove welds in the 1G position on carbon steel. During and after each operation, welds are visually examined by the welder and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GMAW (spray) groove welding, in 1G position, on carbon steel.
2. Provide instruction on visual examination of GMAW (spray) groove welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for GMAW (spray) groove welding, in 1G position, on carbon steel.
4. Provide training exercises on making 1G, single and multiple pass GMAW (spray) groove welds, using 0.035 in. or 0.045 in. diameter E70S-X electrodes, and 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), on carbon steel
5. Observe trainee operating GMAW (spray) equipment on carbon steel.
6. Observe trainee following safe GMAW (spray) practices.
7. Visually inspect trainee's GMAW (spray) groove welds.
8. Develop and administer formative or diagnostic tests on GMAW (spray) groove welding principles of operation and essential process variables.
9. Prepare trainee for the GMAW (spray) principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.6.
10. Keep training records reflecting each trainee's successful completion of making groove welds in the 1G position on carbon.

3.3.1 MODULE 5: GAS METAL ARC WELDING (GMAW-S, GMAW spray transfer)

KEY INDICATOR 12: Passes GMAW (spray) welder performance qualification test on carbon steel.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, GMAW (spray) equipment and accessories, 90% Ar /10% CO₂ shielding gas (or other acceptable mixture for spray transfer), 0.035 in. or 0.045 in. diameter E70S-X electrodes, 3/8 in. thick carbon steel base metal, Welding Procedure Specification AWS EDU GMAW-02, and drawing number AWS EDU-2, the trainee will perform GMAW (spray) welder performance qualification test on carbon steel with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound GMAW (spray) fillet and groove welds on carbon steel. Test assembly is prepared according to drawing specifications. In accordance with AWS QC10, WPS AWS EDU GMAW-02, and drawing number AWS EDU-2, the trainee passes the fabrication, weld symbol interpretation and welding elements of GMAW (spray) welder performance qualification test on carbon steel.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and GMAW (spray) fillet and groove welding elements of GMAW (spray) welder performance qualification test on carbon steel.
2. Administer GMAW (spray) welder performance qualification test on carbon steel upon completion of GMAW (spray) on carbon steel training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting each trainee's successful completion of GMAW (spray) welder performance qualification test on carbon steel.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for Safety and Health of Welders, Drawing and Welding Symbol Interpretation, GMAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the GMAW-S and GMAW (spray) performance qualification tests on carbon steel, may be reported to AWS to obtain Level I—Entry Welder certification in GMAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 1: Performs safety inspections of FCAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, FCAW equipment and accessories, and FCAW-G/GM shielding gas supply system equipment and accessories, the trainee performs safety inspections of protective clothing and equipment, hand tools, FCAW equipment and accessories, FCAW-G/GM shielding gas supply system equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective clothing and equipment, hand tools, FCAW equipment and accessories, FCAW-G/GM shielding gas supply system equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of FCAW operations. In the course of daily operations, the trainee is observed following safe FCAW practices on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation for FCAW equipment and accessories, and FCAW/GM shielding gas supply system equipment and accessories.
2. Provide demonstrations on ANSI Z49.1, Section 11, *Arc Welding and Cutting Equipment Safety*.
3. Provide demonstrations on routine safety inspections of protective equipment and clothing, hand tools, FCAW equipment and accessories, FCAW-G/GM shielding gas supply system equipment and accessories, and work area.
4. Provide instruction on ANSI Z49.1, Section 11.
5. Reinforce previous instruction from ANSI Z49.1, Part I—*General Aspects*.
6. Introduce relevant terms and definitions and observe trainee using proper FCAW terms and definitions.
7. Observe trainee conducting safety inspections for FCAW.
8. Observe trainee following safe FCAW practices.
9. Develop and administer formative or diagnostic tests on safe FCAW practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep training records reflecting each trainee's successful completion of training in FCAW safe practices.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 2: Makes minor external repairs to FCAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on repair materials, equipment and tools, the trainee will make minor external repairs to FCAW equipment and accessories, and FCAW-G/GM shielding gas supply system equipment and accessories.

EVALUATION CRITERIA: The trainee makes repairs to FCAW equipment and accessories, and FCAW-G/GM shielding gas supply system equipment and accessories as required, in accordance with the manufacturer's recommendations and the institution's repair policy. The correct materials, equipment, and tools are selected. The assignment is completed in a timely manner. The objective is performed as required during the FCAW portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on FCAW equipment and accessories identification.
2. Provide instruction and demonstrations on FCAW-G/GM shielding gas supply system equipment and accessories identification.
3. Provide instruction and demonstrations on minor external repairs on FCAW equipment and accessories.
4. Provide instruction and demonstrations on minor external repairs on FCAW-G/GM shielding gas supply system equipment and accessories.
5. Introduce relevant terms and definitions and observe trainee using proper FCAW terms and definitions.
6. Provide training exercises on making minor external repairs on FCAW equipment and accessories.
7. Provide training exercises on making minor external repairs on FCAW-G/GM shielding gas supply system equipment and accessories.
8. Observe each trainee's ability to carry out training exercises on making minor external repairs on FCAW equipment and accessories.
9. Observe each trainee's ability to carry out training exercises on making minor external repairs on FCAW-G/GM shielding gas supply system equipment and accessories.
10. Observe trainee following safe practices for FCAW while making repairs.
11. Develop and administer formative or diagnostic tests on FCAW equipment and accessories, and FCAW-G/GM shielding gas supply system equipment and accessories identification and making minor external repairs.
12. Prepare trainee for the FCAW equipment and accessories, and FCAW-G/GM shielding gas supply system equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Processes—Part 1*.
13. Keep records reflecting each trainee's successful completion of training in FCAW equipment and accessories, FCAW-G/GM shielding gas supply system equipment and accessories identification, and making minor external repairs.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 3: Sets up for FCAW-G/GM operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-G/GM equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.045 in. or 0.052 in. diameter E71T-1 electrodes, and carbon steel base metal, the trainee will set up and prepare to perform FCAW-G/GM operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, shielding gas, and filler metals are selected. FCAW-G/GM equipment and accessories are set up and adjusted to the proper voltage, wire feed speed, and polarity. FCAW-G/GM shielding gas supply system equipment and accessories are set up and adjusted to the proper flow rate. Parts are assembled according to job requirements. The objective is performed on a routine basis during the FCAW-G/GM portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-G/GM equipment and accessories set up for carbon steel.
2. Provide demonstrations on FCAW-G/GM shielding gas supply system equipment and accessories set up for carbon steel.
3. Provide instruction on FCAW-G/GM principles of operation on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on shielding gases for FCAW-G/GM on carbon steel.
6. Provide instruction on FCAW-G/GM filler metal identification and selection for carbon steel.
7. Introduce relevant terms and definitions and observe trainee using proper FCAW-G/GM terms and definitions.
8. Provide trainee with practice setting up FCAW-G/GM equipment and accessories for carbon steel.
9. Provide trainee with practice setting up FCAW-G/GM shielding gas supply system equipment and accessories for carbon steel.
10. Observe trainee setting up FCAW-G/GM equipment and accessories for carbon steel.
11. Observe trainee setting up FCAW-G/GM shielding gas supply system equipment and accessories for carbon steel.
12. Observe trainee following safe FCAW-G/GM practices.

13. Develop and administer formative or diagnostic tests on FCAW-G/GM equipment set up, principles of operation, and carbon steel base and filler metal identification and selection.

14. Prepare trainee for the FCAW-G/GM equipment set up, principles of operation, and carbon steel base and filler metal identification and selection portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Processes—Part 1*.

15. Keep training records reflecting each trainee's successful completion of training in FCAW-G/GM equipment set up, principles of operation, and carbon steel base and filler metal identification and selection.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 4: Operates FCAW-G/GM equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-G/GM equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.045 in. or 0.052 in. diameter E71T-1 electrodes, carbon steel base metal, and a welding assignment, the trainee will perform FCAW-G/GM operations on carbon steel.

EVALUATION CRITERIA: The trainee's FCAW-G/GM welding is completed as required by the welding assignment on a routine basis. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-G/GM equipment operations on carbon steel.
2. Provide instruction on FCAW-G/GM principles of operation on carbon steel.
3. Provide instruction on essential process variables for FCAW-G/GM on carbon steel.
4. Provide training exercises on FCAW-G/GM equipment operations on carbon steel.
5. Provide training exercises on starting and maintaining a FCAW-G/GM arc on carbon steel.
6. Provide training exercises on making 1G, single layer, multiple pass, stringer bead FCAW-G/GM welds, using 0.045 in. or 0.052 in. diameter E71T-1 electrodes, and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
7. Provide training exercises on making 1G, multiple layer, multiple pass, stringer bead FCAW-G/GM welds, using 0.045 in. or 0.052 in. diameter E71T-1 electrodes, and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
8. Observe trainee operating FCAW-G/GM equipment on carbon steel.
9. Observe trainee following safe FCAW-G/GM practices.
10. Visually inspect trainee's FCAW-G/GM stringer bead welds.
11. Develop and administer formative or diagnostic tests on FCAW-G/GM principles of operation and essential process variables.
12. Prepare trainee for the FCAW-G/GM principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Process—Part 1*.
13. Keep training records reflecting each trainee's successful completion of training in FCAW-G/GM principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 5: Makes fillet welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-G/GM equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.045 in. or 0.052 in. diameter E71T-1 electrodes, carbon steel base metals, and a welding assignment, the trainee will make FCAW-G/GM fillet welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound FCAW-G/GM fillet welds in all positions on carbon steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-G/GM fillet welding, in all positions, on carbon steel.
2. Provide instruction on visual examination of FCAW-G/GM fillet welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for FCAW-G/GM fillet welding, in all positions, on carbon steel.
3. Provide training exercises on making 1F, single and multiple pass FCAW-G/GM fillet welds, using 0.045 in. or 0.052 in. diameter E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
4. Provide training exercises on making 2F, single and multiple pass FCAW-G/GM fillet welds, using 0.045 in. or 0.052 in. diameter E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
5. Provide training exercises on making 3F, single and multiple pass FCAW-G/GM fillet welds, using 0.045 in. or 0.052 in. diameter E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
6. Provide training exercises on making 4F, single and multiple pass FCAW-G/GM fillet welds, using 0.045 in. or 0.052 in. diameter E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
7. Observe trainee operating FCAW-G/GM equipment on carbon steel.
8. Observe trainee following safe FCAW-G/GM practices.
9. Visually inspect trainee's FCAW-G/GM fillet welds.
10. Develop and administer formative or diagnostic tests on FCAW-G/GM fillet welding principles of operation and essential process variables.
11. Prepare trainee for the FCAW-G/GM principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Process—Part 1*.
12. Keep training records reflecting each trainee's successful completion of making fillet welds in all positions on carbon steel.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 6: Makes groove welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-G/GM equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.045 in. or 0.052 in. E71T-1 electrodes, carbon steel base metal, and a welding assignment, the trainee will make FCAW-G/GM groove welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound FCAW-G/GM groove welds in all positions on carbon steel. During and after each operation, welds are visually examined by the welder and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-G/GM groove welding, in all positions, on carbon steel.
2. Provide instruction on visual examination of FCAW-G/GM groove welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for FCAW-G/GM groove welding, in all positions, on carbon steel.
3. Provide training exercises on making 1G, single and multiple pass FCAW-G/GM groove welds, using 0.045 in. or 0.052 in. E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
4. Provide training exercises on making 2G, single and multiple pass FCAW-G/GM groove welds, using 0.045 in. or 0.052 in. E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
5. Provide training exercises on making 3G, single and multiple pass FCAW-G/GM groove welds, using 0.045 in. or 0.052 in. E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
6. Provide training exercises on making 4G, single and multiple pass FCAW-G/GM groove welds, using 0.045 in. or 0.052 in. E71T-1 electrodes and CO₂ (G) or 75% Ar /25% CO₂ (GM) shielding gas, on carbon steel.
7. Observe trainee operating FCAW-G/GM equipment on carbon steel.
8. Observe trainee following safe FCAW-G/GM practices.
9. Visually inspect trainee's FCAW-G/GM groove welds.
10. Develop and administer formative or diagnostic tests on FCAW-G/GM groove welding principles of operation and essential process variables.
11. Prepare trainee for the FCAW-G/GM principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Process—Part 1*.
12. Keep training records reflecting each trainee's successful completion of making groove welds in all positions on carbon steel.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 7: Passes FCAW-G/GM welder performance qualification test on carbon steel.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, FCAW-G/GM equipment and accessories, CO₂ or 75% Ar/25% CO₂ shielding gas, 0.045 in. or 0.052 in. E71T-1 electrodes, 3/8 in. thick carbon steel base metal, Welding Procedure Specification AWS EDU FCAW-01 (G) or AWS EDU FCAW-02 (GM), and drawing number AWS EDU-1, the trainee will perform FCAW-G/GM welder performance qualification test on carbon steel using either FCAW-G or FCAW-GM with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound FCAW-G or FCAW-GM fillet and groove welds. Test assembly is prepared according to drawing specifications. In accordance with the requirements of AWS QC10, WPS AWS EDU FCAW-01 (G) or WPS AWS EDU FCAW-02 (GM), and drawing number AWS EDU-1, the trainee passes FCAW-G/GM welder performance qualification test on carbon steel.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and FCAW-G/GM fillet and groove welding elements of FCAW-G/GM welder performance qualification test on carbon steel.
2. Administer FCAW-G/GM welder performance qualification test on carbon steel upon completion of FCAW-G/GM on carbon steel training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting each trainee's successful completion of FCAW-G/GM welder performance qualification test on carbon steel.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for Safety and Health of Welders, Drawing and Welding Symbol Interpretation, FCAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the FCAW-G/GM and FCAW-S performance qualification tests on carbon steel, may be reported to AWS to obtain Level I—Entry Welder certification in FCAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 8: Sets up for FCAW-S operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-S equipment and accessories, 0.045 in. or 0.052 in. E71T-11 electrodes, and carbon steel base metal, the trainee will set up and prepare to perform FCAW-S operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, shielding gas, and filler metals are selected. FCAW-S equipment and accessories are set up and adjusted to the proper voltage, wire feed speed, and polarity. Parts are assembled according to job requirements. The objective is performed on a routine basis during the FCAW-S portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-S equipment and accessories set up for carbon steel.
2. Provide instruction on FCAW-S principles of operation on carbon steel.
3. Provide instruction on carbon steel shapes, identification and selection.
4. Provide instruction on FCAW-S filler metals identification and selection for carbon steel.
5. Introduce relevant terms and definitions and observe trainee using proper FCAW-S terms and definitions.
6. Provide trainee with practice setting up FCAW-S equipment and accessories for carbon steel.
7. Observe trainee setting up FCAW-S equipment and accessories for carbon steel.
8. Observe trainee following safe FCAW-S practices.
9. Develop and administer formative or diagnostic tests on FCAW-S equipment setup, principles of operation, and carbon steel base and filler metal identification and selection.
10. Prepare trainee for the FCAW-S equipment set up, principles of operation, and carbon steel base and filler metal identification and selection portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Processes—Part 1*.
11. Keep training records reflecting each trainee's successful completion of training in FCAW-S equipment set up, principles of operation, and carbon steel base and filler metal identification and selection.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 9: Operates FCAW-S equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-S equipment and accessories, 0.045 in. or 0.052 in. diameter E71T-11 electrodes, carbon steel base metals, and a welding assignment, the trainee will perform FCAW-S operations.

EVALUATION CRITERIA: The trainee's FCAW-S welding is completed as required by the welding assignment on a routine basis. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-S equipment operations on carbon steel.
2. Provide instruction on FCAW-S principles of operation on carbon steel.
3. Provide instruction on essential process variables for FCAW-S on carbon steel.
4. Provide training exercises on FCAW-S equipment operation on carbon steel.
5. Provide training exercises on starting and maintaining a FCAW-S arc on carbon steel.
6. Provide training exercises on making 1G, single layer, multiple pass, stringer bead FCAW-S welds, using 0.045 in. or 0.052 in. diameter E71T-11 electrodes, on carbon steel.
7. Provide training exercises on making 1G, multiple layer, multiple pass, stringer bead FCAW-S welds, using 0.045 in. or 0.052 in. diameter E71T-11 electrodes, on carbon steel.
8. Observe trainee operating FCAW-S equipment on carbon steel.
9. Observe trainee following safe FCAW-S practices.
10. Visually inspect trainee's stringer bead welds.
11. Develop and administer formative or diagnostic tests on FCAW-S principles of operation and common process variables.
12. Prepare trainee for the FCAW-S principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Process—Part 1*.
13. Keep training records reflecting each trainee's successful completion of training in FCAW-S equipment principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 10: Makes fillet welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-S equipment and accessories, 0.045 in. or 0.052 in. E71T-11 electrodes, carbon steel base metals, and a welding assignment, the trainee will make FCAW-S fillet welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound FCAW-S fillet welds in all positions on carbon steel. During and after each operation, welds are visually examined by the welder and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-S fillet welding, in all position, on carbon steel.
2. Provide instruction on visual examination of FCAW-S fillet welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for FCAW-S fillet welding, in all positions, on carbon steel.
3. Provide training exercises on making 1F single and multiple pass FCAW-S fillet welds on carbon steel.
4. Provide training exercises on making 2F single and multiple pass FCAW-S fillet welds on carbon steel.
5. Provide training exercises on making 3F single and multiple pass FCAW-S fillet welds on carbon steel.
6. Provide training exercises on making 4F single and multiple pass FCAW-S fillet welds on carbon steel.
7. Observe trainee operating FCAW-S equipment on carbon steel.
8. Observe trainee following safe FCAW-S practices.
9. Visually inspect trainee's FCAW-S fillet welds.
10. Develop and administer formative or diagnostic tests on FCAW-S fillet welding principles of operation and essential process variables.
11. Prepare trainee for the FCAW-S principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Process—Part 1*.
12. Keep training records reflecting each trainee's successful completion of making fillet welds in all positions on carbon steel.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 11: Makes groove welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, FCAW-S equipment, 0.045 in. or 0.052 in. E71T-11 electrodes, carbon steel base metal, and a welding assignment, the trainee will make FCAW-S groove welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound FCAW-S groove welds in all positions on carbon steel. During and after each operation, welds are visually examined by the welder and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on FCAW-S groove welding, in all position, on carbon steel.
2. Provide instruction on visual examination of FCAW-S groove welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for FCAW-S groove welding, in all positions, on carbon steel.
4. Provide training exercises on making 1G single and multiple pass FCAW-S groove welds, using 0.045 in. or 0.052 in. E71T-11 electrodes on carbon steel.
5. Provide training exercises on making 2G single and multiple pass FCAW-S groove welds, using 0.045 in. or 0.052 in. E71T-11 electrodes on carbon steel.
6. Provide training exercises on making 3G uphill, single and multiple pass FCAW-S groove welds, using 0.045 in. or 0.052 in. E71T-11 electrodes on carbon steel.
7. Provide training exercises on making 4G single and multiple pass FCAW-S groove welds, using 0.045 in. or 0.062 in. E71T-11 electrodes on carbon steel.
8. Observe trainee operating FCAW-S equipment on carbon steel.
9. Observe trainee following safe FCAW-S practices.
10. Visually inspect trainee's FCAW-S groove welds.
11. Develop and administer formative or diagnostic tests on FCAW-S groove welding principles of operation and essential process variables.
12. Prepare trainee for the FCAW-S principles of operation and essential process variables portion of a written examination from the relevant sections of *AWS Welding Handbook, Volume 2, Welding Process—Part 1*.
13. Keep training records reflecting each trainee's successful completion of making groove welds in all positions on carbon steel.

3.3.1 MODULE 6: FLUX CORED ARC WELDING (FCAW-G/GM, FCAW-S)

KEY INDICATOR 12: Passes FCAW-S welder performance qualification test on carbon steel.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, FCAW-S equipment, 0.045 in. or 0.052 in. E71T-11 electrodes, 3/8 in. thick carbon steel base metal, Welding Procedure Specification AWS EDU FCAW-03, and drawing number AWS EDU-1, the trainee will perform FCAW-S welder performance qualification test on carbon steel with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound FCAW-S fillet and groove welds. Test assembly is prepared according to drawing specifications. In accordance with the requirements of AWS QC10, WPS AWS EDU FCAW-03, and drawing number AWS EDU-1, the trainee passes FCAW-S welder performance qualification testing on carbon steel.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and FCAW-S fillet and groove welding elements of FCAW-S welder performance qualification test on carbon steel.
2. Administer FCAW-S welder performance qualification test on carbon steel upon completion of FCAW-S on carbon steel training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting each trainee's successful completion of FCAW-S welder performance qualification test on carbon steel.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for Safety and Health of Welders, Drawing and Welding Symbol Interpretation, FCAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the FCAW-G/GM and FCAW-S performance qualification tests on carbon steel, may be reported to AWS to obtain Level I—Entry Welder certification in FCAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 1: Performs safety inspections of GTAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, GTAW equipment and accessories, and GTAW shielding gas supply system equipment and accessories, the trainee performs safety inspections of protective clothing and equipment, hand tools, GTAW equipment and accessories, GTAW shielding gas supply system equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective clothing and equipment, hand tools, GTAW equipment and accessories, GTAW shielding gas supply system equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of GTAW operations. In the course of daily operations, the trainee is observed following safe GTAW practices on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation for GTAW equipment and accessories, and shielding gas supply system equipment and accessories.
2. Provide demonstrations relevant to ANSI Z49.1, Section 11, *Arc Welding and Cutting Equipment Safety*.
3. Provide demonstrations relevant to routine safety inspections of protective equipment and clothing, hand tools, GTAW equipment and accessories, shielding gas supply system equipment and accessories, and work area.
4. Provide instruction relevant to ANSI Z49.1, 11.
5. Reinforce previous instruction from ANSI Z49.1, Part I—General Aspects.
6. Introduce relevant terms and definitions and observe trainee using proper GTAW terms and definitions.
7. Observe trainee conducting safety inspections for GTAW.
8. Observe trainee following safe practices for GTAW.
9. Develop and administer formative or diagnostic tests on safe GTAW practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep records reflecting each trainee's successful completion of training in GTAW safe practices.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 2: Makes minor external repairs to GTAW equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on repair materials, equipment and tools, the trainee will make minor external repairs to GTAW equipment and accessories, and GTAW shielding gas supply system equipment and accessories.

EVALUATION CRITERIA: The trainee makes repairs to GTAW equipment and accessories, and GTAW shielding gas supply system equipment and accessories as required, in accordance with the manufacturer's recommendations and the institution's repair policy. The correct repair materials, equipment and tools are selected. The assignment is completed in a timely manner. The objective is performed as required during the GTAW portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on GTAW equipment and accessories identification.
2. Provide instruction and demonstrations on GTAW shielding gas supply system equipment and accessories identification.
3. Provide instruction and demonstrations on minor external repairs on GTAW equipment and accessories.
4. Provide instruction and demonstrations on minor external repairs on GTAW shielding gas supply system equipment and accessories.
5. Introduce relevant terms and definitions and observe trainee using proper GTAW terms and definitions.
6. Provide training exercises on making minor external repairs on GTAW equipment and accessories.
7. Provide training exercises on making minor external repairs on GTAW shielding gas supply system equipment and accessories.
8. Observe each trainee's ability to carry out training exercises on making minor external repairs on GTAW equipment and accessories.
9. Observe each trainee's ability to carry out training exercises on making minor external repairs on GTAW shielding gas supply system equipment and accessories.
10. Observe trainee following safe GTAW practices.
11. Develop and administer formative or diagnostic tests on GTAW equipment and accessories, and GTAW shielding gas supply system equipment and accessories identification and making minor external repairs.
12. Prepare trainee for the GTAW equipment and accessories, and GTAW shielding gas supply system equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of AWS C5.5, and *AWS Welding Handbook, Vol. 2, Welding Processes—Part 1*.
13. Keep training records reflecting each trainee's successful completion of training in GTAW equipment and accessories, GTAW shielding gas supply system equipment and accessories identification, and making minor external repairs.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 3: Sets up for GTAW operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, ER70S-X filler metals, appropriate tungsten electrodes, and carbon steel base metal, the trainee will set up and prepare to perform GTAW operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, electrodes, shielding gas, and filler metals are selected. GTAW equipment and accessories are set up and adjusted to proper amperage range and polarity. GTAW shielding gas supply system equipment and accessories are set up and adjusted to the proper flow rate. Parts are assembled according to job requirements. The objective is performed on a routine basis during the GTAW on carbon steel portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW equipment and accessories set up for carbon steel.
2. Provide demonstrations on GTAW shielding gas supply system equipment and accessories set up for carbon steel.
3. Provide instruction on GTAW principles of operation on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on tungsten electrode identification, selection and preparation for carbon steel welding.
6. Provide instruction on GTAW filler metal identification and selection for carbon steel.
7. Introduce relevant terms and definitions and observe trainee using proper GTAW terms and definitions.
8. Provide trainee with practice setting up GTAW equipment and accessories for carbon steel.
9. Provide trainee with practice setting up GTAW shielding gas supply system equipment and accessories for carbon steel.
10. Observe trainee setting up GTAW equipment and accessories for carbon steel.
11. Observe trainee setting up GTAW shielding gas supply system equipment and accessories for carbon steel.
12. Observe trainee following safe GTAW practices.

13. Develop and administer formative or diagnostic tests on GTAW equipment set up, principles of operation, and carbon steel base metal, filler metal and electrode identification and selection.

14. Prepare trainee for the GTAW equipment set up, principles of operation, and carbon steel base metal, filler metal and electrode identification and selection portion of a written examination from the relevant sections of AWS C5.5/C5.5M.

14. Keep training records reflecting each trainee's successful completion of training in GTAW equipment set up, principles of operation, and carbon steel base metal, filler metal and electrode identification and selection.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 4: Operates GTAW equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, carbon steel base metal, and a welding assignment, the trainee will perform GTAW operations on carbon steel.

EVALUATION CRITERIA: The trainee's GTAW welding is completed as required by the welding assignment on a routine basis. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW equipment operations on carbon steel.
2. Provide instruction on GTAW principles of operation on carbon steel.
3. Provide instruction on essential process variables for GTAW on carbon steel.
4. Provide training exercises on GTAW equipment operations on carbon steel.
5. Provide training exercises on starting and maintaining a GTAW arc on carbon steel.
6. Provide training exercises on making 1G, single layer, single pass, stringer bead GTAW welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes and Ar shielding gas, on carbon steel.
7. Observe trainee operating GTAW equipment on carbon steel.
8. Observe trainee following safe GTAW practices.
9. Visually inspect trainee's GTAW stringer bead welds.
9. Develop and administer formative or diagnostic tests on GTAW principles of operation and essential process variables.
10. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
11. Keep training records reflecting each trainee's successful completion of training in GTAW principles of operation, and essential process variables and performance exercises on carbon steel.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 5: Makes fillet welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, carbon steel base metal, and a welding assignment, the trainee will make GTAW fillet welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound GTAW fillet welds in all positions on carbon steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW fillet welding, in all positions, on carbon steel.
2. Provide instruction on visual examination of GTAW fillet welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for GTAW fillet welding, in all positions, on carbon steel.
4. Provide training exercises on making 1F, single pass GTAW fillet welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
5. Provide training exercises on making 2F, single pass GTAW fillet welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
6. Provide training exercises on making 3F, single pass GTAW fillet welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
7. Provide training exercises on making 4F, single pass GTAW fillet welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
8. Observe trainee operating GTAW equipment on carbon steel.
9. Observe trainee following safe GTAW practices.
10. Visually inspect trainee's GTAW fillet welds.
11. Develop and administer formative or diagnostic tests on GTAW fillet welding principles of operation and essential process variables.
12. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
13. Keep training records reflecting each trainee's successful completion of making fillet welds in all positions on carbon steel.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 6: Makes groove welds in all positions on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, carbon steel base metal, and a welding assignment, the trainee will make GTAW groove welds in all positions on carbon steel.

EVALUATION CRITERIA: The trainee produces sound GTAW groove welds in all positions on carbon steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW groove welding, in all positions, on carbon steel.
2. Provide instruction on visual examination of GTAW groove welds made on carbon steel.
3. Provide instruction on welding procedures and workmanship for GTAW groove welding, in all positions, on carbon steel.
4. Provide training exercises on making 1G, single pass GTAW groove welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
5. Provide training exercises on making 2G, single pass GTAW groove welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
6. Provide training exercises on making 3G, single pass GTAW groove welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
7. Provide training exercises on making 4G, single pass GTAW groove welds, using 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on carbon steel.
8. Observe trainee operating GTAW equipment.
9. Observe trainee following safe GTAW practices.
10. Visually inspect trainee's GTAW groove welds.
11. Develop and administer formative or diagnostic tests on GTAW groove welding principles of operation and essential process variables.
12. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
13. Keep training records reflecting each trainee's successful completion of making groove welds in all positions on carbon steel.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 7: Passes GTAW welder performance qualification test on carbon steel.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER70S-X filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, 10-14 gauge carbon steel base metal, Welding Procedure Specification AWS EDU GTAW-01, and drawing number AWS EDU-3, the trainee will perform a GTAW welder performance qualification test on carbon steel with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound GTAW fillet and groove welds. Test assembly is prepared according to drawing specifications. In accordance with the requirements of AWS QC10, WPS AWS EDU GTAW-01, and drawing number AWS EDU-3, the trainee passes GTAW welder performance qualification test on carbon steel.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and GTAW fillet and groove welding elements of GTAW welder performance qualification test on carbon steel.
2. Administer GTAW welder performance qualification testing on carbon steel upon completion of training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting results of GTAW welder performance qualification test on carbon steel.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for Safety and Health of Welders, Drawing and Welding Symbol Interpretation, GTAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the GTAW carbon steel, austenitic stainless steel, and aluminum performance qualification tests, may be reported to AWS to obtain Level I—Entry Welder certification in GTAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 8: Sets up for GTAW operations on austenitic stainless steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, ER3XX filler metals, appropriate tungsten electrodes, and austenitic stainless steel base metal, the trainee will set up and prepare to perform GTAW operations on austenitic stainless steel.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, electrodes, shielding gas, and filler metals are selected. GTAW equipment and accessories are set up and adjusted for proper amperage range and polarity. GTAW argon shielding gas supply system equipment and accessories are set up and adjusted to the proper flow rate. Parts are assembled according to job requirements. The objective is performed on a routine basis during the GTAW on austenitic stainless steel portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW equipment and accessories set up for austenitic stainless steel.
2. Provide demonstrations on GTAW shielding gas supply system equipment and accessories set up for austenitic stainless steel.
3. Provide instruction on GTAW principles of operation on austenitic stainless steel.
4. Provide instruction on austenitic stainless steel shapes, identification and selection.
5. Provide instruction on EWX-Y electrode identification, selection and preparation for austenitic stainless steel.
6. Provide instruction on GTAW filler metal identification and selection for austenitic stainless steel.
7. Introduce relevant terms and definitions and observe trainee using proper GTAW terms and definitions.
8. Provide trainee with practice setting up GTAW equipment and accessories for austenitic stainless steel.
9. Provide trainee with practice setting up GTAW shielding gas supply system equipment and accessories for austenitic stainless steel.
10. Observe trainee setting up GTAW equipment and accessories for austenitic stainless steel.
11. Observe trainee setting up GTAW shielding gas supply system equipment and accessories for austenitic stainless steel.
12. Observe trainee following safe GTAW practices.

13. Develop and administer formative or diagnostic tests on GTAW equipment set up, principles of operation, and austenitic stainless steel base metal, filler metal and electrode identification and selection.

14. Prepare trainee for the GTAW equipment set up, principles of operation, and austenitic stainless steel base metal, filler metal and electrode identification and selection portion of a written examination from the relevant sections of AWS C5.5/C5.5M.

15. Keep training records reflecting each trainee's successful completion of training in GTAW equipment set up, principles of operation, and austenitic stainless steel base metal, filler metal and electrode identification and selection.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 9: Operates GTAW equipment on austenitic stainless steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, austenitic stainless steel base metal, and a welding assignment, the trainee will perform GTAW operations on austenitic stainless steel.

EVALUATION CRITERIA: The trainee's GTAW welding is completed as required by the welding assignment on a routine basis. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW equipment operations on austenitic stainless steel.
2. Provide instruction on GTAW principles of operation on austenitic stainless steel.
3. Provide instruction on essential process variables for GTAW on austenitic stainless steel.
4. Provide training exercises on GTAW equipment operations on austenitic stainless steel.
5. Provide training exercises on starting and maintaining a GTAW arc on austenitic stainless steel.
6. Provide training exercises on making 1G, single layer, single pass, stringer bead GTAW welds, using 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes and Ar shielding gas, on austenitic stainless steel.
7. Observe trainee operating GTAW equipment on austenitic stainless steel.
8. Observe trainee following safe GTAW practices.
9. Visually inspect trainee's GTAW stringer bead welds.
9. Develop and administer formative or diagnostic tests on GTAW principles of operation and essential process variables.
10. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
11. Keep training records reflecting each trainee's successful completion of training in GTAW principles of operation, essential process variables, and performance exercises on austenitic stainless steel.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 10: Makes fillet welds in the 1F, 2F and 3F positions, on austenitic stainless steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, austenitic stainless steel base metal, and a welding assignment, the trainee will make GTAW fillet welds in 1F, 2F and 3F positions on austenitic stainless steel.

EVALUATION CRITERIA: The trainee produces sound GTAW fillet welds in 1F, 2F and 3F positions on austenitic stainless steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW fillet welding, in 1F, 2F and 3F positions, on austenitic stainless steel.
2. Provide instruction on visual examination of GTAW fillet welds made on austenitic stainless steel.
3. Provide instruction on welding procedures and workmanship for GTAW fillet welding, in 1F, 2F and 3F positions, on austenitic stainless steel.
4. Provide training exercises on making 1F, single pass GTAW fillet welds, using 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on austenitic stainless steel.
5. Provide training exercises on making 2F, single pass GTAW fillet welds, using 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on austenitic stainless steel.
6. Provide training exercises on making 3F, single pass GTAW fillet welds, using 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on austenitic stainless steel.
7. Observe trainee operating GTAW equipment on austenitic stainless steel.
8. Observe trainee following safe GTAW practices.
9. Visually inspect trainee's GTAW fillet welds.
10. Develop and administer formative or diagnostic tests on GTAW fillet welding principles of operation and essential process variables.
11. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
12. Keep training records reflecting each trainee's successful completion of making fillet welds in the 1F, 2F and 3F positions on austenitic stainless steel.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 11: Makes groove welds in the 1G and 2G positions, on austenitic stainless steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, austenitic stainless steel base metal, and a welding assignment, the trainee will make GTAW groove welds in 1G and 2G positions on austenitic stainless steel.

EVALUATION CRITERIA: The trainee produces sound GTAW groove welds in 1G and 2G positions on austenitic stainless steel. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW groove welding, in 1G and 2G positions, on austenitic stainless steel.
2. Provide instruction on visual examination of GTAW groove welds made on austenitic stainless steel.
3. Provide instruction on welding procedures and workmanship for GTAW groove welding, in 1G and 2G positions, on austenitic stainless steel.
4. Provide training exercises on making 1G, single pass GTAW groove welds, using 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on austenitic stainless steel.
5. Provide training exercises on making 2G, single pass GTAW groove welds, using 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, and Ar shielding gas, on austenitic stainless steel.
6. Observe trainee operating GTAW equipment.
7. Observe trainee following safe GTAW practices.
8. Visually inspect trainee's GTAW groove welds.
9. Develop and administer formative or diagnostic tests on GTAW groove welding principles of operation and essential process variables.
10. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
11. Keep training records reflecting each trainee's successful completion of making groove welds in the 1G and 2G positions, on austenitic stainless steel.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 12: Passes GTAW welder performance qualification test on austenitic stainless steel.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 3/32 in. diameter ER3XX filler metal, 1/16 in. to 1/8 in. diameter tungsten electrodes, 10-14 gauge austenitic stainless steel base metal, Welding Procedure Specification AWS EDU GTAW-02, and drawing number AWS EDU-4, the trainee will perform a GTAW welder performance qualification test on austenitic stainless steel with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound GTAW fillet and groove welds. Test assembly is prepared according to drawing specifications. In accordance with the requirements of AWS QC10, WPS AWS EDU GTAW-02, and drawing number AWS EDU-4, the trainee passes GTAW welder performance qualification test on austenitic stainless steel.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and GTAW fillet and groove welding elements of GTAW welder performance qualification test on austenitic stainless steel.
2. Administer GTAW welder performance qualification testing on austenitic stainless steel upon completion of training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting results of GTAW welder performance qualification test on austenitic stainless steel.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for Safety and Health of Welders, Drawing and Welding Symbol Interpretation, GTAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the GTAW carbon steel, austenitic stainless steel, and aluminum performance qualification tests, may be reported to AWS to obtain Level I—Entry Welder certification in GTAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 13: Sets up for GTAW operations on aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, ER4043 filler metal, EWP or EWZr electrodes, and aluminum base metal, the trainee will set up and prepare to perform GTAW operations on aluminum.

EVALUATION CRITERIA: The trainee is prepared to weld. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, base metal, electrodes, shielding gas, and filler metals are selected. GTAW equipment and accessories are set up and adjusted to proper amperage range and polarity. GTAW shielding gas supply system equipment and accessories are set up and adjusted to the proper flow rate. Parts are assembled according to job requirements. The objective is performed on a routine basis during the GTAW on aluminum portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW equipment and accessories set up for aluminum.
2. Provide demonstrations on GTAW shielding gas supply system equipment and accessories set up for aluminum.
3. Provide instruction on GTAW principles of operation on aluminum.
4. Provide instruction on aluminum shapes, identification and selection.
5. Provide instruction on EWP-Y electrode identification, selection and preparation for aluminum.
6. Provide instruction on GTAW filler metal identification and selection for aluminum.
7. Introduce relevant terms and definitions and observe trainee using proper GTAW terms and definitions.
8. Provide trainee with practice setting up GTAW equipment and accessories for aluminum.
9. Provide trainee with practice setting up GTAW shielding gas supply system equipment and accessories for aluminum.
10. Observe trainee setting up GTAW equipment and accessories for aluminum.
11. Observe trainee setting up GTAW shielding gas supply system equipment and accessories for aluminum.
12. Observe trainee following safe GTAW practices.
13. Develop and administer formative or diagnostic tests on GTAW equipment set up, principles of operation, and aluminum base metal, filler metal and electrode identification and selection.
14. Prepare trainee for the GTAW equipment set up, principles of operation, and aluminum base metal, filler metal and electrode identification and selection portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
15. Keep training records reflecting each trainee's successful completion of training in GTAW equipment set up, principles of operation, and aluminum base metal, filler metal and electrode identification and selection.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 14: Operates GTAW equipment on aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes, aluminum base metal, and a welding assignment, the trainee will perform GTAW operations on aluminum.

EVALUATION CRITERIA: The trainee's GTAW welding is completed as required by the welding assignment on a routine basis. During and after the operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW equipment operations on aluminum.
2. Provide instruction on GTAW principles of operation on aluminum.
3. Provide instruction on essential process variables for GTAW on aluminum.
4. Provide training exercises on GTAW equipment operations on aluminum.
5. Provide training exercises on starting and maintaining a GTAW arc on aluminum.
6. Provide training exercises on making 1G, single layer, single pass stringer bead GTAW welds, using 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes and Ar shielding gas, on aluminum.
7. Observe trainee operating GTAW equipment on aluminum.
8. Observe trainee following safe GTAW practices.
9. Visually inspect trainee's GTAW stringer bead welds.
9. Develop and administer formative or diagnostic tests on GTAW principles of operation and essential process variables.
10. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
11. Keep training records reflecting each trainee's successful completion of training in GTAW principles of operation, essential process variables, and performance exercises on aluminum.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 15: Makes fillet welds in the 1F and 2F positions on aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes, aluminum base metal, and a welding assignment, the trainee will make GTAW fillet welds in 1F and 2F positions on aluminum.

EVALUATION CRITERIA: The trainee produces sound GTAW fillet welds in all positions on aluminum. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW fillet welding, in 1F and 2F positions, on aluminum.
2. Provide instruction on visual examination of GTAW fillet welds made on aluminum.
3. Provide instruction on welding procedures and workmanship for GTAW fillet welding, in 1F and 2F positions, on aluminum.
4. Provide training exercises on making 1F, single pass GTAW fillet welds, 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes, and Ar shielding gas, on aluminum.
5. Provide training exercises on making 2F, single pass GTAW fillet welds, using 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes, and Ar shielding gas, on aluminum.
8. Observe trainee operating GTAW equipment on aluminum.
9. Observe trainee following safe GTAW practices.
10. Visually inspect trainee's GTAW fillet welds.
11. Develop and administer formative or diagnostic tests on GTAW fillet welding principles of operation and essential process variables.
12. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
13. Keep training records reflecting each trainee's successful completion of making fillet welds in the 1F and 2F positions on aluminum.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 16: Makes groove welds in the 1G position on aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes, aluminum base metal, and a welding assignment, the trainee will make GTAW groove welds in 1G position on aluminum.

EVALUATION CRITERIA: The trainee produces sound GTAW groove welds in 1G and 2G positions on aluminum. During and after each operation, welds are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on GTAW groove welding, in 1G position, on aluminum
2. Provide instruction on visual examination of GTAW groove welds made on aluminum
3. Provide instruction on welding procedures and workmanship for GTAW groove welding, in 1G position, on aluminum.
4. Provide training exercises on making 1G, single pass GTAW groove welds, using 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes, and Ar shielding gas, on aluminum.
6. Observe trainee operating GTAW equipment.
7. Observe trainee following safe GTAW practices.
8. Visually inspect trainee's GTAW groove welds.
9. Develop and administer formative or diagnostic tests on GTAW groove welding principles of operation and essential process variables.
10. Prepare trainee for the GTAW principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.5/C5.5M.
11. Keep training records reflecting each trainee's successful completion of making groove welds in the 1G position on aluminum.

3.3.1 MODULE 7: GAS TUNGSTEN ARC WELDING (GTAW)

KEY INDICATOR 17: Passes GTAW welder performance qualification test on aluminum.

OBJECTIVE: Provided with protective clothing and equipment, hand tools, GTAW equipment and accessories, argon shielding gas, 1/16 in. to 1/32 in. diameter ER4043 filler metal, 1/16 in. to 1/8 in. diameter EWP or EWZr electrodes, 10-14 gauge aluminum base metal, Welding Procedure Specification AWS EDU GTAW-03, and drawing number AWS EDU-5, the trainee will perform GTAW welder performance qualification test on aluminum with no assistance from the instructor.

EVALUATION CRITERIA: The trainee produces sound GTAW fillet and groove welds. Test assembly is prepared according to drawing specifications. In accordance with the requirements of AWS QC10, WPS AWS EDU GTAW-03, and drawing number AWS EDU-5, the trainee passes GTAW welder performance qualification test on aluminum.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Prepare trainee for the fabrication, weld symbol interpretation and GTAW fillet and groove welding elements of GTAW welder performance qualification test on aluminum.
2. Administer GTAW welder performance qualification testing on aluminum upon completion of training in accordance with the requirements of AWS QC10.
3. Keep training records reflecting results of GTAW welder performance qualification test on aluminum.

NOTE: For Training Organizations participating in SENSE Level I—Entry Welder, the test scores for Safety and Health of Welders, Drawing and Welding Symbol Interpretation, GTAW, Thermal Cutting Processes, and Welding Inspection and Testing written tests, along with the results of the GTAW carbon steel, austenitic stainless steel, and aluminum performance qualification tests, may be reported to AWS to obtain Level I—Entry Welder certification in GTAW. Alternatively, documentation may be submitted at the end of the complete Level I—Entry Welder program for certification as a Level I—Entry Welder. See AWS QC10, clauses 9, 10, and 11 for details.

3.3 Recommended Modular Guidelines for Level I—Entry Welder Training

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 1: Performs safety inspections of manual OFC equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, manual OFC equipment and accessories, and manual OFC gas supply system equipment and accessories, the trainee performs safety inspections of protective equipment and clothing, hand tools, manual OFC equipment and accessories, manual OFC gas supply system equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective clothing and equipment, hand tools, manual OFC equipment and accessories, manual OFC gas supply system equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of manual OFC operations. In the course of daily operations, the trainee is observed following safe manual OFC practices on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation for manual OFC equipment and accessories, and manual OFC gas supply system equipment and accessories.
2. Provide demonstrations on ANSI Z49.1, Section 10, *Oxyfuel Gas Welding and Cutting Safety*.
3. Provide demonstrations on routine safety inspections of protective equipment and clothing, hand tools, manual OFC equipment and accessories, manual OFC gas supply system equipment and accessories, and work area.
4. Provide instruction on ANSI Z49.1, Section 10.
5. Reinforce previous instruction from ANSI Z49.1, Part 1—*General Aspects*.
6. Introduce relevant terms and definitions and observe trainee using proper manual OFC terms and definitions.
7. Observe trainee conducting safety inspections for manual OFC.
8. Observe trainee following safe manual OFC practices.
9. Develop and administer formative or diagnostic tests on safe manual OFC practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep records reflecting each trainee's successful completion of training in manual OFC safe practices.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 2: Makes minor external repairs to manual OFC equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on repair materials, equipment and tools, the trainee will make minor external repairs to manual OFC equipment and accessories, and manual OFC gas supply system equipment and accessories.

EVALUATION CRITERIA: The trainee makes repairs to manual OFC equipment and accessories, and manual OFC gas supply system equipment and accessories as required, in accordance with the manufacturer's recommendations and the institution's repair policy. The correct repair materials, equipment and tools are selected. The assignment is completed in a timely manner. The objective is performed as required during the manual OFC portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on manual OFC equipment and accessories identification.
2. Provide instruction and demonstrations on manual OFC gas supply system equipment and accessories identification.
3. Provide instruction and demonstrations on minor external repairs on manual OFC equipment and accessories.
4. Provide instruction and demonstrations on minor external repairs on manual OFC gas supply system equipment and accessories.
5. Introduce relevant terms and definitions and observe trainee using proper manual OFC terms and definitions.
6. Provide training exercises on making minor external repairs on manual OFC equipment and accessories.
7. Provide training exercises on making minor external repairs on manual OFC gas supply system equipment and accessories.
8. Observe each trainee's ability to carry out training exercises on making minor external repairs on manual OFC equipment and accessories.
9. Observe each trainee's ability to carry out training exercises on making minor external repairs on manual OFC gas supply system equipment and accessories.
10. Observe trainee following safe manual OFC practices.
11. Develop and administer formative or diagnostic tests on manual OFC equipment and accessory, manual OFC gas supply system equipment and accessories identification, and making minor external repairs.

12. Prepare trainee for the manual OFC equipment and accessories, and manual OFC gas supply system equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of AWS C4.2/C4.2M, Recommended Practices for Safe Oxyfuel Gas Cutting Torch Operation.

13. Keep training records reflecting each trainee's successful completion of training in manual OFC equipment and accessories, and manual OFC gas supply system equipment and accessories identification, and making minor external repairs.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 3: Sets up for manual OFC operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual OFC equipment and accessories, manual OFC gas supply system equipment and accessories, and carbon steel base metal, the trainee will set up for manual OFC operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to cut. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, and base metal are selected. Manual OFC equipment and accessories are set up and adjusted for proper operation. Manual OFC gas supply system equipment and accessories are set up and adjusted for proper gas pressures and supply. Parts are positioned and area is prepared for safe cutting operations. The objective is performed on a routine basis during the manual OFC portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on manual OFC equipment and accessories set up for carbon steel.
2. Provide demonstrations on manual OFC gas supply system equipment and accessories set up for carbon steel.
3. Provide instruction on manual OFC principles of operation on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on manual OFC cutting tip identification and selection for carbon steel.
6. Introduce relevant terms and definitions and observe trainee using proper manual OFC terms and definitions.
7. Provide trainee with practice setting up manual OFC equipment and accessories for carbon steel.
8. Provide trainee with practice setting up manual OFC gas supply system equipment and accessories for carbon steel.
9. Observe trainee setting up manual OFC equipment and accessories for carbon steel.
10. Observe trainee setting up manual OFC gas supply system equipment and accessories for carbon steel.
11. Observe trainee following safe manual OFC practices.
12. Develop and administer formative or diagnostic tests on manual OFC equipment set up, principles of operation and cutting tip identification and selection.
13. Prepare trainee for manual OFC equipment set up, principles of operation and cutting tip identification and selection portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
14. Keep training records reflecting each trainee's successful completion of training in manual OFC equipment set up, principles of operation, and cutting tip identification and selection.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 4: Operates manual OFC equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual OFC equipment and accessories, manual OFC gas supply system equipment and accessories, carbon steel base metal and a cutting assignment, the trainee will perform manual OFC operations on carbon steel.

EVALUATION CRITERIA: The trainee's manual OFC cutting is completed as required by the cutting assignment on a routine basis. During and after the operation, cut edges and surfaces are visually examined by the trainee, and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on manual OFC equipment operations on carbon steel.
2. Provide instruction on manual OFC principles of operation on carbon steel.
3. Provide instruction on essential process variables for manual OFC on carbon steel.
4. Provide training exercises on manual OFC equipment operations on carbon steel.
5. Provide training exercises on lighting and adjusting the manual OFC torch.
6. Provide training exercises on making flat position straight, square edge manual OFC cuts on carbon steel.
7. Observe trainee operating manual OFC equipment on carbon steel.
8. Observe trainee following safe manual OFC practices.
9. Visually inspect trainee's manual OFC cut edges and surfaces.
10. Develop and administer formative or diagnostic tests on manual OFC principles of operation and essential process variables.
11. Prepare trainee for the manual OFC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
12. Keep training records reflecting each trainee's successful completion of training in manual OFC principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 5: Performs straight, square edge cutting operations in flat position, on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual OFC equipment and accessories, manual OFC gas supply systems and accessories, 0.25 inch to 1.00 inch thickness carbon steel base metal and a cutting assignment, the trainee will make manual OFC straight, square edge cuts in the flat position on carbon steel.

EVALUATION CRITERIA: The trainee produces sound manual OFC straight, square edge cuts in the flat position on carbon steel. After each operation, cut edges and surfaces are visually examined by the trainee, and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstration on manual OFC straight, square edge, cuts on limited thickness range of carbon steel.
2. Provide instruction on visual examination of manual OFC cut edges and surfaces.
3. Provide instruction on cutting procedures and workmanship for manual OFC straight, square edge cuts in the flat position on carbon steel.
4. Provide training exercises on making flat position straight, square edge manual OFC cuts on various thickness carbon steel.
5. Observe trainee operating manual OFC equipment on carbon steel.
6. Observe trainee following safe manual OFC practices.
7. Visually inspect trainee's manual OFC cut edges and surfaces.
8. Develop and administer formative or diagnostic tests on manual OFC straight, square edge cutting principles of operation and essential process variables.
9. Prepare trainee for the manual OFC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
10. Keep training records reflecting each trainee's successful completion of making straight, square edge cuts on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 6: Performs shape, square edge cutting operations in the flat position on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual OFC equipment and accessories, manual OFC gas supply systems and accessories, 0.25 inch to 1.00 inch thickness carbon steel base metal and a cutting assignment, the trainee will make manual OFC shape, square edge, cuts in the flat position on carbon steel.

EVALUATION CRITERIA: The trainee produces sound manual OFC shape, square edge cuts in the flat position on carbon steel. After each operation, cut edges and surfaces are visually examined by the trainee, and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstration on manual OFC shape, square edge, cuts on limited thickness range of carbon steel.
2. Provide instruction on visual examination of manual OFC cut edges and surfaces.
3. Provide instruction on cutting procedures and workmanship for manual OFC shape, square edge cuts on carbon steel.
4. Provide training exercises on making flat position shape, square edge manual OFC cuts on various thickness carbon steel.
5. Observe trainee operating manual OFC equipment on carbon steel.
6. Observe trainee following safe manual OFC practices.
7. Visually inspect trainee's manual OFC cut edges and surfaces.
8. Develop and administer formative or diagnostic tests on manual OFC shape, square edge cutting principles of operation and essential process variables.
9. Prepare trainee for the manual OFC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
10. Keep training records reflecting each trainee's successful completion of making shape, square edge cuts on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 7: Performs straight, bevel edge cutting operations in the flat position on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual OFC equipment and accessories, manual OFC gas supply systems and accessories, 0.25 inch to 1.00 inch carbon steel base metal and a cutting assignment, the trainee will make manual OFC straight, bevel edge cuts on carbon steel.

EVALUATION CRITERIA: The trainee produces sound manual OFC straight, bevel edge cuts in the flat position on carbon steel. After each operation, cut edges and surfaces are visually examined by the trainee, and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstration on manual OFC straight, bevel edge, cuts on limited thickness range of carbon steel.
2. Provide instruction on visual examination of manual OFC cut edges and surfaces.
3. Provide instruction on cutting procedures and workmanship for manual OFC straight, bevel edge cuts on carbon steel.
4. Provide training exercises on making flat position straight, bevel edge manual OFC cuts on various thickness carbon steel.
5. Observe trainee operating manual OFC equipment on carbon steel.
6. Observe trainee following safe manual OFC practices.
7. Visually inspect trainee's manual OFC cut edges and surfaces.
8. Develop and administer formative or diagnostic tests on manual OFC straight, bevel edge, cutting principles of operation and essential process variables.
9. Prepare trainee for the manual OFC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
10. Keep training records reflecting each trainee's successful completion of making straight, bevel edge cuts on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 1: MANUAL OXYFUEL GAS CUTTING (OFC)

KEY INDICATOR 8: Performs scarfing and gouging operations to remove base and weld metal, in flat and horizontal position, on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual OFC equipment and accessories, manual OFC gas supply systems and accessories, welded 0.25 inch to 1.00 inch carbon steel base metal and a cutting assignment, the trainee will use scarfing and gouging operations to remove base and weld metal, in the flat position, on carbon steel.

EVALUATION CRITERIA: The trainee produces sound manual OFC scarfs and gouges, in the flat and horizontal positions, on limited thickness range of carbon steel. The trainee prepares base metal for both initial and repair welding. The trainee removes both weld reinforcement and all weld metal, and the base metal is salvaged for further use. During and after each operation, scarfed and gouged surfaces are visually examined by the welder and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on weld and base metal scarfing and gouging using manual OFC equipment on limited thickness range of carbon steel.
2. Provide instruction on visual examination of manual OFC scarfed and gouged surfaces.
3. Provide instruction on weld metal scarfing (smoothing) using manual OFC scarfing operations, in 1G and 2G positions, on groove welded carbon steel butt joints.
4. Provide instruction on weld and base metal gouging (removal) using manual OFC gouging operations in flat and horizontal positions, on groove and fillet welded carbon steel butt and T joints.
5. Provide instruction on scarfing and gouging procedures and workmanship for manual OFC scarfing and gouging on carbon steel.
6. Provide training exercises on making flat and horizontal, manual OFC scarfs on groove welded butt joints, on various thickness carbon steel.
7. Provide training exercises on making flat and horizontal manual OFC gouges on groove welded butt joints and fillet welded T joints, on various thickness carbon steel.
8. Observe trainee operating manual OFC scarfing and gouging equipment on carbon steel.
9. Observe trainee following safe manual OFC scarfing and gouging practices.
10. Visually inspect trainee's manual OFC scarfed and gouged surfaces.
11. Develop and administer formative or diagnostic tests on manual OFC scarfing and gouging principles of operation and essential process variables.

12. Prepare trainee for the manual OFC scarfing and gouging principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
13. Keep training records reflecting each trainee's successful completion of manual OFC training on flat and horizontal position cuts on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 2: MECHANIZED OXYFUEL GAS CUTTING (OFC) [e.g., TRACK BURNER]

KEY INDICATOR 1: Performs safety inspections of mechanized OFC equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, mechanized OFC equipment and accessories, mechanized OFC gas supply system equipment and accessories, the trainee performs safety inspections of protective equipment, hand tools, mechanized OFC equipment and accessories, OFC gas supply system equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective equipment and clothing, hand tools, mechanized OFC equipment and accessories, mechanized OFC gas supply system equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of mechanized OFC operations. In the course of daily operations, the trainee is observed following safe mechanized OFC practices on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation to mechanized OFC equipment and accessories, and mechanized OFC gas supply system equipment and accessories.
2. Provide demonstrations on ANSI Z49.1 Section 10, *Oxyfuel Gas Welding and Cutting Safety*.
3. Provide demonstrations on routine safety inspections of protective equipment and clothing, hand tools, mechanized OFC equipment and accessories, mechanized OFC gas supply system equipment and accessories, and work area.
4. Provide instruction relevant to ANSI Z49.1, Section 10.
5. Reinforce previous instruction from ANSI Z49.1, Part 1—*General Aspects*.
6. Introduce relevant terms and definitions and observe trainee using proper mechanized OFC terms and definitions.
7. Observe trainee conducting safety inspections for mechanized OFC.
8. Observe trainee following safe mechanized OFC practices.
9. Develop and administer formative or diagnostic tests relevant to safe mechanized OFC practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep records reflecting each trainee's successful completion of training in mechanized OFC safe practices.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 2: MECHANIZED OXYFUEL GAS CUTTING (OFC) [e.g., TRACK BURNER]

KEY INDICATOR 2: Makes minor external repairs to mechanized OFC equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration, repair materials, equipment and tools, the trainee will make minor external repairs to mechanized OFC equipment and accessories, and mechanized OFC gas supply system equipment and accessories

EVALUATION CRITERIA: The trainee's repairs on mechanized OFC equipment and accessories, and mechanized OFC gas supply system equipment and accessories as required, in accordance with the manufacturer's recommendations and the institution's repair policy. The correct repair materials, equipment and tools are selected. The assignment is completed in a timely manner. The objective is performed as required during the mechanized OFC portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on mechanized OFC equipment and accessories identification.
2. Provide instruction and demonstrations on mechanized OFC gas supply system equipment and accessories identification.
3. Provide instructions and demonstrations on minor external repairs on mechanized OFC equipment and accessories.
4. Provide instructions and demonstrations on minor external repairs on mechanized OFC gas supply system equipment and accessories.
5. Introduce relevant terms and definitions and observe trainee using proper mechanized OFC terms and definitions.
6. Provide trainee exercises on making minor external repairs to mechanized OFC equipment and accessories.
7. Provide trainee exercises on making minor external repairs on mechanized OFC gas supply system equipment and accessories.
8. Observe each trainee's ability to carry out training exercise on making minor external repairs on mechanized OFC equipment and accessories.
9. Observe each trainee's ability to carry out training exercise on making minor external repairs on mechanized OFC gas supply system equipment and accessories.
10. Observe trainee following safe mechanized OFC practices.
11. Develop and administer formative or diagnostic tests on mechanized OFC equipment and accessory, mechanized OFC gas supply system equipment, accessories identification, and making minor external repairs.

12. Prepare trainee for the mechanized OFC equipment and accessories, and mechanized OFC gas supply system equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of AWS C4.2/C4.2M, *Recommended Practices for Safe Oxyfuel Gas Cutting Torch Operation*.

13. Keep training records reflecting each trainee's successful completion of training in mechanized OFC equipment and accessories, mechanized OFC gas supply system equipment, accessories identification, and making minor external repairs.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 2: MECHANIZED OXYFUEL GAS CUTTING (OFC) [e.g., TRACK BURNER]

KEY INDICATOR 3: Sets up for mechanized OFC operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, mechanized OFC equipment and accessories, mechanized OFC gas supply system equipment and accessories, hand tools and base metal, the trainee will set up for mechanized OFC operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to cut. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, and base metal are selected. Mechanized OFC equipment and accessories are set up and adjusted for proper operation. Mechanized OFC gas supply system equipment and accessories are set up and adjusted to the proper pressures and supply. Parts are positioned and area is prepared for safe cutting operations. The objective is performed on a routine basis during the mechanized OFC portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on mechanized OFC equipment and accessories set up for carbon steel.
2. Provide demonstrations on mechanized OFC gas supply system equipment and accessories set up for carbon steel.
3. Provide instruction in mechanized OFC principles of operation on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on mechanized OFC cutting tip identification and selection for carbon steel.
6. Introduce relevant terms and definitions and observe trainee using proper mechanized OFC terms and definitions.
7. Provide trainee with practice setting up mechanized OFC equipment and accessories for carbon steel.
8. Provide trainee with practice setting up mechanized OFC gas supply system equipment and accessories for carbon steel.
9. Observe trainee setting up mechanized OFC equipment and accessories for carbon steel.
10. Observe trainee setting up mechanized OFC gas supply system equipment and accessories for carbon steel.
11. Observe trainee following safe mechanized OFC practices.
12. Develop and administer formative or diagnostic tests on mechanized OFC equipment set up, principles of operation and cutting tip identification and selection.
13. Prepare trainee for mechanized OFC equipment set up, principles of operation and cutting tip identification and selection portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
14. Keep training records reflecting each trainee's successful completion of training in mechanized OFC equipment set up, principles of operation, and cutting tip identification and selection.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 2: MECHANIZED OXYFUEL GAS CUTTING (OFC) [e.g., TRACK BURNER]

KEY INDICATOR 4: Operates mechanized OFC equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, mechanized OFC equipment and accessories, mechanized OFC gas supply system equipment and accessories, carbon steel base metal and a cutting assignment, the trainee will perform mechanized OFC operations on carbon steel.

EVALUATION CRITERIA: The trainee's mechanized OFC cutting is completed as required by the cutting assignment on a routine basis. During and after the operation, cut edges and surfaces are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on mechanized OFC equipment operations on carbon steel.
2. Provide instruction on mechanized OFC principles of operation on carbon steel.
3. Provide instruction on essential process variables for mechanized OFC on carbon steel.
4. Provide training exercises on mechanized OFC equipment operations on carbon steel.
5. Provide training exercises on lighting and adjusting the mechanized OFC torch.
6. Provide training exercises on making flat position straight, square edge mechanized OFC cuts on carbon steel.
7. Observe trainee operating mechanized OFC equipment on carbon steel.
8. Observe trainee following safe mechanized OFC practices.
9. Visually inspect trainee's mechanized OFC cut edges and surfaces.
10. Develop and administer formative or diagnostic tests on mechanized OFC principles of operation and essential process variables.
11. Prepare trainee for the mechanized OFC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
12. Keep training records reflecting each trainee's successful completion of training in mechanized OFC principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 2: MECHANIZED OXYFUEL GAS CUTTING (OFC) [e.g., TRACK BURNER]

KEY INDICATOR 5: Performs straight, square edge cutting operations in the flat position on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, mechanized OFC equipment and accessories, mechanized OFC gas supply systems and accessories, 0.25 inch to 1.00 inch carbon steel base metal and a cutting assignment, the trainee will make mechanized OFC straight, square edge cuts in the flat position on carbon steel.

EVALUATION CRITERIA: The trainee produces sound mechanized OFC straight, square edge cuts in the flat position on carbon steel. After each operation, cut edges and surfaces are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstration on mechanized OFC straight, square edge, cuts on limited thickness range of carbon steel.
2. Provide instruction on visual examination of mechanized OFC cut edges and surfaces.
3. Provide instruction on cutting procedures and workmanship for mechanized OFC straight, square edge, cuts, in 1G and 2G positions, on limited thickness range of carbon steel.
4. Provide training exercises on making flat position straight, square edge mechanized OFC cuts on various thickness carbon steel.
6. Observe trainee operating mechanized OFC equipment on carbon steel.
7. Observe trainee following safe mechanized OFC practices.
8. Visually inspect trainee's mechanized OFC cut edges and surfaces.
9. Develop and administer formative or diagnostic tests on mechanized OFC straight, square edge cutting principles of operation and essential process variables.
10. Prepare trainee for the mechanized OFC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
11. Keep training records reflecting each trainee's successful completion of making straight, square edge cuts in the flat position on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 2: MECHANIZED OXYFUEL GAS CUTTING (OFC) [e.g., TRACK BURNER]

KEY INDICATOR 6: Performs straight, bevel edge cutting operations in the flat position on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, mechanized OFC equipment and accessories, mechanized OFC gas supply systems and accessories, 0.25 inch to 1.00 inch carbon steel base metal and a cutting assignment, the trainee will make manual OFC straight, bevel edge cuts in the flat position on carbon steel.

EVALUATION CRITERIA: The trainee produces sound mechanized OFC straight, bevel edge cuts in the flat position on carbon steel. After each operation, cut edges and surfaces are visually examined by the trainee, and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstration on mechanized OFC straight, bevel edge, cuts on limited thickness range of carbon steel.
2. Provide instruction on visual examination of mechanized OFC cut edges and surfaces.
3. Provide instruction on cutting procedures and workmanship for mechanized OFC straight, bevel edge cuts, in flat position, on carbon steel.
4. Provide training exercises on making flat position straight, bevel edge mechanized OFC cuts on various thickness carbon steel.
6. Observe trainee operating mechanized OFC equipment on carbon steel.
7. Observe trainee following safe mechanized OFC practices.
8. Visually inspect trainee's mechanized OFC cut edges and surfaces.
9. Develop and administer formative or diagnostic tests on mechanized OFC straight, bevel edge cutting principles of operation, and essential process variables.
10. Prepare trainee for the mechanized OFC principles of operation, and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
11. Keep training records reflecting each trainee's successful completion of making straight, bevel edge cuts in the flat position on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 3: MANUAL PLASMA ARC CUTTING (PAC)

KEY INDICATOR 1: Performs safety inspections of manual PAC equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, manual PAC equipment and accessories, and manual PAC gas supply system equipment and accessories, the trainee performs safety inspections of protective equipment and clothing, hand tools, manual PAC equipment, manual PAC gas supply system equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective equipment and clothing, hand tools, manual PAC equipment and accessories, manual PAC gas supply system equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of manual PAC operations. In the course of daily operations, the trainee is observed following safe manual PAC practices. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation for manual PAC equipment and accessories, and manual PAC gas supply system equipment and accessories.
2. Provide demonstrations on ANSI Z49.1, Section 11, *Arc Welding and Cutting Equipment Safety*.
3. Provide instruction on routine safety inspections of protective equipment and clothing, hand tools, manual PAC equipment and accessories, manual PAC gas supply system equipment and accessories, and work area.
4. Provide instruction on ANSI Z49.1, Section 11.
5. Reinforce previous instruction from ANSI Z49.1, Part I—*General Aspects*.
6. Introduce relevant terms and definitions and observe trainee using proper manual PAC terms and definitions.
7. Observe trainee conducting safety inspections for manual PAC.
8. Observe trainee following safety manual PAC practices.
9. Develop and administer formative or diagnostic tests on safe manual PAC practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep records reflecting each trainee's successful completion of training in manual PAC safe practices.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 3: MANUAL PLASMA ARC CUTTING (PAC)

KEY INDICATOR 2: Makes minor external repairs to manual PAC equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on repair materials, equipment and tools, the trainee will make minor external repairs to manual PAC equipment, and manual PAC gas supply system equipment and accessories.

EVALUATION CRITERIA: The trainee's repairs to manual PAC equipment, and manual PAC gas supply system equipment and accessories are made as required, in accordance with the manufacturer's recommend-ations and the institution's repair policy. The correct repair materials, equipment and tools are selected. The assignment is competed in a timely manner. The objective is performed as required during the manual PAC portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on manual PAC equipment and accessories identification.
2. Provide instruction and demonstrations on manual PAC gas supply system equipment and accessories identification.
3. Provide instruction and demonstrations on minor external repairs on manual PAC equipment and accessories.
4. Provide instruction and demonstrations on minor external repairs on manual PAC gas supply system equipment and accessories identification.
5. Introduce relevant terms and definitions and observe trainee using proper manual PAC terms and definitions.
6. Provide training exercises on making minor external repairs on manual PAC equipment and accessories.
7. Provide training exercises on making minor external repairs on manual PAC gas supply system equipment and accessories.
8. Observe each trainee's ability to carry out training exercise on making minor external repairs on manual PAC equipment and accessories.
9. Observe each trainee's ability to carry out training exercise on making minor external repairs on manual PAC gas supply system equipment and accessories.
10. Observe trainee following safe manual PAC practices.
11. Develop and administer formative or diagnostic tests on manual PAC equipment and accessory, manual PAC gas supply system equipment and accessories identification, and making minor external repairs.

12. Prepare trainee for the manual PAC equipment and accessories, and manual PAC gas supply system equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of AWS C5.2 Recommended Practices for Plasma Arc Cutting and Gouging.

13. Keep training records reflecting each trainee's successful completion of training in manual PAC equipment and accessories, and manual PAC gas supply system equipment and accessories identification and making minor external repairs.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 3: MANUAL PLASMA ARC CUTTING (PAC)

KEY INDICATOR 3: Sets up for manual PAC operations on carbon steel, austenitic stainless steel, and aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual PAC cutting equipment, manual PAC gas supply system equipment and accessories, carbon steel, aluminum and austenitic stainless steel base metal, the trainee will set up for manual PAC operations on carbon steel, austenitic stainless steel, and aluminum.

EVALUATION CRITERIA: The trainee is prepared to cut. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, and base metal are selected. Manual PAC equipment and accessories are set up and adjusted for proper operation. Manual PAC gas supply system equipment and accessories are set up and adjusted to the proper pressure and supply. Parts are positioned and area is prepared for safe cutting operations. The objective is performed on a routine basis during the manual PAC portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on manual PAC equipment and accessories set up for carbon steel, austenitic stainless steel and aluminum.
2. Provide demonstrations on manual PAC gas supply system equipment and accessories set up for carbon steel, austenitic stainless steel and aluminum.
3. Provide instruction in manual PAC principles of operation on carbon steel, austenitic stainless steel and aluminum.
4. Provide instruction on carbon steel, austenitic stainless steel and aluminum shapes, identification and selection.
5. Provide instruction on manual PAC cutting tip identification and selection for carbon steel, austenitic stainless steel and aluminum.
6. Introduce relevant terms and definitions and observe trainee using proper manual PAC terms and definitions.
7. Provide trainee with practice setting up manual PAC equipment and accessories for carbon steel, austenitic stainless steel and aluminum.
8. Provide trainee with practice setting up manual PAC gas supply system equipment and accessories for carbon steel, austenitic stainless steel and aluminum.
9. Observe trainee setting up manual PAC equipment and accessories for carbon steel, austenitic stainless steel and aluminum.
10. Observe trainee setting up manual PAC gas supply system equipment and accessories for carbon steel, austenitic stainless steel, and aluminum.

11. Observe trainee following safe manual PAC practices.
12. Develop and administer formative or diagnostic tests on manual PAC equipment set up, principles of operation, and cutting tip identification and selection.
13. Prepare trainee for manual PAC equipment set up, principles of operation and cutting tip identification and selection portion of a written examination from the relevant sections of AWS C5.2.
14. Keep training records reflecting each trainee's successful completion of training in manual PAC equipment set up, principles of operation, and cutting tip identification and selection.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 3: MANUAL PLASMA ARC CUTTING (PAC)

KEY INDICATOR 4: Operates manual PAC equipment on carbon steel, austenitic stainless steel, and aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual PAC equipment and accessories, manual PAC gas supply system equipment and accessories, carbon steel, austenitic stainless steel and aluminum base metal and a cutting assignment, the trainee performs manual PAC operations on carbon steel, austenitic stainless steel, and aluminum.

EVALUATION CRITERIA: The trainee's manual PAC cutting is completed as required by the cutting assignment on a routine basis. During and after the operation, cut edges and surfaces are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on manual PAC equipment operations on carbon steel, austenitic stainless steel and aluminum.
2. Provide instruction on manual PAC principles of operation on carbon steel, austenitic stainless steel and aluminum.
3. Provide instruction on essential process variables for manual PAC on carbon steel.
4. Provide training exercises on manual PAC equipment operations on carbon steel, austenitic stainless steel and aluminum.
5. Provide training exercises on starting manual PAC edge and piercing cuts.
6. Provide training exercises on making flat position straight, square edge manual PAC cuts on carbon steel, austenitic stainless steel and aluminum.
7. Observe trainee operating manual PAC equipment on carbon steel, austenitic stainless steel and aluminum.
8. Observe trainee following safe manual PAC practices.
9. Visually inspect trainee's manual PAC cut edges and surfaces.
10. Develop and administer formative or diagnostic tests on manual PAC principles of operation and essential process variables.
11. Prepare trainee for the manual PAC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.2.
12. Keep training records reflecting each trainee's successful completion of training in manual PAC principles of operation, essential process variables, and performance exercises on carbon steel, austenitic stainless steel and aluminum.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 3: MANUAL PLASMA ARC CUTTING (PAC)

KEY INDICATOR 5: Performs straight, square edge, cutting operations, in the flat position, on carbon steel, austenitic stainless steel, and aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual PAC equipment and accessories, manual PAC gas supply systems and accessories, 10 gauge to 14 gauge carbon steel, austenitic stainless steel and aluminum base metal and a cutting assignment, the trainee will make manual PAC straight, square edge cuts in the flat position on carbon steel, austenitic stainless steel, and aluminum.

EVALUATION CRITERIA: The trainee produces sound manual PAC straight, square edge cuts in the flat position on carbon steel, austenitic stainless steel, and aluminum. After each operation, cut edges and surfaces are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstration on manual PAC straight, square edge, cuts on limited thickness range of carbon steel.
2. Provide instruction on visual examination of manual PAC cut edges and surfaces.
3. Provide instruction on cutting procedures and workmanship for manual PAC straight, square edge cuts, the flat position, on carbon steel.
4. Provide training exercises on making flat position straight, square edge, manual PAC cuts on 10 gauge to 14 gauge carbon steel, austenitic stainless steel, and aluminum.
5. Observe trainee operating manual PAC equipment on carbon steel.
6. Observe trainee following safe manual PAC practices.
7. Visually inspect trainee's manual PAC cut edges and surfaces.
8. Develop and administer formative or diagnostic tests on manual PAC straight, square edge cutting principles of operation and essential process variables.
9. Prepare trainee for the manual PAC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.2.
10. Keep training records reflecting each trainee's successful completion of making straight, square edge cuts on carbon steel, austenitic stainless steel, and aluminum.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 3: MANUAL PLASMA ARC CUTTING (PAC)

KEY INDICATOR 6: Performs shape, square edge, cutting operations, in the flat position, on carbon steel, austenitic stainless steel, and aluminum.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual PAC equipment and accessories, manual PAC gas supply systems and accessories, 10 gauge to 14 gauge carbon steel, austenitic stainless steel and aluminum base metal and a cutting assignment, the trainee will make manual PAC shape, square edge cuts in the flat position on carbon steel, austenitic stainless steel, and aluminum.

EVALUATION CRITERIA: The trainee produces sound manual PAC shape, square edge cuts, in the flat and horizontal positions, on carbon steel. After each operation, cut edges and surfaces are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstration on manual PAC shape, square edge, cuts on limited thickness range of carbon steel.
2. Provide instruction on visual examination of manual PAC cut edges and surfaces.
3. Provide instruction on cutting procedures and workmanship for manual PAC shape, square edge, cuts, in all positions, on limited thickness range of carbon steel.
4. Provide training exercises on making flat position shape, square edge manual PAC cuts on 10 gauge to 14 gauge carbon steel, austenitic stainless steel, and aluminum.
5. Observe trainee operating manual PAC equipment on carbon steel.
6. Observe trainee following safe manual PAC practices.
7. Visually inspect trainee's manual PAC cut edges and surfaces.
8. Develop and administer formative or diagnostic tests on manual PAC shape, square edge, cutting principles of operation and essential process variables.
9. Prepare trainee for the manual PAC principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.2.
10. Keep training records reflecting each trainee's successful completion of making square edge cuts on carbon steel, austenitic stainless steel, and aluminum.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 4: MANUAL AIR CARBON ARC CUTTING (CAC-A)

KEY INDICATOR 1: Performs safety inspections of manual CAC-A equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on safety inspection guidelines, protective clothing and equipment, hand tools, manual CAC-A equipment and accessories, and manual CAC-A compressed air supply system equipment and accessories, the trainee performs safety inspections of protective equipment and clothing, hand tools, manual CAC-A equipment and accessories, manual CAC-A compressed air supply system equipment and accessories, and work area.

EVALUATION CRITERIA: The trainee's protective clothing and equipment, hand tools, manual CAC-A equipment and accessories, manual CAC-A compressed air supply system equipment and accessories, and work area meet safety requirements. Hazard warnings are communicated to others in the immediate area prior to the start of manual CAC-A operations. In the course of daily operations, the trainee is observed following safe manual CAC-A practices on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall achieve a score of 90% on the written safety test for Module 2: Safety and Health of Welders, based on ANSI Z49.1: *Safety in Welding, Cutting, and Allied Processes*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide safety tour and orientation for manual CAC-A equipment and accessories, and manual CAC-A compressed air supply system equipment and accessories.
2. Provide demonstrations on ANSI Z49.1, Section 11, *Arc Welding and Cutting Safety*.
3. Provide demonstrations on routine safety inspections of protective equipment and clothing, hand tools, manual CAC-A equipment and accessories, manual CAC-A compressed air supply system equipment and accessories, and work area.
4. Provide instruction on ANSI Z49.1, Section 11.
5. Reinforce previous instruction from ANSI Z49.1, Part 1—*General Aspects*.
6. Introduce relevant terms and definitions and observe trainee using proper manual CAC-A terms and definitions.
7. Observe trainee conducting safety inspections for manual CAC-A.
8. Observe trainee following safe manual CAC-A practices.
9. Develop and administer formative or diagnostic tests on safe manual CAC-A practices.
10. Prepare trainee for the written safety examination based on ANSI Z49.1.
11. Keep records reflecting each trainee's successful completion of training in manual CAC-A safe practices.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 4: MANUAL AIR CARBON ARC CUTTING (CAC-A)

KEY INDICATOR 2: Makes minor external repairs to manual CAC-A equipment and accessories.

OBJECTIVE: Provided with a period of instruction and demonstration on repair materials, equipment and tools, the trainee will make minor external repairs to manual CAC-A equipment and accessories, and manual CAC-A compressed air supply system equipment and accessories.

EVALUATION CRITERIA: The trainee makes repairs to manual CAC-A equipment and accessories, and manual CAC-A compressed air supply system equipment and accessories as required, in accordance with the manufacturer's recommendations, and the institution's repair policy. The correct repair materials, equipment and tools are selected. The assignment is completed in a timely manner. The objective is performed as required during the manual CAC-A portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide instruction and demonstrations on manual CAC-A equipment and accessories identification.
2. Provide instruction and demonstrations on manual CAC-A compressed air supply system equipment and accessories identification.
3. Provide instruction and demonstrations on minor external repairs on manual CAC-A equipment and accessories.
4. Provide instruction and demonstrations on minor external repairs on manual CAC-A compressed air supply system equipment and accessories.
5. Introduce relevant terms and definitions and observe trainee using proper manual CAC-A terms and definitions.
6. Provide training exercises on making minor external repairs on manual CAC-A equipment and accessories.
7. Provide training exercises on making minor external repairs on manual CAC-A compressed air supply system equipment and accessories.
8. Observe each trainee's ability to carry out training exercises on making minor external repairs on manual CAC-A equipment and accessories.
9. Observe each trainee's ability to carry out training exercises on making minor external repairs on manual CAC-A compressed air supply system equipment and accessories.
10. Observe trainee following safe manual CAC-A practices.
11. Develop and administer formative or diagnostic tests on manual CAC-A equipment and accessory, manual CAC-A compressed air supply system equipment and accessories identification and making minor external repairs.

12. Prepare trainee for the manual CAC-A equipment and accessories, and manual CAC-A compressed air supply system equipment and accessories identification and making minor external repairs portion of a written examination from the relevant sections of AWS C5.3, Recommended Practices for Air Carbon Arc Gouging and Cutting.

13. Keep training records reflecting each trainee's successful completion of training in manual CAC-A equipment and accessories, manual CAC-A compressed air supply system equipment, accessories identification, and making minor external repairs.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 4: MANUAL AIR CARBON ARC CUTTING (CAC-A)

KEY INDICATOR 3: Sets up for manual CAC-A scarfing and gouging operations on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal and written instructions, protective clothing and equipment, hand tools, manual CAC-A equipment and accessories, manual CAC-A compressed air supply system equipment and accessories, carbon steel base metal, the trainee will set up for scarfing and gouging operations on carbon steel.

EVALUATION CRITERIA: The trainee is prepared to scarf and gouge with manual CAC-A. Protective clothing and equipment are suitable for job requirements. The proper hand tools, equipment, and base metal are selected. Manual CAC-A equipment and accessories are set up and adjusted to the proper current and polarity. The manual CAC-A compressed air supply system equipment and accessories are set up and adjusted to the proper pressure and supply. Parts are positioned and area is prepared for safe scarfing and gouging operations. The objective is performed on a routine basis during the manual CAC-A portion of the program.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on manual CAC-A equipment and accessories set up for carbon steel.
2. Provide demonstrations on manual CAC-A gas supply system equipment and accessories set up for carbon steel.
3. Provide instruction on manual CAC-A principles of operation on carbon steel.
4. Provide instruction on carbon steel shapes, identification and selection.
5. Provide instruction on manual CAC-A electrode identification and selection for carbon steel.
6. Introduce relevant terms and definitions and observe trainee using proper manual CAC-A terms and definitions.
7. Provide trainee with practice setting up manual CAC-A equipment and accessories for carbon steel.
8. Provide trainee with practice setting up manual CAC-A gas supply system equipment and accessories for carbon steel.
9. Observe trainee setting up manual CAC-A equipment and accessories for carbon steel.
10. Observe trainee setting up manual CAC-A gas supply system equipment and accessories for carbon steel.
11. Observe trainee following safe manual CAC-A practices.

12. Develop and administer formative or diagnostic tests on manual CAC-A equipment set up, principles of operation, and electrode identification and selection.
13. Prepare trainee for manual CAC-A equipment set up, principles of operation and electrode identification and selection portion of a written examination from the relevant sections of AWS C5.3.
14. Keep training records reflecting each trainee's successful completion of training in manual CAC-A equipment set up, principles of operation, and electrode identification and selection.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 4: MANUAL AIR CARBON ARC CUTTING (CAC-A)

KEY INDICATOR 4: Operates manual CAC-A equipment on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual CAC-A equipment and accessories, manual CAC-A compressed air supply system equipment and accessories, carbon steel base metal and a cutting assignment, the trainee will perform manual CAC-A scarfing and gouging operations on carbon steel.

EVALUATION CRITERIA: The trainee's manual CAC-A scarfing and gouging is completed as required by the cutting assignment on a routine basis. During and after the operation, scarfed and gouged surfaces are visually examined by the trainee and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on manual CAC-A equipment operations on carbon steel.
2. Provide instruction on manual CAC-A principles of operation on carbon steel.
3. Provide instruction on essential process variables for manual CAC-A on carbon steel.
4. Provide training exercises on manual CAC-A equipment operations on carbon steel.
5. Provide training exercises on starting and maintaining a manual CAC-A arc on carbon steel.
6. Provide training exercises on making flat position scarfs and gouges using manual CAC-A on carbon steel.
7. Observe trainee operating manual CAC-A equipment on carbon steel.
8. Observe trainee following safe manual CAC-A practices.
9. Visually inspect trainee's manual CAC-A scarfed and gouged surfaces.
10. Develop and administer formative or diagnostic tests on manual CAC-A principles of operation, and essential process variables.
11. Prepare trainee for the manual CAC-A principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C5.3.
12. Keep training records reflecting each trainee's successful completion of training in manual CAC-A principles of operation, essential process variables, and performance exercises on carbon steel.

3.3.1 MODULE 8: THERMAL CUTTING PROCESSES

UNIT 4: MANUAL AIR CARBON ARC CUTTING (CAC-A)

KEY INDICATOR 5: Performs scarfing and gouging operations to remove base and weld metal, in the flat and horizontal positions, on carbon steel.

OBJECTIVE: Provided with a period of instruction and demonstration, verbal or written instructions, protective clothing and equipment, hand tools, manual CAC-A equipment and accessories, manual CAC-A compressed air supply system equipment and accessories, welded 0.25 inch to 1.00 inch carbon steel base metal and a cutting assignment, the trainee will use manual CAC-A scarfing and gouging operations to remove weld and base metal.

EVALUATION CRITERIA: The trainee produces sound manual CAC-A scarfs as well as round and rectangular gouges, in the flat and horizontal positions, on carbon steel. The trainee prepares base metal for both initial and repair welding. The trainee removes both weld reinforcement and all weld metal, and the base metal is salvaged for further use. During and after each operation, scarfed and gouged surfaces are visually examined by the welder, and accepted by the instructor on a routine basis.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Provide demonstrations on weld and base metal scarfing and gouging using manual CAC-A equipment on limited thickness range of carbon steel.
2. Provide instruction on visual examination of manual CAC-A scarfed and gouged surfaces.
3. Provide instruction on weld metal scarfing (smoothing) using manual CAC-A scarfing operations, in 1G and 2G positions, on groove welded carbon steel butt joints.
4. Provide instruction on weld and base metal gouging (removal) using manual CAC-A gouging operations, in flat and horizontal positions, on groove and fillet welded carbon steel butt and T joints.
5. Provide instruction on scarfing and gouging procedures and workmanship for manual CACA scarfing and gouging on limited thickness range of carbon steel.
6. Provide training exercises on making flat and horizontal position manual CAC-A scarfs, on groove welded butt joints, on 0.25 inch to 1.00 inch carbon steel.
7. Provide training exercises on making flat and horizontal position manual CAC-A round and rectangular gouges, on groove welded butt joints and fillet welded T joints, on 0.25 inch to 1.00 inch carbon steel.
8. Observe trainee operating manual CAC-A scarfing and gouging equipment on carbon steel.
9. Observe trainee following safe manual CAC-A scarfing and gouging practices.
10. Visually inspect trainee's manual CAC-A scarfed and gouged surfaces.

11. Develop and administer formative or diagnostic tests on manual CAC-A scarfing and gouging principles of operation, and essential process variables.
12. Prepare trainee for the manual CAC-A scarfing and gouging principles of operation and essential process variables portion of a written examination from the relevant sections of AWS C4.2/C4.2M.
13. Keep training records reflecting each trainee's successful completion of making scarfing and gouging operations in the flat and horizontal positions on carbon steel.

3.3.1 MODULE 9: WELDING INSPECTION AND TESTING PRINCIPLES.

KEY INDICATOR 1: Examines cut surfaces and edges of prepared base metal parts.

OBJECTIVE: Provided with a period of instruction and demonstration visual examination guidelines, verbal or written instructions, protective clothing and equipment, a cutting assignment and measuring tools, the trainee performs visual examination of cut surfaces and edges.

EVALUATION CRITERIA: Cut surfaces are visually examined by the trainee and accepted by the instructor on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall pass the visual examination portion of a written examination from the related sections of AWS C4.2, *Operator's Manual for Oxyfuel Gas Cutting* and AWS C4.1, *Criteria for Describing Oxygen-Cut Surfaces*.

RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction and demonstrations related to the visual examination of oxyfuel gas cut surfaces and edges.
3. Provide instruction and demonstrations related to the visual examination of arc cut surfaces and edges.
4. Provide instruction related to common cutting surface and edge discontinuities.
5. Provide training exercises related to the visual examination of oxyfuel gas cut surfaces and edges.
6. Provide training exercises related to the visual examination of arc cut surfaces and edges.
7. Observe trainee performing visual examination.
8. Observe trainee conducting safe practices.
9. Provide feedback to trainee about his/her visual examination diagnosis.
10. Develop and administer formative (diagnostic) tests relevant to visual examination of cut surfaces and edges.
11. Prepare trainee for the visual examination portion of a written examination from the related sections of AWS C4.2.
12. Keep records reflecting results of visual examination of cut edges and surfaces.

3.3.1 MODULE 9: WELDING INSPECTION AND TESTING PRINCIPLES.

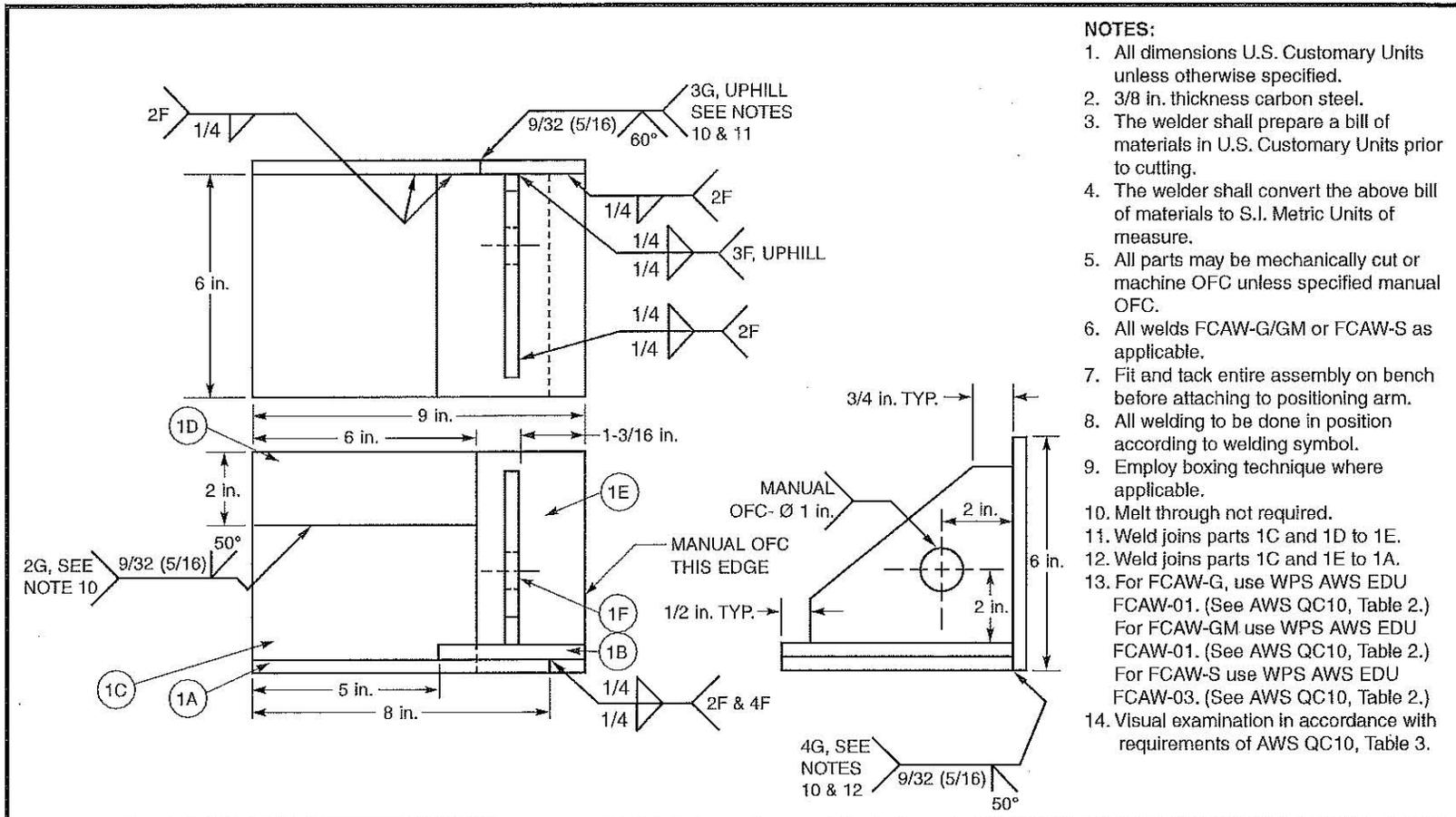
KEY INDICATOR 2: Examines tacks, root passes, intermediate layers and completed welds.

OBJECTIVE: Provided with a period of instruction and demonstration, visual examination guidelines, verbal or written instructions, protective clothing and equipment, a welding assignment and measuring tools, the trainee performs visual examination of tack, intermediate layers, and completed welds.

EVALUATION CRITERIA: Welds made at various stages of assignment are visually examined by the trainee and accepted by the instructor on a routine basis. In accordance with the requirements of AWS QC10, the trainee shall pass the visual examination portion of a written examination from the related sections of AWS B1.11, *Guide for the Visual Examination of Welds*.

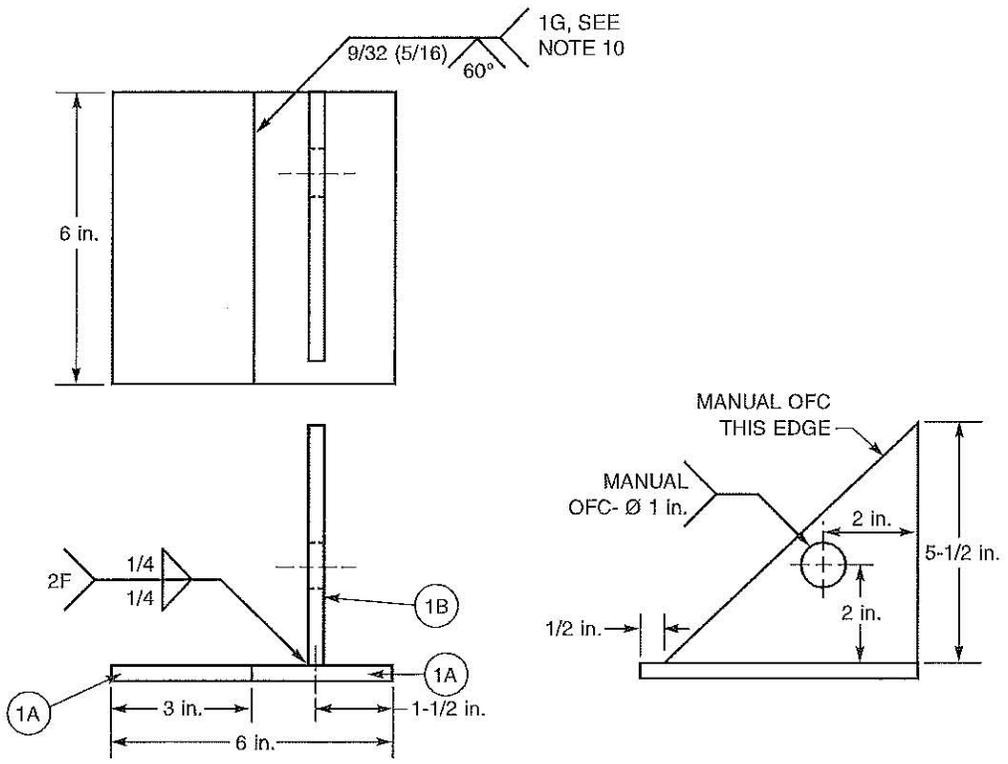
RECOMMENDED INSTRUCTIONAL ACTIVITIES:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction and demonstrations related to the visual examination of welds.
3. Provide instruction related common weld discontinuities.
4. Provide training exercises related to the visual examination of welds.
5. Observe trainee conducting safe visual examination practices.
6. Provide feedback to trainee about his/her visual examination diagnoses.
7. Develop and administer formative (diagnostic) tests relevant to visual examination of welds.
8. Prepare trainee for the visual examination portion of a written examination from the related sections of AWS B1.11.
9. Keep records reflecting results of visual examination of welds.



- NOTES:**
1. All dimensions U.S. Customary Units unless otherwise specified.
 2. 3/8 in. thickness carbon steel.
 3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
 4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
 5. All parts may be mechanically cut or machine OFC unless specified manual OFC.
 6. All welds FCAW-G/GM or FCAW-S as applicable.
 7. Fit and tack entire assembly on bench before attaching to positioning arm.
 8. All welding to be done in position according to welding symbol.
 9. Employ boxing technique where applicable.
 10. Melt through not required.
 11. Weld joins parts 1C and 1D to 1E.
 12. Weld joins parts 1C and 1E to 1A.
 13. For FCAW-G, use WPS AWS EDU FCAW-01. (See AWS QC10, Table 2.)
For FCAW-GM use WPS AWS EDU FCAW-01. (See AWS QC10, Table 2.)
For FCAW-S use WPS AWS EDU FCAW-03. (See AWS QC10, Table 2.)
 14. Visual examination in accordance with requirements of AWS QC10, Table 3.

ID	QTY	SIZE	METRIC CONVERSION	 American Welding Society		
				Entry Welder Performance Qualification		
				FCAW-G/GM, FCAW-S Carbon Steel		
				DATE:	SCALE:	DWG #: AWS EDU-1
				DR BY:	Tolerances: (Unless otherwise specified)	
				APP BY:	DRAWING NOT TO SCALE	
					Fractions: ± 1/16" Angles: +10°, -5°	

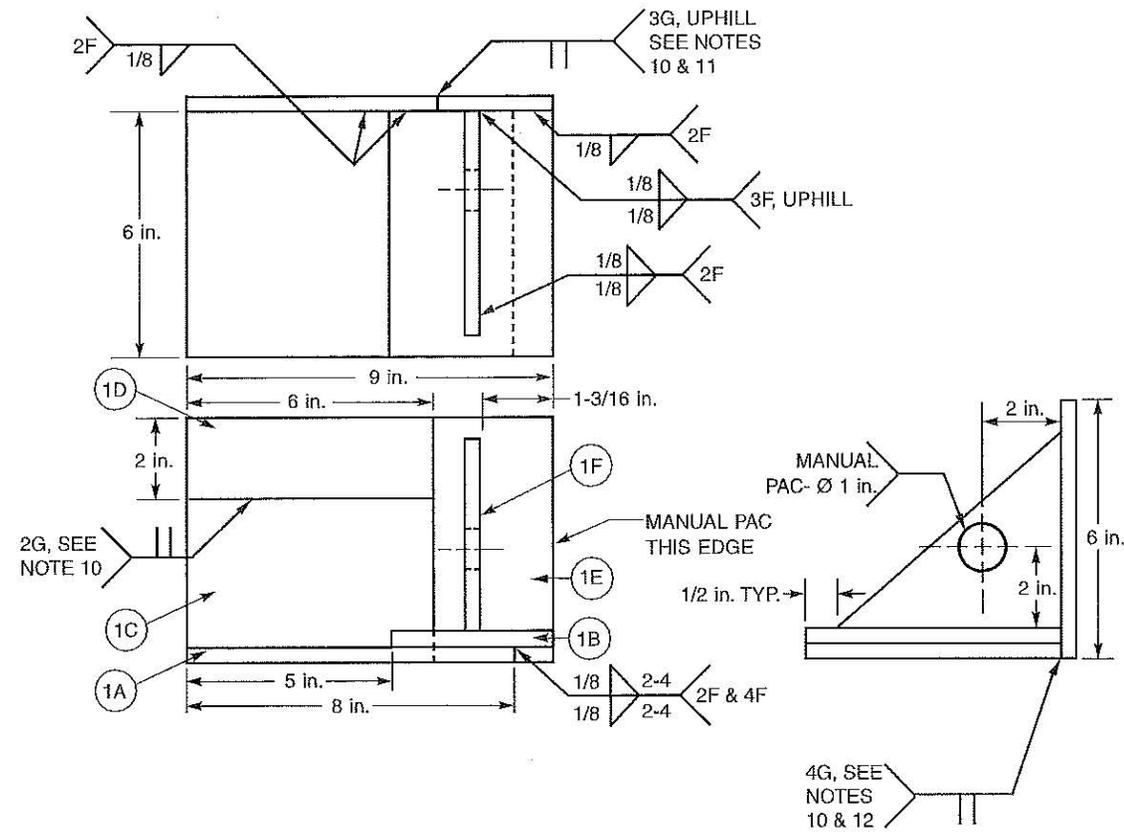


NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 3/8 in. thickness carbon steel.
3. The welder shall prepare a bill of materials in U.S. Customary Units of measure prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine OFC unless specified manual OFC.
6. All welds GMAW Spray Transfer.
7. Fit and tack entire assembly on bench before welding.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.
11. Use WPS AWS EDU GMAW-02, AWS QC10, Table 2.
12. Visual examination in accordance with the requirements of AWS QC10, Table 3.

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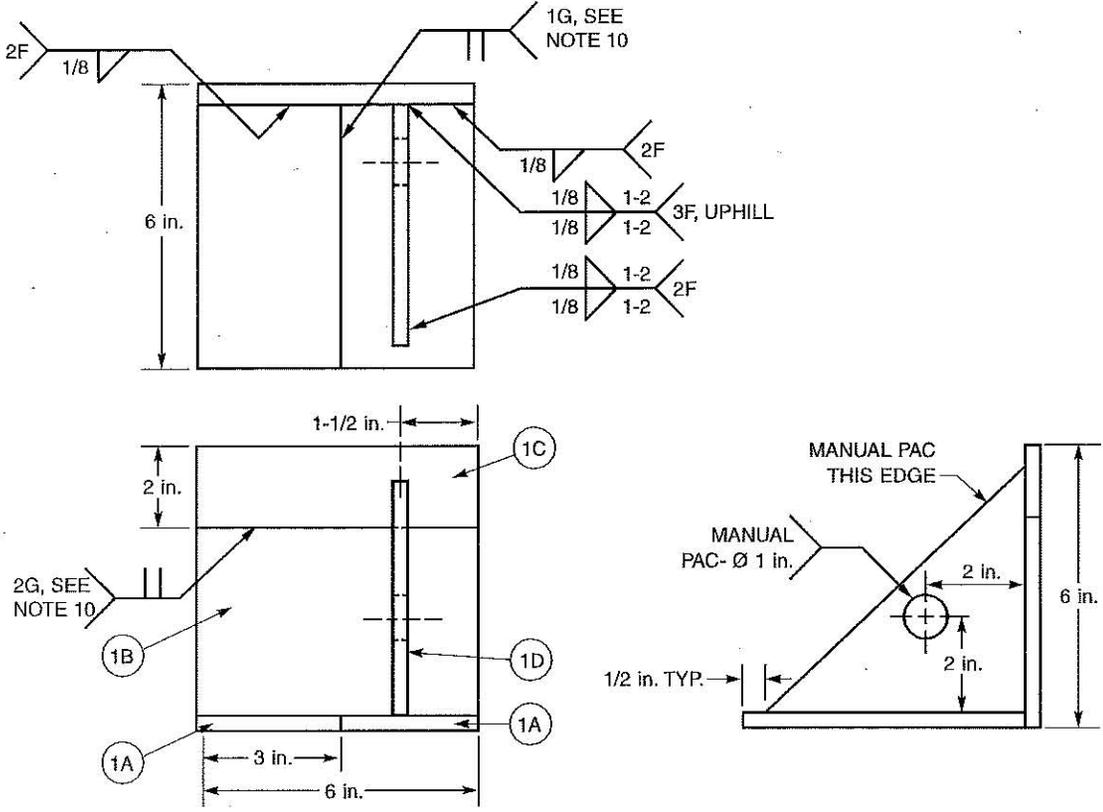
ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				GMAW Spray Transfer, Carbon Steel		
				DATE:	SCALE:	DWG #: AWS EDU-2
				DR BY:	Tolerances: (Unless otherwise specified)	
				APP BY:	DRAWING NOT TO SCALE	
					Fractions: ± 1/16" Angles: +10°, -5°	



NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 10 ga.-14 ga. thickness carbon steel. Optional choice of thickness within range specified.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine PAC unless specified manual PAC.
6. All welds GMAW-S (Short Circuiting Transfer) or GTAW as applicable.
7. Fit and tack entire assembly on bench before attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.
11. Weld joints parts 1C and 1D to 1E.
12. Weld joints parts 1C and 1E to 1A.
13. For GMAW-S, use WPS AWS EDU GMAW-01. (See AWS QC10, Table 2.)
14. For GTAW use WPS AWS EDU GTAW-01. (See AWS QC10, Table 2.)
15. Visual examination in accordance with requirements of AWS QC10, Table 3.

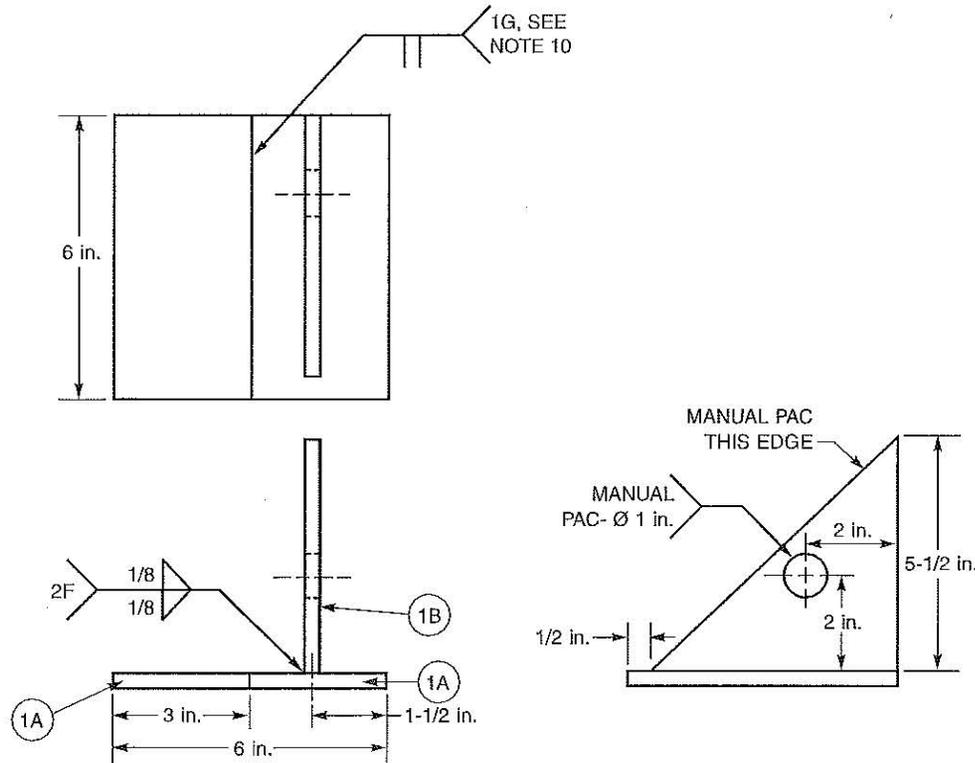
ID	QTY	SIZE	METRIC CONVERSION	 American Welding Society		
				Entry Welder Performance Qualification		
				GMAW-S, GTAW Carbon Steel		
				DATE:	SCALE:	DWG #: AWS EDU-3
				DR BY:	Tolerances: (Unless otherwise specified)	
				APP BY:	DRAWING NOT TO SCALE	
				Fractions: ± 1/16" Angles: +10°, -5°		



- NOTES:**
1. All dimensions U.S. Customary Units unless otherwise specified.
 2. 10 ga.-14 ga. thickness austenitic stainless steel. Optional choice of thickness within range specified.
 3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
 4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
 5. All parts may be mechanically cut or machine PAC unless specified manual PAC.
 6. All welds GTAW.
 7. Fit and tack entire assembly on bench before attaching to positioning arm.
 8. All welding to be done in position according to welding symbol.
 9. Employ boxing technique where applicable.
 10. Melt through not required.
 11. Use WPS AWS EDU GTAW-04. (See AWS QC10, Table 2.)
 12. Visual examination in accordance with requirements of AWS QC10, Table 3.

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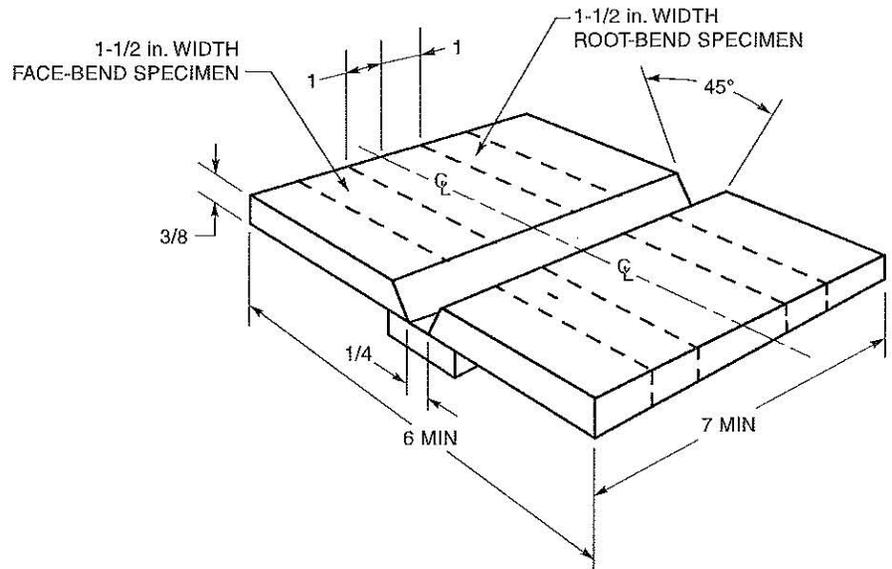
ID	QTY	SIZE	METRIC CONVERSION	 American Welding Society		
				Entry Welder Performance Qualification		
				GTAW Austenitic Stainless Steel		
				DATE:	SCALE:	DWG #: AWS EDU-4
				DR BY:	Tolerances: (Unless otherwise specified)	
				APP BY:	DRAWING NOT TO SCALE	
					Fractions: ± 1/16" Angles: +10°, -5°	



NOTES:

1. All dimensions U.S. Customary Units unless otherwise specified.
2. 10 ga.-14 ga. thickness aluminum. Optional choice of thickness within range specified.
3. The welder shall prepare a bill of materials in U.S. Customary Units prior to cutting.
4. The welder shall convert the above bill of materials to S.I. Metric Units of measure.
5. All parts may be mechanically cut or machine PAC unless specified manual PAC.
6. All welds GTAW.
7. Fit and tack entire assembly on bench before attaching to positioning arm.
8. All welding to be done in position according to welding symbol.
9. Employ boxing technique where applicable.
10. Melt through not required.
11. Use WPS AWS EDU GTAW-03 for 4000/5000 Series aluminum. (See AWS QC10, Table 2.)
12. Visual examination in accordance with requirements of AWS QC10, Table 3.

ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				GTAW Aluminum		
				DATE:	SCALE:	DWG #: AWS EDU-5
				DR BY:	Tolerances: (Unless otherwise specified)	
				APP BY:	DRAWING NOT TO SCALE	
					Fractions: ± 1/16" Angles: +10°, -5°	



NOTES:

1. 3/8 in. thickness carbon steel material.
2. Performance Qualification #1 = 2G, Performance Qualification #2 = 3G, Uphill.
3. All welding done in position, according to applicable performance qualification requirements.
4. The backing thickness shall be 1/4 in. min to 3/8 in. max; backing width 1 in. min.
5. All parts may be mechanically cut or machine OFC.
6. Use WPS AWS EDU SMAW-01 for PQ#1-2G, and AWS EDU SMAW-02 for PQ#2-3G uphill. (See AWS QC10, Table 2.)
7. Visual examination in accordance with requirements of AWS QC10, Table 3.
8. Bend test in accordance with the requirements of QC10, Table 4.

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ID	QTY	SIZE	METRIC CONVERSION	American Welding Society		
				Entry Welder Performance Qualification		
				SMAW Carbon Steel Test Plates		
				DATE:	SCALE:	DWG #: AWS EDU-6
				DR BY:	Tolerances: (Unless otherwise specified) DRAWING NOT TO SCALE Fractions: ± 1/16" Angles: +10°, -5°	
				APP BY:		

Annex A

Recommendations for Support Personnel and Systems

A1. Program Administrator

The administrator, director, or supervisor of any training organization's welding program should be familiar with all types of welding. A practical background in the welding industry would be very helpful. In addition to meeting the minimum state certification requirements, if applicable, the program administrator should be experienced in both instruction and program execution.

Because of the importance of continued contact with area industry, the administrator should be encouraged to join and maintain a membership in the American Welding Society and be active in the local AWS Section. Membership in other professional organizations, particularly in the materials (metals) or educational field, would also be very helpful. Such participation will allow a welding program administrator to maintain effective working relationships with members of local industry, technical experts, and fellow educators. Moreover, the administrator's commitment to these activities sets the example for not only the instructors but also the welding personnel.

A2. Advisory Committee

The Committee is a conglomerate of all interested training incentive sectors. It assists in the advertisement of program implementation, formulation of trainee learning contracts, informing training facility personnel and the community about the program, providing orientation for potential training candidates, their spouses and or parents, planning and implementing "launching" activities, review of final reports and evaluations, and the review of follow-up surveys. The Committee is comprised of, as applicable to the training organization:

- Business Industry representative (chairperson)
- Local section representative of the American Welding Society (AWS)
- Human Resource Development Director, Director of Guidance or Guidance Counselor
- Parent Representative (secondary systems)
- Trainee Representative
- School district Career & Technical Education administration representative
- Welding Instructor(s)
- Business and Industry Representatives
- Welding Engineer

- Welding Inspector
- Welding Technician
- Welding Supervisor
- One or two experienced welders
- Welding supply representatives
- Former Welding Student from Welding Program

The duties of the Advisory Committee may vary according to the preferences and composition of the representatives from the geographical area and, if applicable, various state models. However, the baseline duties should include the following:

1. Provides advice and assistance in the selection, purchase, and installation of equipment appropriate to both the instructional environment and the requirements of modern industry.
2. Assists in the development and implementation of continuing education experiences, including advanced course work, for welding educators.
3. Assists with the preparation and review of instructional materials and the ongoing development of instructional pedagogy.
4. Fosters participation in appropriate community service and educational projects, stressing the value of such activities as an excellent means of recruiting and motivating individuals.
5. Encourages welding personnel to apply for scholarships and enter competitions sponsored by such entities as the American Welding Society (AWS), SkillsUSA, and other educational opportunities.
6. Conducts follow-up surveys of graduates, who have been successfully placed in welding related occupations.
7. Supports the program through assistance in public relations and welding personnel recruitment.
8. Sponsors career days, plant tours, and related activities designed to stimulate interest in welding and related fields as possible career opportunities.
9. Provides assistance in obtaining materials for practice, projects and testing.
10. Provides assistance in establishing internship opportunities in area businesses.

A3. AWS Certified Welding Educator (AWS QC5)

The Welding Instructor is a person who identifies welding training requirements, prepares instructional plans, conducts training classes and evaluates welding personnel performance. This instructor may teach using prepared instructional materials or self prepared instructional materials. The instructor should be certified to AWS QC5, *Standard for Certification of Welding Educators*.

Instructors should be responsible for continually updating their technical knowledge. Furthermore, it is incumbent upon welding instructors to strive to enhance their own teaching abilities. Welding instructors will find participation in the programs of appropriate industry and educational associations beneficial to their effectiveness as educators. On a regular basis, instructors, as members of AWS, should visit local industry, attend area welding educational programs sponsored by local AWS section and/or the annual AWS International Welding Exposition in order to stay up-to-date on the latest technological trends. Industry and trade magazines provide another excellent means of continuing education and many are available to educators free of cost. Attitude, demeanor, and dedication to the welding industry are essential qualities as instructors set the example for their welding students.

A4. Safety Requirements

All training organizations shall develop and enforce sound safety programs, beginning with the orientation of welding personnel and continuing through graduation. Each training organization shall teach safety theory and practice safety at all times. All safety practices shall conform to local, state, and federal regulations, and ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*. See Annex F, *Reference Materials, Safety*, for additional applicable AWS Safety Standards.

A5. Assessment

Trainee assessment should be implemented to measure learning at each step of the program and determine if the trainee has mastered the learning tasks to such a degree that they may move to the next unit, module or level of instruction. In addition, a follow-up assessment should be conducted to measure the trainee's effectiveness on the job and the training organization's delivery of the instructional programs. Follow-up assessment is meant to determine if the training organization is meeting industry needs.

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Annex B

Recommendations for the Trainee Population

B1. Entrance Requirements

B1.1 Career Guidance. The success of recruiting prospective individuals into the welding field will depend on the placement assessment, testing and guidance provided to that individual. Current and long-term needs for skilled welders demand that career counselors present welding as a positive career. The Advisory Committee members play an important role in ensuring that career counselors and the administrative committee have regular, positive contact with the welding industry through plant tours, open houses, and personal contacts. Guidance counselors should be made aware that welding not only provides an excellent career, but can also provide preparation for positions such as welding supervisor, quality assurance inspector, production scheduler, etc. Moreover, career enhancement should not cease once training is completed. The Instructors and the Advisory Committee should work to place graduates in appropriate positions and to track their subsequent successes.

B1.2 Basic Prerequisites. Standards for admittance to the welding program should be established by formal evaluation of prospective welding personnel. A basic foundation in computation, physical science, learning to learn, reading, writing, problem solving abilities, creative thinking, interpersonal skills and teamwork is necessary for a person is to have a successful career in welding. In the event that some prospective welding personnel do not demonstrate the academic skills necessary to understand the subject matter, a remedial program, at the same location or nearby training facility, should be set up to provide the missing academic foundation necessary for welding training.

B1.3 Health. Safe operation of the welding equipment and maintaining a work environment appropriate to the welding industry are paramount. Prospective welder trainees should have the ability to meet these critical requirements which include an understanding of OSHA regulations.

B1.4 Age. Individuals shall meet the minimum age requirements stipulated by applicable state and federal laws.

B1.5 Probationary Period. All trainees should be given a trial period in which to demonstrate their ability to perform, and develop good work habits as required by industry. The time limit for such a period will vary according to the training organization and the type of instruction, but should not exceed 15% of the course length. A public school situation may permit a longer time, versus that allowed by a private or industrial training program. During this probationary period, the instructor shall determine whether, in the interest of all concerned, the individual should continue the course of instruction.

B2. Trainee/Instructor Ratio

B2.1 Public School Systems. The training organization shall meet the requirements established by the School Facilities Commission for the state in which the school is located.

B2.2 Other Training Organizations—Private/Industrial. A training organization may choose to meet the requirements established by the School Facilities Commission for the state in which the school is located.

B2.3 Other Training Organizations—Private/Industrial. A training organization not using the requirements established by the School Facilities Commission for the state in which the school is located should combine the recommendations of their advisory committee and the following guide in establishing their Trainee/Instructor Ratio:

B2.3.1 Trainee/Instructor Ratio. The trainee/instructor ratio for each course should be kept as low as possible. A reasonable figure would be fifteen (15) welding trainees to one (1) welding instructor. However, this ratio should never exceed the number of work stations in the laboratory. Twenty (20) welding personnel to one (1) instructor would be the maximum recommended acceptable ratio.

Annex C

Recommendations for Facility Planning

C1. Welding Facilities

C1.1 Public School Systems. The training organization shall meet the requirements established by the School Facilities Commission for the state in which the school is located.

C1.2 Other Training Organizations—Private/Industrial. A training organization may choose to meet the requirements established by the School Facilities Commission for the state in which the school is located.

C1.3 Other Training Organizations—Private/Industrial. A training organization not using the requirements established by the School Facilities Commission for the state in which the school is located should combine the recommendations of their advisory committee and the following guide in establishing their School Welding Facilities.

C1.3.1 Primary Structure(s). The building should be fire proof and well designed. Welding instructional facilities will function best if located on the ground floor, preferably in a one story wing of the main building or in a separate building with covered access ways. Instructional areas in which noisy activities are conducted are best placed farthest from other academic areas of the school or production areas in an industrial facility. Walls should be smooth, with no ledges to collect dust. Floors shall be fire-resistant, waterproof, and contain adequate floor drains. A minimum light level of 100 foot-candles (100 candela) 30 in. (762 mm) from the floor is recommended. To enhance motivation and morale, adequate natural light from windows and skylights should be available. Walls should be prepared with a low reflective paint to reduce ultraviolet radiation. “Cool” colors, blues or greens, are recommended. The various work stations in a laboratory should meet the following objectives:

1. Provide suitable facilities where the instructor may demonstrate the skills and techniques necessary to develop welding competencies.
2. Provide a place at which the welding students may develop such competencies.
3. Provide an area in which power sources, equipment and projects may be secured and serviced.
4. For specific industry welding training facilities, provide special fixtures and production work mock-ups to adequately demonstrate the production work to be expected in order for all students to experience typical job related welding positions, conditions, and interferences.

A modular system of layout should be considered so that a two fold criteria for modern building planning (i.e., flexibility and expandability) can be achieved. The former is accomplished by allowing the maximum possible interchange of work stations and other facilities. Future expansion is planning in terms of multiples of specific work stations needed rather than in terms of the

general area to be added. These features would simplify the work of the architect, increase the usable life of the laboratory, and provide the instructor with more possibilities to offer curriculum changes.

The flexibility and expandability of laboratories should be greatly enhanced if architectural design permits use of non-load-bearing partitions between adjoining areas. Good planning includes the provision of doors large enough to permit easy entry of the largest piece of equipment into each shop. In addition, placement of such doors to permit the maximum degree of future flexibility with changes in partition locations should be considered.

If facilities are to be used for evening classes, easily accessible outside entrances which eliminate the necessity of opening or lighting other parts of the building offer important savings in operating and maintenance costs.

C1.3.2 Classroom(s). Ideally, a room for instruction should be about 20 ft (6.1 m) x 24 ft (7.3 m) and adjacent to the laboratory. Classrooms should provide a clear (but protective) view of the laboratory area. The minimum ceiling height should be 12 ft (3.7 m) or higher. Classrooms should be acoustically insulated from laboratory noise. This space should have chalk and tack boards, a demonstration table, adequate seating facilities and provision for darkening for the use of visual aids. At least one bulletin board should be near the main entrance. Instructors and welding personnel shall have normal access to the classroom. Storage for audiovisual equipment, charts, models, samples, reference texts, etc., needs to be provided. Exhibit cases have strong appeal to parents and observers, especially when located to permit viewing from the outside corridor.

C1.3.3 Laboratory. A minimum of 100 ft² (9.3 m²) of laboratory floor space per individual is considered a good general planning figure, exclusive of washroom, storage, office space and the classroom. At the outset the architect and laboratory planner should take into account state recommendations as to minimum square footage per individual. While they vary from state to state, factors of 75 ft² (7.0 m²) to 150 ft² (13.9 m²) of work space per individual and a minimum of 400 ft² (37.2 m²) to 800 ft² (74.3 m²) for material storage are generally accepted requirements for this particular size area and the subjects to be taught. Floor dimensions of 40 ft (12.2 m) □ 85 ft (25.9 m) are reasonably close to the normally accepted length to width proportions of 2 to 1. The minimum ceiling (clearance) height should be no less than 12 ft (4.3 m). At least one entrance shall be large enough [14 ft (4.3 m) □ 14 ft (4.3 m)] to accommodate bulky materials, equipment and projects. Future expansion should always be considered. While projections of this nature are sometimes only educated guesses at best, adaptability of reorganization should be kept in mind. This should permit additional enrollment, new equipment, or extra shop Subjects to be reasonably accommodated without going below space-per-individual minimums.

Where a hazard exists around machines, the power equipment should be so placed that welding personnel are not in the line of danger. Added protection is given by enclosing this equipment in a safety zone painted on the floor. Wide aisles of travel should be provided between benches, machines, and in areas in front of tool cabinets and storage lockers. These aisles should be a minimum of 3 ft (0.9 m) in width. Aisles of travel may be designated by painted lines similar to those used in industry. Non-skid surfaces such as sand on shellac should be applied to the floor in the area around machines to minimize danger of slipping.

A 6 ft (1.8 m) x 6 ft (1.8 m) area should be planned for welding booths. The process power source should not be contained in the booth area. Welding booths shall be constructed of fire-resistant material, with the walls open at least 12 in. (305 mm) at the bottom to permit air circulation. All four sides of the welding booth should provide complete protection to the welding personnel and others in the area from harmful rays and hot sparks. A minimum of one 10 ft (3.1 m) x 10 ft (3.1 m) demonstration area should be available for every 20 welding personnel. Positioning jigs, independent of other activities to prevent congestion, should be provided.

Tools and supplies should be located as near to work areas as practical and reduce travel and interferences. Machines should be placed to allow for eases of cleaning around the base. Cabinets should fit flush to walls or be trimmed to fit flush for the same reason. Bases for cabinets and benches should provide toe space for comfort and safety of workers.

C1.3.4 Office(s). The entrance to the instructor's office should be easily accessible from the classroom, laboratory and facility corridor. Activities in the classroom and laboratory should be visible from the office. The office window space should be designed to provide maximum vision to all areas along with proper ultra violet light protection. The office ought to provide at least 120 ft² (11.2 m²) of floor space per instructor [size 10 ft (3.1 m) x 12 ft (3.7 m)]. The office needs to be planned with at least one 3 ft (0.9 m) wide door, tile or carpet flooring cover, and an acoustical ceiling with fluorescent lighting. For instructional use and laboratory safety the office should have a telephone. It should also have room for file cabinets, desks, bench with storage underneath for weld supplies, a shelf for boots, and room for two chairs for counseling welding personnel.

C1.3.5 Storage. Decentralized storage should help conserve space and increase efficiency by reducing individual traffic. A storage area for bar stock should be at least 20 ft long (6.1 m) and 7 ft wide (2.1 m), with a door centered at both ends. This permits both economical purchase of steel in long lengths and wall storage within the room. Use of horizontal or vertical racks depends on space limitations and personal preference. Storage of bulk supplies (adequately secured) should be located adjacent to an outside service door for convenient delivery.

Adequate filler metal storage should be considered and should be controlled. Rod, wire, and fluxes, depending on their nature, should be maintained under certain storage conditions. The materials of higher value or requiring temperature control should require the tighter controls to ensure that product quality is retained. Acquisition of a specially designed electrode storage oven is highly recommended.

Open tool cabinets in each process are should conserve welding personnel time and travel while helping them associate proper tool selection and application with a particular activity. This also provides fore easy checking of tools. Space underneath benches and tables is excellent for storage of hardware, small amounts of raw stock or even small projects. Storage for projects of welding personnel and personal belongings is always a problem and should be well thought out.

Cylinder storage should be located near the laboratory, but accessible to truck traffic. All volatile materials should be stored outside in an identified, isolated area to minimize the potential hazards involve. Cylinder storage **shall** follow the guidelines set forth in ANSI Z49.1, *Part II—Specific Processes*, 10.8.2 *Cylinder Storage*.

One door should open directly to the outside from this room so that stock may be loaded into the room with no interference to shop activities. Scrap storage should be located near this entrance.

Thus, material storage areas or rooms should be located conveniently for issuing materials to the welding personnel, for cutting large stock to project size and for the unloading of delivery trucks.

C1.3.6 Personal Services and Changing Facilities. Personal Services should be planned into the laboratory, both for convenience and efficiency. Individual lockers for books and clothing should be near the entrance to keep these items out of the main instructional area. A wash-up sink and water fountain and, where possible, lavatory for each gender should also be included near the entrance.

Hot and cold running water, with suitable drinking fountains in the laboratory, and convenient sanitary restroom are necessities. Washing facilities of either the half round or trough type sink are essential and, as a rule of thumb, should be adequate to accommodate one quarter of the welding personnel simultaneously. Location of the washing facilities should be as near the door as feasible. Drinking fountains are highly desirable and should be available within the welding facility. A safety shower and eye wash station should also be located within each laboratory area. Proper drainage should be considered during installation.

C1.3.7 Lighting. One hundred (100) foot-candles (100 candela) is recommended for general work in any shop while 140 foot-candles (140 candela) would be recommended for more difficult or inspection work. In most cases, the use of indirect lighting to avoid glare and evenly diffuse the light is recommended. When needed, individual machines can be lighted by lamp attachments or through their own built-in light systems. Providing uniform distribution of shadow-free light through the use of indirect or semi-indirect deflectors should also be considered. Adequate lighting shall be provided in each booth.

C1.3.8 Electricity. Electrical power should be supplied with adequate voltage and amperage for each power source. Electrical service should be 208 volt, 230/240 volt, or 460/480 volt, single-phase or three phase, and 60/50 cycle (60/50 Hz), alternating current. The primary service should never be less than 208 volts. Current capacity of 75% more than the known demand should be provided for expansion in the welding facility. Electrical outlets for 110/120 volt service should be placed at convenient locations every 12 ft (3.7 m) and in every booth. Ground fault interrupters should be provided throughout the shop. The use of magnetic starters on all equipment is an additional safety feature which gives a machine motor overload protection as well as low voltage, and no-voltage protection. After a power failure has been corrected, the machine will not start (even if it was running when the failure occurred) until the operator presses the start button.

A disconnect switch that can be locked out, shall be provided to cut off all power equipment, including power sources, in the shop. Panic switches should be strategically located around the entire shop or laboratory and their locations known by all welding personnel. They should be wired to cut off power to every machine. Fused disconnect switches should be provided for each power source and there should be not exposed wiring.

C1.3.9 Ventilation . Individual, movable point of source exhaust pickup systems are preferred to booth hood exhaust systems. Welding station exhausts should be separate from other laboratory exhaust systems. The minimum required air velocity at the zone of welding is 100 ft/min (0.5 m/sec) when the pickup is at its farthest position from the joint being welded. The pickup size and farthest position could be reduced to lower the required capacity of the exhaust system. The use of a qualified heating, ventilation, and air conditioning (HVAC) contractor is highly recommended for design, installation, and maintenance of the exhaust system. Fire resistant, translucent, strip curtains could be lowered to form a booth when greater exhaust efficiency is desired at the demonstration area.

Exhaust systems may ventilate the exhaust from the room. However, the loss of heat during the cold months is a serious objection to room ventilation exhaust systems unless a heated makeup air intake system is used. In the hot months for an air conditioned facility, a cooled makeup air intake system needs to be used. To avoid this energy loss, cartridge (preferred) or electronic precipitator filtration, which cleans the exhausted air and reintroduces it back into the laboratory to save heated or air conditioned air, should be used. These units need careful placement to properly exhaust welding fumes from a welding laboratory.

C1.3.10 Heating. Heating and cooling capacity shall take into consideration the provision of a supply of fresh, clean incoming air. The laboratory heating system should automatically maintain a temperature of 68°F (20°C) measured 60 in. (1.5 m) above the floor. The classroom and the office should be kept at 70°F (21°C) measured 30 in. (762 mm) above the floor. A system of even heat distribution should be kept within 5% of these temperatures for health reasons and for stability of equipment and stored materials.

C1.3.11 Safety. Information regarding safety can be found in ANSI Z49.1, and additional applicable AWS Safety Standards in Annex F, Reference Materials, Safety, as well as all other applicable local, state and federal regulations. Equipment shall conform to the OSHA requirements for “lockout and tagout.”

All safety features of the primary structure(s) and its support system(s) shall conform to any local, state, or federal governing codes. The school shall be able to pass an inspection of the local and state Fire Marshal and possess a certificate of conformance from the regional OSHA engineer.

C2. Instructional Equipment and Supplies

C2.1 Public School Systems. The training organization shall meet the requirements established by the School Facilities Commission for the state in which the school is located. The school’s advisory committee should review these requirements and make recommendations for adjustments to instructional equipment and supplies. If the School Facilities Commission does not have requirements for instructional equipment and supplies, the advisory committee should make recommendations for instructional equipment and supplies using C2.3.1-C2.3.5 for guidance.

C2.2 Other Training Organizations—Private/Industrial. A training organization may choose to meet the requirements established by the School Facilities Commission for the state in which the school is located.

C2.3 Other Training Organizations—Private/Industrial. A training organization not using the requirements established by the School Facilities Commission for the state in which the school is located should combine the recommendations of their advisory committee and the following guide in establishing their School Welding Facilities.

C2.3.1 Welding/Cutting. The total number of welding work stations should exceed the number of welding personnel enrolled. Ideally, there should be 25% more welding stations than there are welding personnel, in order to provide for expansion of enrollment. Most of the stations

C2.3 Other Training Organizations—Private/Industrial. A training organization not using the requirements established by the School Facilities Commission for the state in which the school is located should combine the recommendations of their advisory committee and the following guide in establishing their School Welding Facilities.

C2.3.1 Welding/Cutting. The total number of welding work stations should exceed the number of welding personnel enrolled. Ideally, there should be 25% more welding stations than there are welding personnel, in order to provide for expansion of enrollment. Most of the stations should be equipped with multi-process power sources. Since SMAW is the most popular welding process, it and at least one other joining process should be linked together.

C2.3.2 Arc Welding. At least thirteen (13) multi-process constant current/constant voltage power sources for SMAW, GMAW, GTAW, and FCAW, and thirteen (13) constant current AC/DC power sources with high frequency for GTAW should be provided for every 20 welding personnel. Local industry and adult extension classes may dictate modifications to this structure.

Power sources for SMAW, and GTAW should have minimum rated output of 60% duty cycle at 175 amperes. Power sources for GMAW and FCAW should have a minimum rated output of 100% duty cycle at 175 amperes. Power sources shall be installed in accordance with the National Electrical Code, and be equipped with work leads, electrode holders, guns and/or torches.

An engine driven welder (1) per school should be adequate with both constant current and constant voltage output. Minimum rated welding output should be 200 amps cc/cv at 60% duty cycle. The fuel supply can be gasoline, diesel or propane.

C2.2.3 Oxyfuel Gas Cutting and Welding. Five (5) oxyfuel gas cutting/heating/welding torches should be provided for every 20 welding personnel. It is recommended that one (1) oxyfuel gas cutting machine be made available for demonstration and instruction. All oxyfuel gas equipment should be of industrial quality and should be appropriate for the thickness of the material being utilized in the instruction program. A distribution system for piping gases to work stations is recommended, along with one (1) portable cylinder set up per 20 welding personnel. This will facilitate instruction in safely setting up and changing compressed gas cylinders. Flashback arresters shall be provided.

C2.3.4 Plasma Arc Cutting (PAC). Two (2) plasma arc cutting machines should be provided for every 20 welding personnel. Equipment that utilizes compressed air is recommended for cutting. Plasma arc gouging is also a recommended feature. Optional compressed gases can be available, but are not a mandatory part of the cutting package. The plasma arc power source and torch should be rated to cut a minimum of 1/2 in. (12.7 mm) carbon steel at 10 in. (254 mm) per minute travel speed.

C2.2.5 Air Carbon Arc Cutting (CAC-A). Two (2) cutting/gouging torch should be provided for every 20 welding personnel. CAC-A equipment uses compressed air for either cutting or gouging. The torch and machine should be rated to cut/gouge a minimum of 1 in. (25.4 mm) carbon steel at 10 in. (254 mm) per minute travel speed. The CAC-A power source should have a minimum rated output of 60% duty cycle at 300 amperes.

Annex D

Recommendations for Personal and Shop: Materials, Equipment, and Tools

D1. Public School Systems

The training organization shall meet the requirements established by the School Facilities Commission for the state in which the school is located. The school's advisory committee should review these requirements and make recommendations for adjustments to personal and shop materials, equipment and tools. If the School Facilities Commission does not have requirements for personal and shop materials, equipment and tools, the advisory committee should make recommendations for personal and shop materials, equipment and tools using the following listing of recommendations for personal and shop materials, equipment and tools for guidance.

D2. Other Training Organizations—Private/Industrial

May choose to meet the requirements established by the School Facilities Commission for the state in which the school is located.

D3. Other Training Organizations—Private/Industrial

Not using the requirements established by the School Facilities Commission for the state in which the school is located should combine the recommendations of their advisory committee and the following guide in establishing the Personal and Shop Materials, Equipment and Tools for their Welding Facilities.

D4. Recommendations for Personal and Shop Material, Equipment, and Tools

D4.1 Personal Protective Clothing and Equipment

- suitable fire-resistant work clothing (to match service conditions for welding process employed)
- leather welding jacket, cape, sleeves or apron (optional)
- leather welding gloves clothing (to match service conditions for welding process employed)
- hightop leather safety shoes or boots (steel toed are recommended)
- welders hat or skullcap

- safety glasses or prescription glasses with side shields (clear lens)
- burning goggles or face shield (OFC & PAC)
- 2 ea. #5 filter plate
- 2 ea. #7 filter plate
- 4 ea. clear cover plate
- hearing protection (ear plugs)
- welding helmet
- welding filter plates (to match amperage and welding process employed) and clear cover plates

D4.2 Personal Tools

- carbon steel wire brush
- stainless steel wire brush
- 16 ounce ball peen hammer
- soap stone
- center punch
- metal scribe
- steel dividers (radius maker, min. 6 in.)
- handheld calculator
- measuring devices
- steel tape measure (minimum 10 in.)
- combination square set
- english/metric steel bench rule (min. 12 in.)
- chipping hammer
- 10 in. mill file (half round-bastard cut)
- cold chisel (size optional)
- pliers, wrenches and clamps
- 12 in. adjustable wrench
- tank wrench (optional)
- 10 in. groove or slip joint pliers
- 6 in. side or diagonal cutting pliers
- 6 in. needle nosed pliers

- 10 in. vice grips 10 in. vice grip clamp
- allen or hex wrench set (to 3/8 in.)
- screwdrivers
- flat head
- phillips head
- oxyfuel friction lighter, flints and tip cleaners
- flashlight
- fillet gage

D4.3 Shop Equipment and Tools

- first aid kit
- eye wash station
- chemical shower
- fire extinguisher
- bench vice (medium duty)
- 4 each 8 in. c-clamps
- grinders (2 each) and accessories
- 4 in., 4-1/2 in. or 5 in. right angle grinder
- 7 in./9 in. right angle grinder
- 25 each grinding wheels (general purpose and aluminum)
- needle gun or scaler
- 1 set adjustable wrenches
- 1 set allen or hex wrenches (to 3/8 in.)
- 1 set screwdrivers (flat and phillips head)
- 1 set vice grips
- steel topped layout or work bench (4 ft x 8 ft x 31 in. recommended)
- oxyfuel burning table with dross pan and replacement slats (4 ft x 8 ft x 31 in. recommended)
- work area protective screens (as required)
- ventilation equipment
- electrode oven
- guided bend test jig or machine

- compressed air supply and accessories (minimum delivery 80 psi @ 8 cfm per station)
- 1/2 in. compressed air hose (length optional) compressed air regulator (to match system out-put)
- M/F quick couples and adaptors (to accommodate pneumatic tools or air carbon arc cutting torch)
- hose repair kit with crimping tool

D4.4 Arc Welding/Cutting Power Source(s) and Accessories

NOTE: Selection of a single multipurpose power source able to meet all welding needs with respect to process, method of metal transfer and materials is limited. Given this limitation, a combination of power sources may be necessary to meet entry level welder training needs.

D4.4.1 Shielded Metal Arc Welding (minimum rating—AC/DC—constant current (CC) 175 amp @ 60% duty cycle)

- 25 ft 2/0 electrode cable
- 25 ft 2/0 workpiece cable
- 2/0 cable lugs and connects (to suit)
- ground clamp (amp capacity to suit)
- electrode holder (to 3/16 in. capacity)

D4.4.2 Gas Tungsten Arc Welding (minimum rating—AC/DC—constant current (CC) 175 amp @ 60% duty cycle)

- high frequency control
- gas purge control (optional)
- remote control (optional)
- water circulation and control (optional)
- torch (25 ft, amps and cooling to suit) accessory kit (to suit)
- part repair/replacement kit (to suit)
- flow meter(s) (argon, helium service)

D4.4.3 Air Carbon Arc Cutting (minimum rating—AC/DC—constant current (CC) 300 amp @ 60%)

- 25 ft 2/0 electrode cable
- 25 ft 2/0 workpiece cable
- 2/0 cable lugs and connects (to suit)
- ground clamp (amp capacity to suit)
- torch (light-medium duty)

D4.4.4 Gas Metal Arc Welding (Spray and Short Circuit) (minimum rating—DC—constant voltage (CV or CP) 175 amp @ 100% duty cycle)

- 25 ft 2/0 electrode cable
- 25 ft 2/0 workpiece cable
- 2/0 cable lugs and connects (to suit)
- ground clamp (amp capacity to suit)
- wire feeder (to suit power supply and wire diameter)
- gun (15 ft, amp and cooling to suit)
- consumable parts kit (0.030-0.045)
- parts repair/replacement kit (to suit)
- flow meter(s) (CO₂ or mixtures Argon/Oxygen, Argon/CO₂)

D4.4.5 Flux Cored Arc Welding (minimum rating—DC—constant voltage (CV or CP) 175 amp @ 100%)

- 25 ft 2/0 electrode cable
- 25 ft 2/0 workpiece cable
- 2/0 cable lugs and connects (to suit)
- ground clamp (amp capacity to suit)
- wire feeder (to suit power supply and wire diameter)
- self-shielded gun (15 ft, amp and cooling to suit)
- gas shielded gun (15 ft, amp and cooling to suit)
- consumable parts kit
- parts repair/replacement kit (to suit)
- flow meter(s) (CO₂ or mixtures Argon/CO₂)

D4.4.6 Plasma Arc Cutting (minimum rating—1/2 in. cut at 10 inches per minute on carbon steel)

- torch (25 ft low volt, air primary and secondary)
- consumable parts kit (to suit)
- parts repair/replacement kit (to suit)
- air regulator (to suit)

D4.4.7 Manual Oxyfuel Gas Cutting

- cutting torch (manual or combination assembly)
- oxygen regulator (to suit system)
- fuel gas regulator (to suit system)

- 25 ft oxyfuel gas hose
- 4 each (per unit) 00-3/0 cutting tips
- 4 each (per unit) 2/0 gouging tips
- 1 each (per unit) heating tip (optional)
- consumable parts kit
- parts repair/replacement kit (to suit)
- cylinder cart
- tank wrench
- friction lighter, flints and tip cleaner

D4.4.8 Machine Oxyfuel Gas

- cutting machine torch assembly (to suit)
- drive unit (track burner)
- rails or track
- oxygen regulator (to suit supply)
- fuel gas regulator (to suit supply)
- 25 ft oxyfuel gas hose
- 2 each (per unit) 00-2/0 cutting tips
- consumable parts kit
- parts repair/replacement kit (to suit)
- tank wrench
- friction lighter, flints and tip cleaner

D4.4.9 Oxyfuel Gas Supply

- oxygen supply (capacity to suit)
- fuel gas supply (capacity and type to suit)

D4.5 Fabrication Equipment (optional)

- shear 1/4 in. capacity
- ironworker
- pedestal grinder
- band saw
- drill press
- crane (A-frame)

- cage, cylinder storage
- tool room, secure storage

D4.6 Materials

- drawings or sketches
- base metal
- 3/8 in. plain carbon steel plate
- 10—14 gage plain carbon steel sheet (gage size optional)
- 10—14 gage stainless steel sheet (gage size optional)
- 10—14 gage aluminum sheet (gage size optional)
- useable pieces of all types material (thickness optional)

D4.6.1 SMAW Filler Metal

- 100# 3/32 in. E7018

D4.6.2 GMAW Filler Metal and Shielding Gas

- 14# spool (per unit) 0.035 in. E70-SX
- 14# spool (per unit) 0.045 in. E70-SX
- 75% argon + 25% CO₂ (capacity to suit) or CO₂ (capacity to suit)
- argon + 2-5% O₂ (capacity to suit)
- anti-spatter spray or gel

D4.6.3 FCAW Filler Metal and Shielding Gas

- 14# spool (per unit) 0.045 in. E71T-1
- 14# spool (per unit) 1/16 in. E71T-1
- 14# spool (per unit) 0.045 in. E71T-11
- 14# spool (per unit) 1/16 in. E71T-11
- CO₂ (capacity to suit) or 75% argon +25% CO₂ (capacity to suit)

D4.6.4 GTAW Electrodes, Filler Metal, and Shielding Gas

- 4 packages at 10 pieces each 1/16 in. EWLa-2
- 4 packages at 10 pieces each 3/32 in. EWLa-2
- 4 packages at 10 pieces each 1/8 in. EWLa-2
- 4 packages at 10 pieces each 1/16 in. EWCe-2
- 4 packages at 10 pieces each 3/32 in. EWCe-2
- 4 packages at 10 pieces each 1/8 in. EWCe-2

- 4 packages at 10 pieces each 1/16 in. EWP
- 4 packages at 10 pieces each 3/32 in. EWP
- 4 packages at 10 pieces each 1/8 in. EWP
- 4 packages at 10 pieces each 1/16 in. EWZr
- 4 packages at 10 pieces each 3/32 in. EWZr
- 4 packages at 10 pieces each 1/8 in. EWZr
- 40# 1/16 in. ER70-S2 (carbon steel rod)
- 40# 3/32 in. ER70-S2 (carbon steel rod)
- 40# 1/16 in. ER4043 (aluminum rod)
- 40# 3/32 in. ER4043 (aluminum rod)
- 40# 1/16 in. ER3XX (stainless rod)
- 40# 3/32 in. ER3XX (stainless rod)
- 100% argon (capacity to suit)
- CAC-A electrodes
- 100# 5/32 in. E7018
- 100# 1/8 in. E6010
- 100# 5/32 in. E6010
- 100# 1/8 in. E6011
- 100# 5/32 in. E6011
- 4 boxes 1/8 in. DC copper clad, pointed
- 4 boxes 5/32 in. DC copper clad, pointed
- 4 boxes 1/4 in. DC copper clad, pointed
- 4 boxes 3/8 in. DC copper clad, flat

Annex E

Training Achievement Record

AWS SENSE LEVEL I—ENTRY WELDER TRAINING ACHIEVEMENT RECORD

Name _____ Trainee ID # _____ Date Entered Training _____

Training Facility _____

Address _____

Address _____

Address _____

Telephone # _____

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Module, Units and Key Indicators	Performance Rating	Date Completed	Instructor's Initials	Trainee's Initials
1. Occupational Orientation	_____	_____	_____	_____
1. Prepares time or job cards, reports or records.	_____	_____	_____	_____
2. Performs house keeping duties.	_____	_____	_____	_____
3. Follows verbal instructions to complete work assignments.	_____	_____	_____	_____
4. Follows written instructions to complete work assignments.	_____	_____	_____	_____
2. Safety and Health of Welders	_____	_____	_____	_____
1. Demonstrates proper use and inspection of Personal Protection Equipment (PPE).	_____	_____	_____	_____
2. Demonstrates proper safe operation practices in the work area.	_____	_____	_____	_____

Module, Units and Key Indicators	Performance Rating	Date Completed	Instructor's Initials	Trainee's Initials
3. Demonstrates proper use and inspection of ventilation equipment.	_____	_____	_____	_____
4. Demonstrates proper Hot Zone operation.	_____	_____	_____	_____
5. Demonstrates proper work actions for working in confined spaces.	_____	_____	_____	_____
6. Demonstrates proper use of precautionary labeling and MSDS information.	_____	_____	_____	_____
7. Demonstrates proper inspection and operation of equipment used for each required welding and thermal cutting process. (This is best done as a part of the process module/unit for each of the required welding and thermal cutting processes.)	_____	_____	_____	_____
3. Drawing and Welding Symbol Interpretation	_____	_____	_____	_____
1. Interprets basic elements of a drawing or sketch.	_____	_____	_____	_____
2. Interprets welding symbols information.	_____	_____	_____	_____
3. Fabricates parts from a drawing or sketch.	_____	_____	_____	_____
4. Shielded Metal Arc Welding (SMAW)	_____	_____	_____	_____
1. Performs safety inspections of SMAW equipment and accessories.	_____	_____	_____	_____
2. Makes minor external repairs to SMAW equipment and accessories.	_____	_____	_____	_____
3. Sets up for SMAW operations on carbon steel.	_____	_____	_____	_____
4. Operates SMAW equipment on carbon steel.	_____	_____	_____	_____
5. Makes fillet welds in all positions on carbon steel.	_____	_____	_____	_____
6. Makes groove welds in all positions on carbon steel.	_____	_____	_____	_____
7. Passes SMAW welder performance qualification test (2G and 3G, uphill, limited thickness test plates) on carbon steel.	_____	_____	_____	_____
5. Gas Metal Arc Welding (GMAW-S, GMAW Spray Transfer)	_____	_____	_____	_____
1. Performs safety inspections of GMAW equipment and accessories.	_____	_____	_____	_____

Module, Units and Key Indicators	Performance Rating	Date Completed	Instructor's Initials	Trainee's Initials
2. Makes minor external repairs to GMAW equipment and accessories.	_____	_____	_____	_____
<i>Short Circuiting Transfer</i>				
3. Sets up for GMAW-S operations on carbon steel.	_____	_____	_____	_____
4. Operates GMAW-S equipment on carbon steel.	_____	_____	_____	_____
5. Makes fillet welds in all positions on carbon steel.	_____	_____	_____	_____
6. Makes groove welds in all positions on carbon steel.	_____	_____	_____	_____
7. Passes GMAW-S welder performance qualification test on carbon steel.	_____	_____	_____	_____
<i>Spray Transfer</i>				
8. Sets up for GMAW (spray) operations on carbon steel.	_____	_____	_____	_____
9. Operates GMAW (spray) equipment on carbon steel.	_____	_____	_____	_____
10. Makes fillet welds in the 1F and 2F positions on carbon steel.	_____	_____	_____	_____
11. Makes groove welds in the 1G position on carbon steel.	_____	_____	_____	_____
12. Passes GMAW (spray) welder performance qualification test on carbon steel.	_____	_____	_____	_____
6. Flux Cored Arc Welding (FCAW-G/GM, FCAW-S)	_____	_____	_____	_____
1. Performs safety inspections of FCAW equipment and accessories.	_____	_____	_____	_____
2. Makes minor external repairs to FCAW equipment and accessories.	_____	_____	_____	_____
<i>Gas Shielded</i>				
3. Sets up for FCAW-G/GM operations on carbon steel.	_____	_____	_____	_____
4. Operates FCAW-G/GM equipment on carbon steel.	_____	_____	_____	_____
5. Makes fillet welds in all positions on carbon steel.	_____	_____	_____	_____
6. Makes groove welds in all positions on carbon steel.	_____	_____	_____	_____
7. Passes FCAW-G/GM welder performance qualification test on carbon steel.	_____	_____	_____	_____

Module, Units and Key Indicators	Performance Rating	Date Completed	Instructor's Initials	Trainee's Initials
<i>Self-Shielded</i>				
8. Sets up for FCAW-S operations on carbon steel.	_____	_____	_____	_____
9. Operates FCAW-S equipment on carbon steel.	_____	_____	_____	_____
10. Makes fillet welds in all positions on carbon steel.	_____	_____	_____	_____
11. Makes groove welds in all positions on carbon steel.	_____	_____	_____	_____
12. Passes FCAW-S welder performance qualification test on carbon steel.	_____	_____	_____	_____
7. Gas Tungsten Arc Welding (GTAW)				
1. Performs safety inspections of GTAW equipment and accessories.	_____	_____	_____	_____
2. Makes minor external repairs to GTAW equipment and accessories.	_____	_____	_____	_____
<i>Carbon Steel</i>				
3. Sets up for GTAW operations on carbon steel.	_____	_____	_____	_____
4. Operates GTAW equipment on carbon steel.	_____	_____	_____	_____
5. Makes fillet welds in all positions on carbon steel.	_____	_____	_____	_____
6. Makes groove welds in all positions on carbon steel.	_____	_____	_____	_____
7. Passes GTAW welder performance qualification test on carbon steel.	_____	_____	_____	_____
<i>Austenitic Stainless Steel</i>				
8. Sets up for GTAW operations on austenitic stainless steel.	_____	_____	_____	_____
9. Operates GTAW equipment on austenitic stainless steel.	_____	_____	_____	_____
10. Makes fillet welds in the 1F, 2F and 3F positions on austenitic stainless steel.	_____	_____	_____	_____
11. Makes groove welds in the 1G and 2G positions on austenitic stainless steel.	_____	_____	_____	_____
12. Passes GTAW welder performance qualification test on austenitic stainless steel.	_____	_____	_____	_____

Module, Units and Key Indicators	Performance Rating	Date Completed	Instructor's Initials	Trainee's Initials
<i>Aluminum</i>				
13. Sets up for GTAW operations on aluminum.	_____	_____	_____	_____
14. Operates GTAW equipment on aluminum.	_____	_____	_____	_____
15. Makes fillet welds in the 1F and 2F positions on aluminum.	_____	_____	_____	_____
16. Makes groove welds in the 1G position on aluminum.	_____	_____	_____	_____
17. Passes GTAW welder performance qualification test on aluminum.	_____	_____	_____	_____
8. Thermal Cutting Processes				
Unit 1: Manual Oxyfuel Cutting (OFC)				
1. Performs safety inspections of manual OFC equipment and accessories.	_____	_____	_____	_____
2. Makes minor external repairs to manual OFC equipment and accessories.	_____	_____	_____	_____
3. Sets up for manual OFC operations on carbon steel.	_____	_____	_____	_____
4. Operates manual OFC equipment on carbon steel.	_____	_____	_____	_____
5. Performs straight, square edge cutting operations in the flat and horizontal positions on carbon steel.	_____	_____	_____	_____
6. Performs shape, square edge cutting operations in the flat and horizontal positions on carbon steel.	_____	_____	_____	_____
7. Performs straight, bevel edge cutting operations in the flat and horizontal positions on carbon steel.	_____	_____	_____	_____
8. Performs scarfing and gouging operations to remove base and weld metal, in the flat and horizontal positions on carbon steel.	_____	_____	_____	_____
Unit 2: Mechanized Oxyfuel Cutting (OFC) (e.g., Track Burner)				
1. Performs safety inspections of mechanized OFC equipment and accessories.	_____	_____	_____	_____
2. Makes minor external repairs to mechanized OFC equipment and accessories.	_____	_____	_____	_____
3. Sets up for mechanized OFC operations on carbon steel.	_____	_____	_____	_____

Module, Units and Key Indicators	Performance Rating	Date Completed	Instructor's Initials	Trainee's Initials
4. Operates mechanized OFC equipment on carbon steel.	_____	_____	_____	_____
5. Performs straight, square edge cutting operations in the flat position on carbon steel.	_____	_____	_____	_____
6. Performs straight, bevel edge cutting operations in the flat position on carbon steel.	_____	_____	_____	_____
Unit 3: Manual Plasma Arc Cutting (PAC)				
1. Performs safety inspections of manual PAC equipment and accessories.	_____	_____	_____	_____
2. Makes minor external repairs to manual PAC equipment and accessories.	_____	_____	_____	_____
3. Sets up for manual PAC operations on carbon steel, austenitic stainless steel and aluminum.	_____	_____	_____	_____
4. Operates manual PAC equipment on carbon steel, austenitic stainless steel, and aluminum.	_____	_____	_____	_____
5. Performs straight, square edge cutting operations in the flat and horizontal positions on carbon steel, austenitic stainless steel and aluminum.	_____	_____	_____	_____
6. Performs shape, square edge cutting operations in the flat and horizontal positions on carbon steel, austenitic stainless steel and aluminum.	_____	_____	_____	_____
Unit 4: Manual Air Carbon Arc Cutting (CAC-A)				
1. Performs safety inspections of manual CAC-A equipment and accessories.	_____	_____	_____	_____
2. Makes minor external repairs to manual CAC-A equipment and accessories.	_____	_____	_____	_____
3. Sets up for manual CAC-A scarfing and gouging operations on carbon steel.	_____	_____	_____	_____
4. Operates manual CAC-A equipment on carbon steel.	_____	_____	_____	_____
5. Performs scarfing and gouging operations to remove base and weld metal in the flat and horizontal positions on carbon steel.	_____	_____	_____	_____
9. Welding Inspection and Testing				
1. Examines cut surfaces and edges of prepared base metal parts.	_____	_____	_____	_____
2. Examines tacks, root passes, intermediate layers and completed welds	_____	_____	_____	_____

INSTRUCTOR USE ONLY: Knowledge Related Subject Matter (Classroom Instruction)

(Check all boxes where applicable)

- (A) Occupational Orientation
- (B) Safety and Health of Welders
- (C) Drawing and Welding Symbol Interpretation
- (D) Welding Inspection and Testing
- Arc Welding Process**
- (E) Shielded Metal Arc Welding
- (F) Gas Metal Arc Welding
- (G) Flux Cored Arc Welding
- (H) Gas Tungsten Arc Welding

Thermal Cutting Processes

- (I) Manual Oxyfuel Gas Cutting
- (J) Mechanized Oxyfuel Gas Cutting
- (K) Manual Plasma Arc Cutting
- (L) Manual Air Carbon Arc Cutting

	Coursework Completion											
	A	B	C	D	E	F	G	H	I	J	K	L
1. General Welding Safety												
2. Welding Terms and Definitions												
3. Drawing Fundamentals												
4. Drawing Interpretation												
5. Welding Symbol Fundamentals												
6. Welding Symbol Interpretation												
7. Fabrication Principles												
8. Safe SMAW Practices												
9. Safe GMAW Practices												
10. Safe FCAW Practices												
11. Safe GTAW Practices												
12. SMAW Component Identification												
13. GMAW Component Identification												
14. FCAW Component Identification												
15. GTAW Component Identification												
16. SMAW Filler Metal Selection and Identification												
17. GMAW Filler Metal Selection and Identification												

INSTRUCTOR USE ONLY: Knowledge Related Subject Matter (Classroom Instruction)

(Check all boxes where applicable)

- (A) Occupational Orientation
 - (B) Safety and Health of Welders
 - (C) Drawing and Welding Symbol Interpretation
 - (D) Welding Inspection and Testing
- Arc Welding Process**
- (E) Shielded Metal Arc Welding
 - (F) Gas Metal Arc Welding
 - (G) Flux Cored Arc Welding
 - (H) Gas Tungsten Arc Welding

Thermal Cutting Processes

- (I) Manual Oxyfuel Gas Cutting
- (J) Mechanized Oxyfuel Gas Cutting
- (K) Manual Plasma Arc Cutting
- (L) Manual Air Carbon Arc Cutting

	Coursework Completion												
	A	B	C	D	E	F	G	H	I	J	K	L	
18. FCAW Filler Metal Selection and Identification													
19. GTAW Filler Metal Selection and Identification													
20. SMAW Principles of Operation													
21. GMAW Principles of Operation													
22. FCAW Principles of Operation													
23. GTAW Principles of Operation													
24. SMAW Essential Process Variables													
25. GMAW Essential Process Variables													
26. FCAW Essential Process Variables													
27. GTAW Essential Process Variables													
28. Base Metal Identification and Selection (Plain Carbon Steel)													
29. Base Metal Identification and Selection (Austenitic Stainless Steel)													
30. Base Metal Identification and Selection (Aluminum)													
31. Manual OFC Safe Practices													
32. Manual OFC Component Identification													
33. Manual OFC Principles of Operation													

INSTRUCTOR USE ONLY: Knowledge Related Subject Matter (Classroom Instruction)

(Check all boxes where applicable)

- (A) Occupational Orientation
- (B) Safety and Health of Welders
- (C) Drawing and Welding Symbol Interpretation
- (D) Welding Inspection and Testing

Arc Welding Process

- (E) Shielded Metal Arc Welding
- (F) Gas Metal Arc Welding
- (G) Flux Cored Arc Welding
- (H) Gas Tungsten Arc Welding

Thermal Cutting Processes

- (I) Manual Oxyfuel Gas Cutting
- (J) Mechanized Oxyfuel Gas Cutting
- (K) Manual Plasma Arc Cutting
- (L) Manual Air Carbon Arc Cutting

	Coursework Completion											
	A	B	C	D	E	F	G	H	I	J	K	L
34. Manual OFC Essential Process Variables												
35. Mechanized OFC Safe Practices												
36. Mechanized OFC Components Identification												
37. Mechanized OFC Principles of Operation												
38. Mechanized OFC Essential Process Variables												
39. PAC Safe Practices												
40. PAC Components Identification												
41. PAC Principles of Operation												
42. PAC Essential Process Variables												
43. CAC-A Safe Practices												
44. CAC-A Components Identification												
45. CAC-A Electrode Identification and Selection												
46. CAC-A Principles of Operation												
47. CAC-A Essential Process Variables												
48. Visual Examination of Cut Surfaces												
49. Visual Examination of Welds												

**INSTRUCTOR USE ONLY:
Testing and Evaluation**

Test Attempts (3 Maximum)	Test Score	Date Completed	Instructor's Initials	Trainee's Initials
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Written Tests - Practical Knowledge

Module 2: Safety and Health of Welders (90% required to pass)

(Modules listed below - 75% required to pass)

Module 3: Drawing and Welding Symbol Interpretation

Module 4: Shielded Metal Arc Welding (SMAW)

Module 5: Gas Metal Arc Welding (GMAW)

Module 6: Flux Cored Arc Welding (FCAW-G/GM, FCAW-S)

Module 7: Gas Tungsten Arc Welding (GTAW)

Module 8: Thermal Cutting Processes

Module 9: Welding Inspection and Testing

NOTE: Module 1: Occupational Orientation does not have a written test.

Pass / Fail

Performance Qualification

GMAW-S (Short Circuiting Transfer)

GMAW (Spray Transfer)

FCAW-G/GM (Gas Shielded)

FCAW-S (Self-Shielded)

GTAW (Carbon Steel)

GTAW (Austenitic Stainless Steel)

GTAW (Aluminum)

SMAW (Carbon Steel) Test Plates

2G (Horizontal Groove)

3G, Uphill (Vertical, Uphill Progression, Groove)

Annex F

Reference Materials

Safety

ANSI Z49.1	Safety in Welding, Cutting, and Allied Processes (Filter Plate)
AWS	F2.2 Lens Shade Selector (Filter Plate)
AWS F4.1	Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping
AWS AWN	Arc Welding and Cutting Noise
AWS	Arc Welding and Cutting Safety
AWS FSW	Fire Safety in Welding and Cutting
AWS OWS	Oxyfuel Gas Welding, Cutting, and Heating Safety
AWS PCWC	Preparing Containers for Welding or Cutting: 2001
AWS SGSH	The Independent Shop's Guide to Welding Safety and Health
AWS SHF	Safety and Health Fact Sheets, 3rd Edition
WHB-1.X	Welding Handbook Volume Two, Welding Science and Technology

Welding Symbols

AWS A2.1 WC & DC	Welding Symbols Charts (Wall & Desk Chart)
AWS A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination

Terms and Definitions

AWS A3.0	Standard Welding Terms and Definitions
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Filler Metals and Electrodes

AWS A5.1/A5.1M	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.9/A5.9M	Specification for Bare Stainless Welding Electrodes and Rods
AWS A5.10/A5.10M	Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods

AWS A5.12/A5.12M	Specification for Tungsten and Tungsten-Alloy Electrodes for Arc Welding and Cutting
AWS A5.18/A5.18M	Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
AWS A5.20/A5.20M	Specification for Carbon Steel Electrodes for Flux Cored Arc Welding

Welding Procedures and Performance Qualifications

AWS B2.1	Standard for Welding Procedure and Performance Qualification
AWS B4.0	Standard Methods for Mechanical Testing of Welds
AWS EDU FCAW-01	Standard Welding Procedure Specification for CO ₂ Shielded Flux Cored Arc Welding on carbon Steel, (M-1 or P-1, Group 1 or 2), 1/8 through 1-1/2 inch thick, E70T-1 and E71T-1, As-Welded Condition
AWS EDU FCAW-02	Standard Welding Procedure Specification for 75%Ar/25%CO ₂ Shielded Flux Cored Arc Welding on carbon Steel, (M-1 or P-1, Group 1 or 2), 1/8 through 1-1/2 inch thick, E70T-1 and E71T-1, As-Welded Condition
AWS EDU FCAW-03	Standard Welding Procedure Specification for Self Shielded Flux Cored Arc Welding on carbon Steel, (M-1 or P-1, Group 1 or 2), 1/8 through 3/4 inch thick, E71T-11, As-Welded Condition
AWS EDU GMAW-01	Standard Welding Procedure Specification for Gas Metal Arc Welding—Short Circuit Transfer on carbon Steel, (M-1/P-1, Group 1 or 2), 10 through 18 Gauge, As-Welded Condition
AWS EDU GMAW-02	Standard Welding Procedure Specification for Gas Metal Arc Welding—Spray on carbon Steel, (M-1/P-1, Group 1 or 2), 3/16 through 3/4 inch Thick, As-Welded Condition
AWS EDU GTAW-01	Standard Welding Procedure Specification for Gas Tungsten Arc Welding on carbon Steel, (M-1/P-1, Group 1 or 2), 10 through 18 Gauge, As-Welded Condition, with or without Backing
AWS EDU GTAW-02	Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Austenitic Stainless Steel, (M-8/P-8), 10 through 18 Gauge, As-Welded Condition, with or without Backing
AWS EDU GTAW-03	Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Aluminum, (M-22/P-22), 10 through 18 Gauge, As-Welded Condition, with or without Backing
AWS EDU GTAW-04	Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Aluminum, (M-23/P-23), 10 through 18 Gauge, As-Welded Condition, with or without Backing

AWS EDU SMAW-01 Standard Welding Procedure Specification for Shielded Metal Arc Welding on carbon Steel, (M-1/P-1, Group 1 or 2), 3/16 through 3/4 inch thick, Position 2G, As-Welded Condition, with Backing

AWS EDU SMAW-02 Standard Welding Procedure Specification for Shielded Metal Arc Welding on carbon Steel, (M-1/P-1, Group 1 or 2), 3/16 through 3/4 inch thick, Position 3G, Uphill, As-Welded Condition, with Backing.

Visual Examination

AWS B1.11 Guide for the Visual Inspection of Welds

Oxyfuel Gas Cutting Process

AWS C4.1 Set Criteria for Describing Oxygen-Cut Surfaces (wall chart), and Oxygen Cutting Surface Roughness Gauge

AWS C4.2/C4.2M Recommended Practices for Safe Oxyfuel Gas Cutting Torch Operation

AWS C4.3/C4.3M Recommended Practices for Safe Oxyfuel Gas Heating Torch Operation

AWS C4.4/C4.4M Recommended Practices for Heat Shaping and Straightening with Oxy-fuel Gas Heating Torches

AWS C4.5M Uniform Designation System for Oxyfuel Nozzles

Arc Welding and Cutting Processes

AWS C5.2 Recommended Practices for Plasma Arc Cutting and Gouging

AWS C5.3 Recommended Practices for Air Carbon Arc Gouging and Cutting

AWS C5.5/C5.5M Recommended Practices for Gas Tungsten Arc Welding

AWS C5.6 Recommended Practices for Gas Metal Arc Welding

WHB-2.X Welding Handbook Volume Two, Welding Processes—Part 1

WHB-3.X Welding Handbook Volume Three, Welding Processes—Part 2

Base Metals (Identification and Selection)

WHB-4.X Welding Handbook Volume Four, Materials and Applications—Part 1

WHB-5.X Welding Handbook Volume Five, Materials and Applications—Part 2

Program Implementation and Development

AWS QC10 Specification for Qualification and Certification of Level I—Entry Welder

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