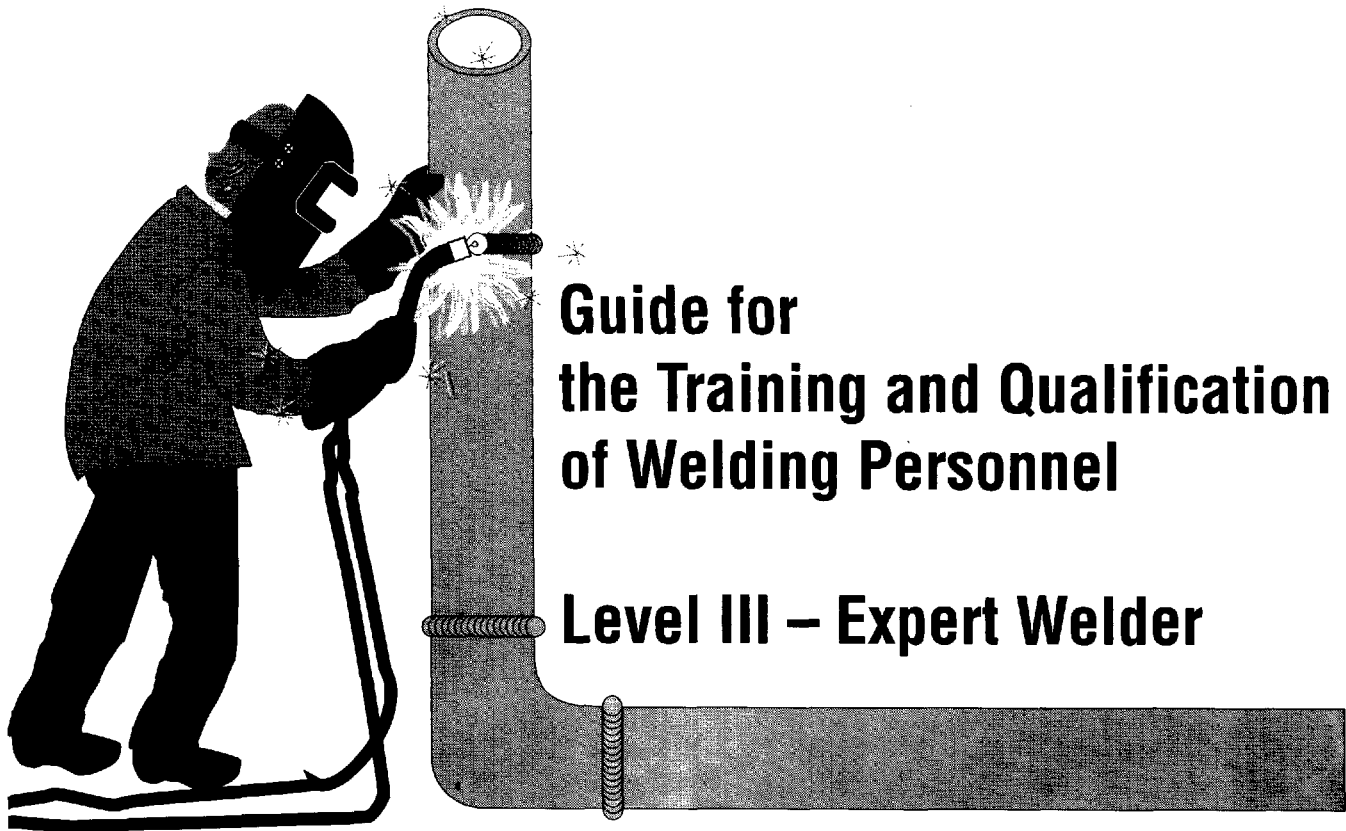




# **Guide for the Training and Qualification of Welding Personnel**

## **Level III – Expert Welder**



**American Welding Society**



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# Guide for the Training and Qualification of Welding Personnel

## Level III – Expert Welders

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Prepared by  
AWS Education Department

Under the Direction of  
AWS Education Grant Committee

Approved by  
AWS Board of Directors

### Abstract

This guide contains information to assist education and training facilities in the development and administration of competency-based training that leads to the qualification and certification of trainees in accordance with the requirements of AWS QC12, *Specification for the Qualification and Certification for Level III – Expert Welders*. Included are sections on curriculum and qualification guidelines, as well as recommendations for facility planning, materials, equipment, and tools.



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*A special note of appreciation is extended to each member of the American Welding Society who participated in the second industrial survey that helped identify the skill requirements for the Level III – Expert Welder.*

## Foreword

(This Foreword is not a part of EG4.0-96, *Guide for the Training and Qualification of Welding Personnel Level III – Expert Welder*, but is included for information purposes only.)

The American Welding Society (AWS), recognizing the need for competent welders, through a grant by the U. S. Department of Education (DOEd), formed the Education Grant Committee and assigned them the task of preparing this 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 the training given be of a quality and quantity that adequately prepares trainees for industrial assignments at various levels of skill development well into the next century. To this end, Level III – Expert Welders come to the workforce possessing a prerequisite amount of knowledge, attitudes, skills and habits required to perform tasks autonomously, including the selection and use of appropriate techniques and equipment, and to apply theoretical knowledge and motor skills with minimum supervision.

As the name implies, it is the intent of this document to serve as a *Guide* for those wishing to establish, expand, or enhance a private or public training program for Level III – Expert Welders. The basic requirements contained in this document are established as a result of individuals from a broad range of businesses, job classifications and industrial or educational areas participating in a national survey to identify welder skills. In conjunction with industry's response and the AWS Education Grant Committee's consensus, this document establishes the minimum requirements necessary to standardize the training and qualification of Level III – Expert Welders throughout the United States of America. Members of the AWS community and the Education Grant Committee have a growing interest in positively promoting welder training and providing minimum standards for its delivery.

The American Welding Society welcomes comments on this publication, and communications should be addressed to: The American Welding Society, Attention: Director of Education, 550 N. W. LeJeune Road, Miami, Florida, 33126.

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## 1. General

**1.1 Scope.** This guide establishes a minimum skill standard defining training and qualification requirements that are necessary for Participating Organizations to develop and administer a Level III – Expert Welder Program in accordance with AWS QC12, *Specification for the Qualification and Certification for Level III – Expert Welders*. This Guide is intended to specify a credible path for post-secondary or employer-based training facilities to build new programs and/or enhance existing programs to administer Level III – Expert Welder training and qualification. Use of this guide is voluntary. Participating Organizations desiring to certify a trainee as an AWS Certified Level III – Expert Welder shall consider the training and qualification guidelines within this document as mandatory requirements under the requirements of AWS QC12. Participating Organizations may elect to supersede written examination and certify welders according to the requirements of AWS QC1, *Standard for AWS Certification of Welding Inspectors*. Further, Participating Organizations may also elect to use, or become, AWS Accredited Test Facilities under the requirements of AWS QC4, *Standard for Accreditation of Test Facilities for AWS Certified Welder Program* and qualify expert welders according to the requirements of AWS QC7, *Standard for AWS Certified Welders*.

## 1.2 Objectives

**1.2.1** Provide training facilities with an industrial awareness of the occupational description, conditions, task listing, and profile that encompasses the job classification of Level III – Expert Welder.

**1.2.2** Establish a broad competency-based curriculum detailing the minimum acceptable skill and work experience requirements for the training and qualification of expert welders.

**1.2.3** Provide training facilities participating in the certification of expert welders with a list of learning objectives and learning activities necessary to accomplish Level III – Expert Welder training.

**1.2.4** Provide training facilities participating in the certification of expert welders with the references needed to compare existing or new curriculum with the AWS documents specified in this guide.

**1.2.5** Provide training facilities participating in the certification of expert welders with information related to the administration of Level III – Expert Welder, written examination and performance qualification testing.

**1.2.6** Provide training facilities participating in the certification of expert welders with information related to optional AWS QC12, *Level III – Expert Welder Program* requirements for written examinations administered under AWS QC1, *Standard for AWS Certification of Welding Inspectors*.

**1.2.7** Provide training facilities participating in the certification of expert welders with information related to optional AWS QC12, *Level III – Expert Welder Program* requirements for performance qualification tests administered at an AWS QC4, *Accredited Test Facility* through the AWS QC7, *Certified Welder Program*.

### 1.3 Requirements

**1.3.1** Unless the post-secondary or employer-based training facility elects to become a Participating Organization under the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*, use of this document is voluntary.

**1.3.2** Participating Organizations shall meet the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*.

**1.3.3** Participating Organizations shall ensure that existing or new training materials are in compliance with the AWS documents specified in section 3, *Curriculum Guidelines* of this guide.

**1.3.4** Participating Organizations shall administer a written safety examination prior to trainee performance of tasks in the work area or laboratory, in accordance with the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*.

**1.3.5** Participating Organizations shall administer performance qualification testing at the end of training for each applicable welding process in accordance with the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*.

**1.3.6** Participating Organizations shall provide a means for trainees to take a three part examination consisting of Part A - Welding Fundamentals and Safety (based on the applicable subject matter identified in section 3, *Curriculum Guidelines* of this guide), Part B - Practical Welding Specification Interpretation (visual examination of weld samples), and Part C - Code Book Interpretation (open book examination based on one of the following: AWS D1.1, API 1104 or ASME Section IX).

**1.3.7** Trainees desiring entrance into the AWS Level III – Expert Welder Certification program shall possess the necessary documentation of training, or demonstrate the ability to pass workmanship qualifications, written examination and performance qualifications in accordance with the requirements of AWS QC10, *Specification for Qualification and Certification for Entry Level Welders* and AWS QC11, *Specification for Qualification and Certification for Level II – Advanced Welders*.

**1.3.8** Trainees desiring AWS Level III – Expert Welder Certification shall pass a three part examination consisting of Part A - Welding Fundamentals and Safety (based on the applicable subject matter identified in section 3, *Curriculum Guidelines* of this guide), Part B - Practical Welding Specification Interpretation (visual examination of weld samples), and Part C - Code Book Interpretation (open book examination based on one of the following: AWS D1.1, API 1104 or ASME Section IX).

**1.3.8.1** Trainees desiring AWS Level III – Expert Welder Certification through training, testing and examination under the requirements of AWS QC12 shall meet the requirements of **1.3.7**, **1.3.8** and document two years of multiple welding process work experience (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that has a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure.

**1.3.8.2** Trainees desiring AWS Level III – Expert Welder Certification through testing and examination under the requirements of AWS QC12 shall meet the requirements of **1.3.7**, **1.3.8** and document seven years welding work experience. Said work experience shall consist of three years in a single process and 4 years using multiple processes, (with a minimum of 6 months fabrication

experience that includes drawing interpretation, layout and fitup duties) that have a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure.

**1.3.8.3** At the discretion of a Participating Organization, credit for completion of individual training requirements and work experience may be simultaneously granted to an AWS QC12 Level III – Expert Welder applicant provided the work experience or experiential learning meets or exceeds the requirements for either work experience or training.

**1.3.8.4** Current AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI), with QC1 CWI examination scores 72% or higher,, shall be recognized as having met the requirements for AWS QC12 Expert Welder written examination (refer to section 5).

**1.3.8.5** Current AWS QC7 Certified Welders shall be recognized as having met the requirements for AWS QC12 Expert Welder performance qualifications, provided said certifications meet or exceed the requirements set forth in the AWS QC12 – Expert Welder Program. (refer to section 4.)

**1.3.9** Trainees failing the AWS Level III – Expert Welder Certification written examination shall retest on all portions of the exam until competency is achieved in accordance with the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*. This requirement however, shall not supersede the authority of the local training evaluation criteria as established in the facility's guidelines.

**1.3.10** Trainees desiring AWS Level III – Expert Welder Certification shall pass performance qualification tests in accordance with the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*.

**1.3.11** Optional written examinations for Level III – Expert Welders shall conform to the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*, for written examinations administered under AWS QC1, *Standard for AWS Certification of Welding Inspectors*. (Refer to section 5 of this guide.)

**1.3.11.1** In accordance with the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*, all applicants for written examinations administered under AWS QC1, *Standard for AWS Certification of Welding Inspectors* shall be required to take a supplemental written safety examination and pass with 90% accuracy. (Refer to section 5 of this guide.)

**1.3.12** Optional welder performance qualification tests for Level III – Expert Welders shall conform to the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*, for welder performance tests administered at an AWS QC4, *Accredited Test Facility* using the AWS QC7, *Certified Welder Program*. (Refer to section 4 of this guide.)

**1.3.13** Participating Organizations shall keep training records reflecting the results of Level III – Expert Welder training, written examination, performance qualification, and as applicable optional AWS QC7 welder performance qualification tests or AWS QC1 Certified Welding Inspector examination.

## 2. Industrial Awareness

**2.1 Scope.** Training facilities must understand the needs of industry and provide programs that prepare students to fill these needs. To establish a successful program for welder training, the first step would be to understand the job functions of this person in industry. This is difficult because of the highly diverse nature of these functions and the fact that they vary 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 information pertinent to the skills a Level III – Expert Welder should possess. From a needs assessment and analysis, a profile of the Level III – Expert Welder was developed (refer to Figure 1). The profile identifies skill and knowledge areas common to all expert welders, regardless of their unique situation in industry. To assist institutions in increasing their awareness of industry's needs, the following sections include portions of the occupational data collected during the needs assessment and analysis phase of this project.

**2.2 Level III – Expert Welder Definition.** An individual employed in this position is considered to possess a prerequisite amount of knowledge, attitude, skills, and habits required to perform tasks autonomously, including the selection and use of appropriate techniques and equipment, and to apply theoretical knowledge and motor skills with minimum supervision.

**2.3 Level III – Expert Welder Occupational Description.** The position is comprised of the following areas:

**2.3.1 Prerequisite Knowledge and Skills.** Trainees desiring entrance into the AWS Level III – Expert Welder Certification program shall possess the necessary documentation of training, or demonstrate the ability to pass workmanship qualifications, written examination and performance qualifications in accordance with the requirements of AWS QC10, *Specification for Qualification and Certification for Entry Level Welders* and AWS QC11, *Specification for Qualification and Certification for Level II – Advanced Welders*.

**2.3.1.1** Trainees desiring AWS Level III – Expert Welder Certification through training, examination and testing under the requirements of AWS QC12 shall document two years of multiple welding process work experience (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that has a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure prior to issuance of Level III – Advanced Welder Certification.

**2.3.1.2** Trainees desiring AWS Level III – Expert Welder Certification through examination and testing under the requirements of AWS QC12 shall document seven years welding work experience. Said work experience shall consist of three years in a single process and 4 years using multiple processes (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that have a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure prior to issuance of Level III – Advanced Welder Certification.

**2.3.1.3** Current AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI), with QC1 CWI examination scores 72% or higher, shall be recognized as having met the requirements for AWS QC12 Expert Welder written examination (refer to section 5).

**2.3.1.4** Current AWS QC7 Certified Welders shall be recognized as having met the requirements for AWS QC12 Expert Welder performance qualifications, provided said certifications meet or exceed the requirements set forth in the AWS QC12 – Expert Welder Program. (refer to section 4)

**2.3.2 Supervision and Management.** Demonstrates the ability to lead others while performing hands-on tasks during fabrication and welding operations. Is capable of administering hands-on training. Has a basic understanding of training methods, learning and training styles, and assessment of trainee progress. Is knowledgeable about equipment selection and specifications for purchase. Has the ability to estimate welding and material costs and quantities.

**2.3.3 Layout/fitup Practices.** Possesses the prerequisite drawing and welding symbol interpretation skills of a Level II – Advanced Welder. Demonstrates the ability to troubleshoot fabrication setups and processes. Participates in the specification of equipment selection and purchase. Performs a variety of hands-on tasks associated with layout and fitup while supervising others during the fabrication process. Employs first level inspection practices during various stages of fabrication. Fabricates jigs, fixtures and positioners. From complex drawings the Expert Welder sets up, prepares cutting lists and sequences parts for fabrication and assembly of weldments. During assembly the Expert Welder compensates for distortion and shrinkage.

**2.3.4 Welding Codes and Other Standards.** Possesses the prerequisite knowledge and interpretation skills of welding codes and other standards for a Level II – Advanced Welder. Demonstrates the ability to locate and use welding and inspection requirement information from; Welding Procedure Specifications (WPS's), AWS D1.1, *Structural Welding Code – Steel*, API Standard 1104, *Standard for Welding Pipelines and Related Facilities*, ASME, *Boiler and Pressure Vessel Code – Section IX* and In-House (Employer) Standards.

**2.3.5 Welding Inspection and Testing.** Possesses the prerequisite knowledge and interpretation skills of welding inspection and testing for a Level II – Advanced Welder. Demonstrates the ability to interpret welding and inspection requirements for various assignments. Interprets welding inspection results from visual examination, penetrant testing and magnetic particle testing. Prepares inspection reports. Has a fundamental understanding of ultrasonic and radiographic testing results. Performs visual examination, bend, penetrant and magnetic particle testing. Demonstrates the ability to take or suggest corrective actions.

**2.3.6 Arc Welding.** Possesses the prerequisite arc welding skills of a Level II Advanced Welder. Demonstrates the ability to troubleshoot welding setups and processes. Participates in the specification of equipment selection and purchase. Performs a variety of hands-on tasks while supervising others during welding. Employs first level inspection practices during various stages of welding. Has an understanding of welding metallurgy including; mechanical and chemical properties of metals, weld zone metallurgy, residual stress and control of distortion. Demonstrates knowledge of joint design and preparation, selection of materials, arc welding application, weld quality, weld repairs (corrective actions) and welding inspection. Sets up the components and accessories of a complete welding system. Sets up shielded metal arc welding operations, for all position fillet and groove welding on an unlimited thickness range of carbon steel and stainless steel plate and pipe. Sets up gas metal arc welding (short circuit transfer) operations, for all position fillet and groove welding on an unlimited thickness range of carbon steel plate and pipe. Sets up gas metal arc welding (spray transfer) operations, for a limited position, unlimited thickness range of carbon steel plate and pipe. Sets up gas

metal arc welding (spray transfer and pulsed arc) for all positions fillet and groove welding an unlimited thickness range of aluminum plate and pipe. Sets up flux cored arc welding operations, for all position fillet and groove welding on an unlimited thickness range of carbon steel plate and pipe. Sets up gas tungsten arc welding operations, for all position fillet and groove welding within a limited thickness range of carbon steel, stainless steel and aluminum sheet and tubing. Sets up and performs gas tungsten arc welding operations, for limited position fillet and groove welding within a limited thickness range of nickel, copper, magnesium and/or titanium sheet metals.

**2.3.7 Oxyfuel Gas Cutting.** Possesses the prerequisite oxyfuel gas cutting skills of a Level II Advanced Welder. Demonstrates the ability to troubleshoot cutting setups and processes. Participates in the specification of equipment selection and purchase. Performs a variety of hands-on tasks while supervising others during cutting. Employs first level inspection practices during various stages of cutting. Sets up and performs manual oxyfuel gas cutting operations that include straight and shape cutting, beveling, and weld removal (weld washing) for various product forms including plate and pipe. Sets up and operates machine oxyfuel gas cutting equipment (track burner) to perform straight cutting and beveling operations. Demonstrates knowledge of preparation and selection of materials, cutting applications, cut quality and cut surface repairs (corrective actions). Performs minor external repairs to equipment and accessories.

**2.3.8 Arc Cutting and Gouging.** Possesses the prerequisite arc cutting skills of a Level II Advanced Welder. Demonstrates the ability to troubleshoot cutting setups and processes. Participates in the specification of equipment selection and purchase. Performs a variety of hands-on tasks while supervising others during cutting. Employs first level inspection practices during various stages of cutting. Sets up and performs manual air carbon arc cutting operations on various product forms including plate and pipe. Sets up and performs manual plasma arc cutting operations on various product forms including plate and pipe. Sets up and operates machine plasma arc cutting equipment (track burner) to perform straight cutting and beveling operations. Demonstrates knowledge of preparation and selection of materials, arc cutting applications, cut quality and cut surface repairs (corrective actions). Performs minor external repairs to equipment and accessories.

## **2.4 Level III – Expert Welder Occupational Conditions.**

**2.4.1 Work Environment.** Level III – Expert 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 union or non-union facilities.

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

**2.4.3 Worker Profile.** This position involves leadership, concentration, decision making, and physical tasks.

**2.4.3.1 Physical Requirements.** Level III – Expert Welders must meet the physical requirements established by the employer.

**2.4.3.2 Employability.** Level III – Expert Welders should exhibit good leadership, written, oral, and listening skills, in addition to competency in problem solving and decision making. These individuals should display good judgement, dependability and interact well with people.

AWS Level III – Expert Welders are capable of performing welding inspection that includes visual examination, bend, penetrant and magnetic particle testing. They are able to interpret test results and prepare inspection reports. These individual may be employed as a working lead- or foreperson and have layout and fitting skills with the ability to work from complex drawings.

AWS Level III – Expert Welders who achieved certification through training, examination and testing possess a minimum of two years of multiple welding process work experience (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that has a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure prior to issuance of Level III – Advanced Welder Certification.

AWS Level III – Expert Welders who achieved certification through examination and testing possess a minimum of seven years welding work experience consisting of three years in a single process and 4 years using multiple processes (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that have a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure prior to issuance of Level III – Advanced Welder Certification.

AWS Level III – Expert Welders, depending on AWS QC12 written examination options, may enter the workplace as AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI).

AWS Level III – Expert Welders, depending on AWS QC12 performance qualification options, may enter the workplace as AWS QC7 Certified Welders possessing welder certifications to a recognized standard or employer's qualified welding procedure specification.

**2.4.3.3 Education.** Level III – Expert Welder training may be accomplished through postsecondary, vocational-technical schools, junior colleges, universities, apprenticeship or employer-based welder training programs. Sufficient workplace skills (i.e. foundation skills such as: reading, writing, math, science, communication skills, adaptability skills, employability skills and leadership skills) are required to complete requisite welding related knowledge and skills training.

AWS QC10, Entry Level Welder and AWS QC11, Level II – Advanced Welder skills achieved and substantiated through training/testing or testing alone are a prerequisite to AWS QC12 Level III – Expert Welder training.

Current AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI), with QC1 CWI examination scores 72% or higher, shall be recognized as having met the requirements for AWS QC12 Expert Welder written examination (refer to section 5).

Current AWS QC7 Certified Welders shall be recognized as having met the requirements for AWS QC12 Expert Welder performance qualifications, provided said certifications meet or exceed the requirements set forth in the AWS QC12 – Expert Welder Program. (refer to section 4)

## LEVEL III - EXPERT WELDER PROFILE

[Minimum Training and Qualification Requirements]

### BASIC SKILLS AND KNOWLEDGE

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                           |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>**COMMUNICATION</b> | <b>*ENTRY LEVEL &amp; LEVEL II WELDER REQUIREMENTS</b><br>PROVIDE DETAILED, SEQUENTIAL DIRECTIONS<br>APPLY CRITICAL THINKING SKILLS TO LOCATE INFORMATION<br>ORGANIZE INFORMATION INTO TASK SEQUENCING<br>WRITE TECHNICAL REPORTS                                                                                                                                                                                                                             |                                                                                                           |
| <b>**MATHEMATICS</b>   | <b>*ENTRY LEVEL &amp; LEVEL II WELDER REQUIREMENTS</b><br>CALCULATE MATERIAL QUANTITY AND COST FOR FABRICATION<br>CALCULATE BASIC WELDING COSTS                                                                                                                                                                                                                                                                                                               | <b>*RECOMMEND ASSESSMENT AND PLACEMENT TESTING PRIOR TO ENTRY INTO THE EXPERT WELDER TRAINING PROGRAM</b> |
| <b>**LEADERSHIP</b>    | <b>PERSONAL LEADERSHIP SKILLS</b><br>DIAGNOSTIC (PROBLEM SOLVER, CRITICAL AND CREATIVE THINKER)<br>PERCEPTUAL (COMMUNICATES WELL, VERBALLY AND THROUGH LISTENING)<br>BEHAVIORAL (TEAMWORK, NEGOTIATION, INTERPERSONAL DELEGATION, MOTIVATION, COACHING, COUNSELING)<br><b>ADMINISTER HANDS-ON TRAINING</b><br><b>PERFORM DUTIES AS A WORKING FOREMAN OR LEAD PERSON</b><br><b>USE INNOVATION TO SOLVE PROBLEMS</b><br><b>PERFORM JOB SCHEDULING FUNCTIONS</b> | <b>**RECOMMEND ASSESSMENT AND TESTING PRIOR TO EXITING EXPERT WELDER TRAINING</b>                         |

### WORK EXPERIENCE

|                             |                                                                                                                                                                                   |                                                                                         |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| <b>WITH FORMAL TRAINING</b> | 2 YEARS WELDING RELATED WORK EXPERIENCE WITH LEVEL III TRAINING                                                                                                                   |                                                                                         |
| <b>NO FORMAL TRAINING</b>   | SEVEN YEARS WELDING RELATED WORK EXPERIENCE WITH:<br>3 YEARS IN A SINGLE PROCESS<br>4 YEARS IN MULTI-PROCESSES<br>ABILITY TO TEST OUT OF LEVEL I, II AND III WELDER CERTIFICATION | <b>COMPLETION OF LEVEL I &amp; II CERTIFICATION REQUIREMENTS</b>                        |
| <b>FABRICATION</b>          | A MINIMUM OF 6 MONTHS FABRICATION RELATED WORK EXPERIENCE INCLUDING DRAWING INTERPRETATION, LAYOUT AND FITUP DUTIES SHALL BE INCLUDED IN THE ABOVE WORK EXPERIENCE REQUIREMENTS   | <b>WORK EXPERIENCE MUST BE DOCUMENTED PRIOR TO APPLYING FOR LEVEL III CERTIFICATION</b> |

Figure 1 – Level III – Expert Welder Profile. This information was developed as a result of a needs assessment and analysis from a national survey distributed to a mailing list obtained from the roles of AWS membership.



## LEVEL III - EXPERT WELDER PROFILE

[Minimum Training and Qualification Requirements]

### RELATED SKILLS AND KNOWLEDGE

|                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                       |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SAFE PRACTICES                               | GENERAL SAFETY<br>PROTECTION OF PERSONNEL<br>PROTECTION OF THE WORK AREA<br>VENTILATION<br>FIRE PREVENTION AND PROTECTION<br>CONFINED SPACES<br>PRECAUTIONARY LABELING                                                                                                                                                                                                                                                                                                                      | MANDATORY SAFETY PRETEST<br>AND<br>MANDATORY SAFETY POST-TEST                                                                                                                         |
| *ELECTRICAL<br>FUNDAMENTALS                  | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>USE ELECTRICAL MEASUREMENT TOOLS<br>PERFORM SIMPLE ELECTRICAL TROUBLESHOOTING                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                       |
| *DRAWING/WELDING<br>SYMBOL<br>INTERPRETATION | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>**RECOGNIZE AND INTERPRET NDE SYMBOLS<br>**RECOGNIZE AND INTERPRET PIPING SYMBOLS<br>**INTERPRET WELDING SYMBOL INFORMATION FROM COMPLEX DRAWINGS<br>**KNOWLEDGE AND SELECTION OF JOINT DESIGN<br>SUPERVISE OTHERS IN FABRICATION FROM DRAWINGS                                                                                                                                                                                            |                                                                                                                                                                                       |
| ***LAYOUT & FITUP                            | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>TROUBLESHOOT SETUPS AND PROCESSES<br>PARTICIPATE IN THE SPECIFICATION OF EQUIPMENT PURCHASES<br>FABRICATION OF JIGS AND FIXTURES<br>PREPARATION OF CUTTING LISTS<br>SEQUENCING OF PARTS FOR FABRICATION<br>COMPENSATE FOR DISTORTION AND SHRINKAGE<br>FABRICATE WELDMENTS FROM COMPLEX DRAWINGS                                                                                                                                            | *RECOMMEND ASSESSMENT<br>AND PLACEMENT TESTING<br>PRIOR TO ENTRY INTO THE<br>EXPERT WELDER TRAINING<br>PROGRAM<br><br>**PRACTICAL KNOWLEDGE TEST<br>AND/OR<br>PERFORMANCE EVALUATION  |
| WELDING CODES &<br>OTHER STANDARDS           | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>**INTERPRET WELDING AND INSPECTION REQUIREMENTS FROM:<br>WELDING PROCEDURE SPECIFICATION INFORMATION<br>AWS D1.1 CODE INFORMATION<br>API 1104 CODE INFORMATION<br>ASME, SEC IX CODE INFORMATION<br>IN-HOUSE STANDARDS                                                                                                                                                                                                                      | ***LAYOUT AND FITUP TRAINING<br>MAY BE SUBSTITUTED WITH 6<br>MONTHS DOCUMENTED<br>EMPLOYMENT IN RELATED<br>SUBJECTS OR THROUGH CO-<br>OPERATIVE WORK AGREE-<br>MENTS (SCHOOL-TO-WORK) |
| WELDING INSPECTION<br>AND TESTING            | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>INTERPRETATION OF WELDING INSPECTION RESULTS FROM:<br>VISUAL EXAMINATION<br>PENETRANT TESTING<br>MAGNETIC PARTICLE TESTING<br>FUNDAMENTAL UNDERSTANDING OF ULTRASONIC TESTING RESULTS<br>FUNDAMENTAL UNDERSTANDING OF RADIOGRAPHIC TESTING RESULTS<br>PREPARE WELDING INSPECTION REPORTS<br>*PERFORM VISUAL EXAMINATION<br>PERFORM PENETRANT TESTING<br>PERFORM MAGNETIC PARTICLE TESTING<br>ABILITY TO TAKE OR SUGGEST CORRECTIVE ACTIONS | OPTIONAL EXAMINATION<br>AWS QC1 - CWI PROGRAM<br>CERTIFIED WELDING INSPECTOR                                                                                                          |

Figure 1 – Level III – Expert Welder Profile (continued).

## LEVEL III - EXPERT WELDER PROFILE

[Minimum Training and Qualification Requirements]

### ARC WELDING PROCESSES and RELATED KNOWLEDGE

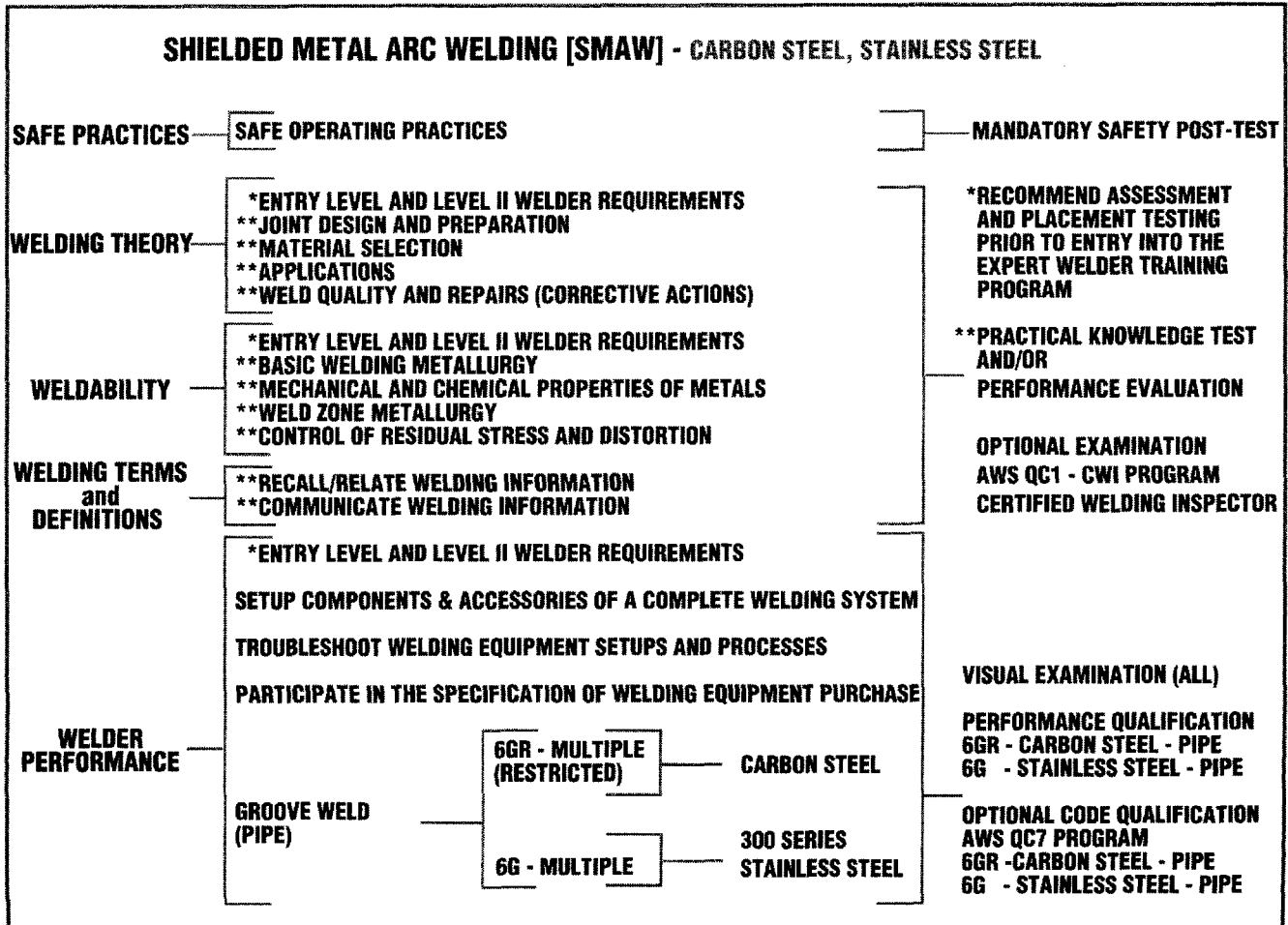


Figure 1 – Level III – Expert Welder Profile (continued).

## LEVEL III - EXPERT WELDER PROFILE

[Minimum Training and Qualification Requirements]

### ARC WELDING PROCESSES and RELATED KNOWLEDGE (CONTINUED)

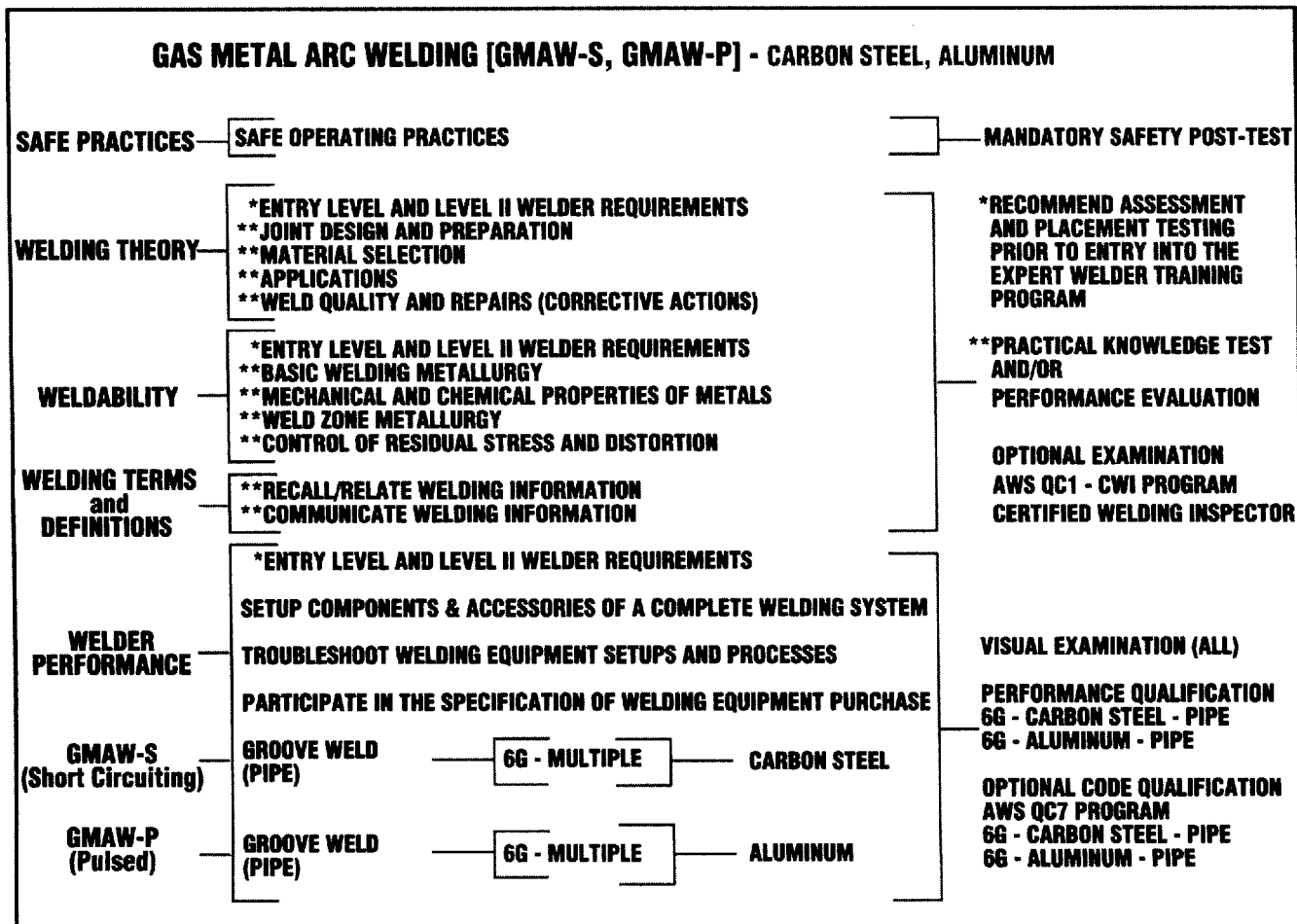


Figure 1 – Level III – Expert Welder Profile (continued).

## LEVEL III - EXPERT WELDER PROFILE

[Minimum Training and Qualification Requirements]

### ARC WELDING PROCESSES and RELATED KNOWLEDGE (CONTINUED)

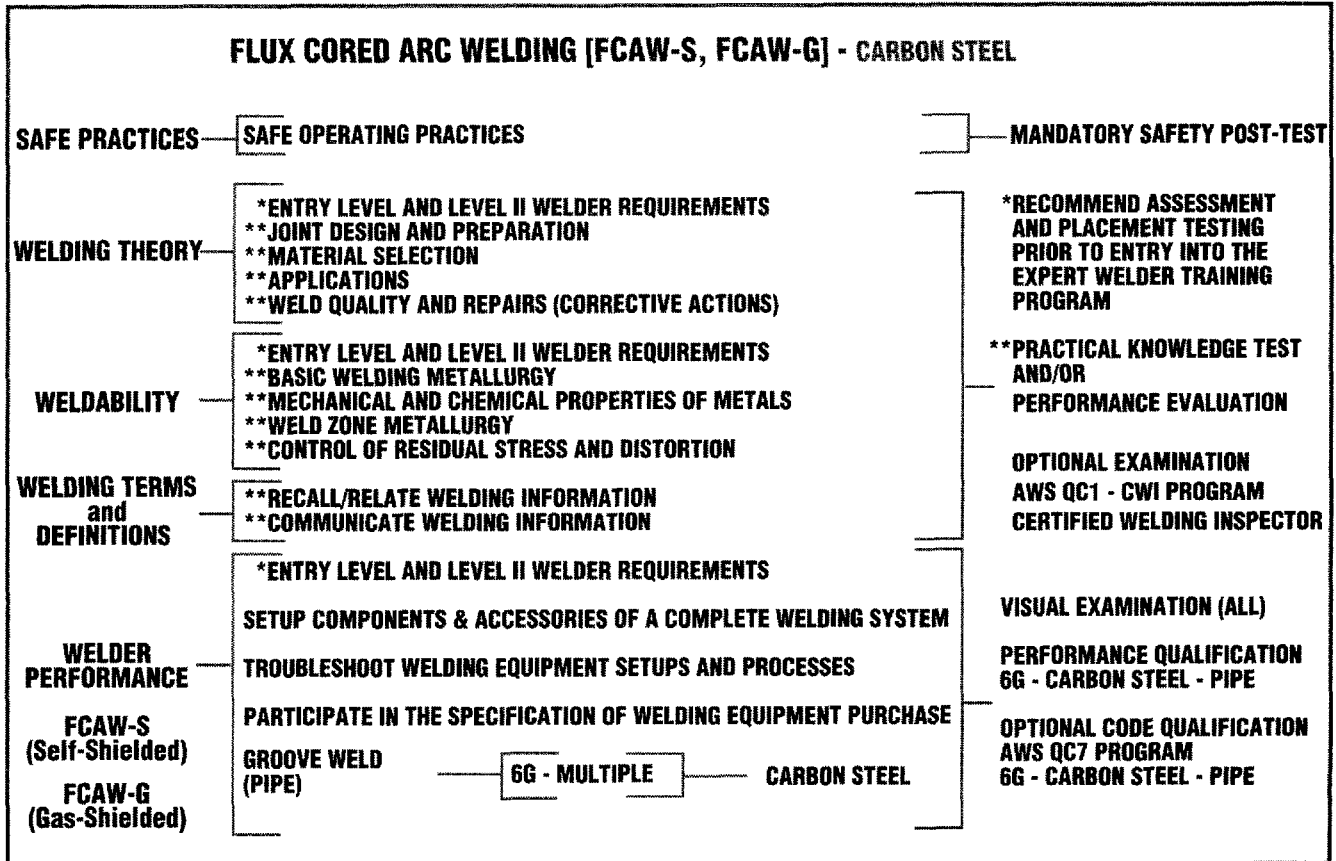


Figure 1 – Level III – Expert Welder Profile (continued).

## LEVEL III - EXPERT WELDER PROFILE

[Minimum Training and Qualification Requirements]

### ARC WELDING PROCESSES and RELATED KNOWLEDGE (CONTINUED)

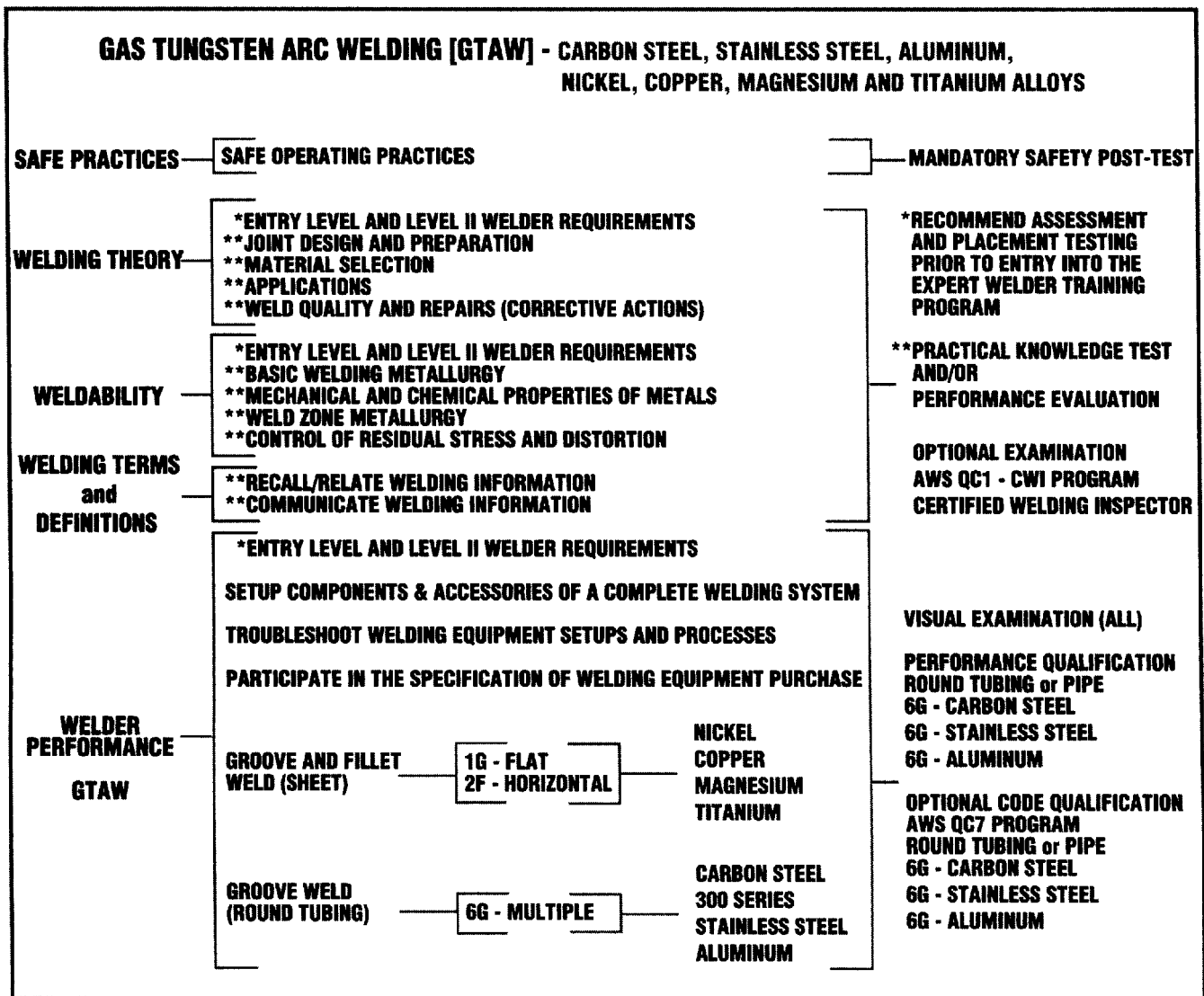


Figure 1 – Level III – Expert Welder Profile (continued).

# **LEVEL III - EXPERT WELDER PROFILE** [Minimum Training and Qualification Requirements] **OXYFUEL GAS AND ARC CUTTING PROCESSES and RELATED KNOWLEDGE** **OXYFUEL GAS CUTTING [OFC] - CARBON STEEL**

|                                                                                        |                                                                                                                                                                                                                                                                                        |                                                                                                                                    |
|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>SAFE PRACTICES</b>                                                                  | SAFE OPERATING PRACTICES<br>HANDLING AND STORAGE OF COMPRESSED GASES                                                                                                                                                                                                                   | MANDATORY SAFETY POST-TEST<br>*RECOMMEND ASSESSMENT AND PLACEMENT TESTING PRIOR TO ENTRY INTO THE ADVANCED WELDER TRAINING PROGRAM |
| <b>CUTTING THEORY</b>                                                                  | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>**MATERIAL SELECTION<br>**APPLICATIONS<br>**CUTTING QUALITY AND REPAIRS (CORRECTIVE ACTIONS)                                                                                                                                          | *PRACTICAL KNOWLEDGE TEST AND/OR PERFORMANCE EVALUATION                                                                            |
| <b>CUTTING TERMS and DEFINITIONS</b>                                                   | **RECALL/RELATE CUTTING INFORMATION<br>**COMMUNICATE CUTTING INFORMATION                                                                                                                                                                                                               |                                                                                                                                    |
| <b>WELDER PERFORMANCE (MANUAL AND MACHINE) [TRACK BURNER] [PIPE CUTTING EQUIPMENT]</b> | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>SETUP COMPONENTS & ACCESSORIES OF A COMPLETE CUTTING SYSTEM<br>TROUBLESHOOT CUTTING EQUIPMENT SETUPS AND PROCESSES<br>PARTICIPATE IN THE SPECIFICATION OF CUTTING EQUIPMENT PURCHASE<br>STRAIGHT CUTTING<br>BEVELING<br>SHAPE CUTTING | OPTIONAL EXAMINATION<br>AWS QC1 - CWI PROGRAM<br>CERTIFIED WELDING INSPECTOR<br>VISUAL EXAMINATION<br>PERFORMANCE EVALUATION       |

## **PLASMA ARC CUTTING [PAC] - CARBON STEEL, STAINLESS STEEL, ALUMINUM, NICKEL, COPPER, MAGNESIUM AND TITANIUM ALLOYS**

|                                      |                                                                                                                                                                                                                                                                                        |                                                                                                                                    |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>SAFE PRACTICES</b>                | SAFE OPERATING PRACTICES<br>HANDLING AND STORAGE OF COMPRESSED GASES                                                                                                                                                                                                                   | MANDATORY SAFETY POST-TEST<br>*RECOMMEND ASSESSMENT AND PLACEMENT TESTING PRIOR TO ENTRY INTO THE ADVANCED WELDER TRAINING PROGRAM |
| <b>CUTTING THEORY</b>                | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>**MATERIAL SELECTION<br>**APPLICATIONS<br>**CUTTING QUALITY AND REPAIRS (CORRECTIVE ACTIONS)                                                                                                                                          | *PRACTICAL KNOWLEDGE TEST AND/OR PERFORMANCE EVALUATION                                                                            |
| <b>CUTTING TERMS and DEFINITIONS</b> | **RECALL/RELATE CUTTING INFORMATION<br>**COMMUNICATE CUTTING INFORMATION                                                                                                                                                                                                               |                                                                                                                                    |
| <b>WELDER PERFORMANCE (MANUAL)</b>   | *ENTRY LEVEL AND LEVEL II WELDER REQUIREMENTS<br>SETUP COMPONENTS & ACCESSORIES OF A COMPLETE CUTTING SYSTEM<br>TROUBLESHOOT CUTTING EQUIPMENT SETUPS AND PROCESSES<br>PARTICIPATE IN THE SPECIFICATION OF CUTTING EQUIPMENT PURCHASE<br>STRAIGHT CUTTING<br>BEVELING<br>SHAPE CUTTING | OPTIONAL EXAMINATION<br>AWS QC1 - CWI PROGRAM<br>CERTIFIED WELDING INSPECTOR<br>VISUAL EXAMINATION<br>PERFORMANCE EVALUATION       |

### 3. Curriculum Guidelines

**3.1 General Guidelines.** It is the sole intent of this document to define a competency-based welding curriculum. The course structure of this curriculum is not sequenced for linear delivery (i.e. from course A to B, etc.). Therefore, it is the responsibility of the post-secondary or employer-based training program to establish any guidelines for the duration of training, prerequisites related to basic skills and sequencing of instructional activities. Training activities should consistently reinforce the use of basic skills (i.e. reading, writing, math and communications) and previously acquired Entry Level and Level II Welder skills.

**3.1.1 Preassessment.** The welding industry wants expert welders with strong reading, writing, mathematics, listening and oral communication, employability and leadership skills that are closely related to job performance. The curriculum in this guide also requires sufficient basic skills to carry out and complete the training. Therefore, it is strongly recommended that prospective trainees undergo a preplacement assessment for basic skill competency prior to entry into the welding program. Further, the competency level for said skills should meet the Grade Level Content or GED Level for the applicable welder level, as defined by federal or state guidelines.

**3.1.2 Curriculum Conventions.** Terminology associated with the curriculum Guidelines is defined as follows:

**Competency-Based Program Outline:** The outline converts the *primary occupation* (i.e. Level III – Expert Welder), *occupational specialties* (e.g. arc welding), *sub-specialties* (e.g. shielded metal arc welding) and *tasks* (e.g. Perform Safety Inspections of Equipment and Accessories) to a *program title* (i.e. Level III – Expert Welder Training), *courses* (e.g. Course B: Arc Welding Principles and Practices), *units* (e.g. Unit #1: Shielded Metal Arc Welding) and *learning objectives* (e.g. Learning Objective #1: Perform safety inspection of equipment and accessories.) The outline assists in modularizing the training program.

**Learning Objectives:** A written statement cast in the future which defines the *conditions* under which learning will occur and the *criteria* for determining when the objective has been attained. The following elements comprise a learning objective:

**Title:** A phrase that specifies the activity. The title of a learning objective is the same as the title of the task from which it was derived.

**Performance Conditions:** A statement which defines the "givens" under which the trainee will perform the objective. In most instances, the conditions define the teaching methods, the equipment, tools materials and supplies given the trainee, and the learning environment where training takes place.

**Desired Behavior:** A statement, written in the future tense, specifying the activity to be performed.

**Evaluation Criteria:** A statement which establishes the standard against which the trainee's performance of the objective is measured. The basic elements of evaluation may contain a product statement (when the objective has been performed correctly), and if appropriate, a process statement, inspection, time limitations or repetitions of the objective performed by the trainee over a given period of time.

**Learning Modules:** A learning module establishes the basis for individualizing the learning objective of the training program. These modules identify and organize learning activities for a learning objective.

**Learning Activities:** An organizational concept that sequences training events in a systematic approach for guiding trainees to a defined objective. Learning activities consist of *knowledge-related* activities and *performance-related activities*. Knowledge-related learning activities are divided into two types: *knowledge acquisition* – sources of information which provide the knowledge needed to perform the learning activity; and *information review* and *testing* (formative testing) activities which guide the instructor in reviewing and assessing the trainee's performance of the learning objective. Knowledge-related learning activities are brought to a close with the trainee's successful completion of a related information test (formative testing). Performance-related learning activities provide the instructor with a means by which to guide the trainee in attaining the objective. Utilizing the now-acquired technical information to guide his or her actions, the trainee receives a *demonstration* of the objective, *practices* performing it until an acceptable level of skill and confidence is gained, and takes a *performance test* (i.e. performance qualifications and written examination) of the same to confirm mastery of the objective. Other performance-related activities may be included in the basic sequence, but the demonstration–practice–performance trilogy is fundamental to ordering performance-related activities.

**Closed Book Examination:** A practical knowledge test for safety and welding related knowledge. This examination will measure the trainee's knowledge, comprehension and application of major subject matter concepts from classroom instruction. This three part *summative test* is administered at the end of the training cycle.

Participating Organizations may elect to substitute AWS QC12 written examination requirements by providing a means for trainees to register and take a written examination through the AWS QC1, *Certified Welding Inspector Program*, and have expert welders certify according to the requirements of AWS QC1, *Standard for AWS Certification of Welding Inspectors*. and section 4, *Optional Welder Qualification – AWS QC7 – Certified Welders* of this guide.

Current AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI), with QC1 CWI examination scores 72% or higher shall be recognized as having met the requirements for AWS QC12 Expert Welder written examination (refer to section 5).

**Performance Qualification:** A practical application test of manipulative skills using all arc welding processes required by AWS QC12, *Specification for the Qualification and Certification for Level III – Expert Welders*. Performance is measured using visual examination and bend test or radiographic criteria. This *summative test* is conducted at the end of the training for each applicable welding process.

Participating Organizations may elect to use, or become, AWS Accredited Test Facilities under the requirements of AWS QC4, *Standard for Accreditation of Test Facilities for AWS Certified Welder Program* and administer performance qualifications, then certify expert welders according to the requirements of AWS QC7, *Standard for AWS Certified Welders* and section 4. *Optional Welder Qualification – AWS QC7 – Certified Welders* of this guide.

Current AWS QC7 Certified Welders shall be recognized as having met the requirements for AWS QC12 Expert Welder performance qualifications, provided said certifications meet or exceed the requirements set forth in the AWS QC12 – Expert Welder Program. (refer to section 4)

**Work Experience:** An individual's work related experience shall be completed prior to issuance of AWS QC12 Level III – Expert Welder Certification. Trainees desiring AWS Level III – Expert Welder Certification through training, examination and testing under the requirements of AWS QC12 shall document two years of multiple welding process work experience (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that has a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure. Trainees desiring AWS Level III – Expert Welder Certification through testing and examination under the requirements of AWS QC12 shall document seven years welding work experience. Said work

experience shall consist of three years in a single process and 4 years using multiple processes that have a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure.

Current AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI), with QC1 CWI examination scores 72% or higher, shall be recognized as having met the requirements for AWS QC12 Expert Welder written (refer to section 5).

Current AWS QC7 Certified Welders shall be recognized as having met the requirements for AWS QC12 Expert Welder performance qualifications, provided said certifications meet or exceed the requirements set forth in the AWS QC12 – Expert Welder Program. (refer to section 4.)

### 3.1.3 Curriculum Implementation.

**3.1.3.1 Review.** Participating Organizations shall review part **3.2 Competency-Based Program Outline** (all inclusive) and **3.3 Learning Modules** (all inclusive), prior to the introduction of the curriculum into the training cycle.

*Note: The Competency-Based Program Outline should not be construed as the steps necessary to administer the curriculum. It, as the title implies, is an outline that may be used to quickly identify a point in training. The Learning Modules are the heart of the curriculum and contain sufficient information for instructors to deliver the training and evaluate a trainee's performance. Learning Modules include course title, learning objectives, performance conditions, desired behavior, evaluation criteria and learning activities.*

**3.1.3.2 Verification.** Participating Organizations shall ensure that their existing or newly developed curriculum is in compliance with all AWS documents specified in part **3.3 Learning Modules**. Verification shall be made in writing in accordance with AWS QC12, *Specification for the Qualification and Certification for Level III – Expert Welders*.

**3.1.3.3 Lesson Plan Development.** Participating Organizations shall develop appropriate lesson plans that include each learning objective and the learning activities specified for each course or unit within a course. (Refer to 3.3 Learning Modules.)

*Note: Not all learning objectives are stand alone in terms of instruction. Some are delivered through a minimum period of instruction and reinforced throughout the training cycle. Determination of stand alone or continuous reinforcement is identified in the evaluation criteria for each learning objective.*

**3.1.3.4 Delivery.** It is the sole responsibility of a Participating Organization to determine sequencing of instruction. However, Participating Organizations shall deliver training in accordance with the learning objectives and learning activities detailed in **3.3 Learning Modules**.

**3.1.3.5 Testing and Examination.** Participating Organizations shall develop and administer appropriate formative tests during and after the completion of classroom instruction. Summative testing for performance qualification, (see Figures 2 through 6), should be administered at the end of training in each applicable welding process. Summative testing for safety and practical welding knowledge shall be administered at the end of the training cycle in accordance with the requirements of AWS QC12, *Specification for the Qualification and Certification for Level III – Expert Welders*.

Participating organizations electing to use the QC7 or AWS QC1 options of AWS QC12 may substitute the written examination or any performance qualification test detailed in **3.3 Learning Modules** for the applicable welder performance qualification test detailed in sections **4, Optional Welder Qualification – AWS QC7 – Certified Welders** and **5, Optional Written Examinations – AWS QC1 – Certified Welding Inspectors**. When the optional AWS QC1 written examination or any AWS QC7

performance qualification test is substituted, it shall not be necessary to duplicate the AWS QC12 written examination or applicable performance qualification test found in **3.3 Learning Modules** of this guide.

Current AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI), with QC1 CWI examination scores 72% or higher, shall be recognized as having met the requirements for AWS QC12 Expert Welder written examination (refer to section 5).

Current AWS QC7 Certified Welders shall be recognized as having met the requirements for AWS QC12 Expert Welder performance qualifications, provided said certifications meet or exceed the requirements set forth in the AWS QC12 – Expert Welder Program. (refer to section 4.)

*Note: In accordance with the requirements of AWS QC12, Specification for Qualification and Certification for Level III – Expert Welders, all applicants for written examinations administered under AWS QC1, Standard for AWS Certification of Welding Inspectors shall be required to take a supplemental written safety examination and pass with 90% accuracy. (Refer to section 4 of this guide.)*

**3.1.3.6 Work Experience and/or Experiential Learning.** Participating Organizations may at their discretion grant credit for both training and work experience simultaneously when either or both work experience and experiential learning are part of the institutions curriculum, provided the work or experiential learning meet or exceed the extent of training or work experience required in accordance with AWS QC12, Expert Welder Program.

**3.1.3.7 Record Keeping.** Participating Organizations shall develop appropriate records that track each trainee's achievements. In addition, appropriate records shall be developed so that trainees may keep a self-record of achievement. See Annex E.

**3.1.3.8 Documentation, Certification and Registry.** Participating Organizations desiring AWS QC12 Level III – Expert Welder certification for trainees shall comply with the requirements of AWS QC12, *Specification for Qualification and Certification for Level III – Expert Welders*, sections **7. Documentation, 8, Certification and 9, National Registry of Level III – Expert Welders.**

Trainees desiring AWS Level III – Expert Welder Certification through training, examination and testing under the requirements of AWS QC12 shall document two years of multiple welding process work experience (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that has a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure.

Trainees desiring AWS Level III – Expert Welder Certification through testing and examination under the requirements of AWS QC12 shall document seven years welding work experience. Said work experience shall consist of three years in a single process and 4 years using multiple processes (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that have a direct relationship to weldments fabricated to a standard or employer's qualified welding procedure.

Current AWS QC1 Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI), with QC1 CWI examination scores 72% or higher, shall be recognized as having met the requirements for AWS QC12 Expert Welder written examination and **5, Optional Written Examination – AWS QC1 – Certified Welding Inspectors** of this guide.

Current AWS QC7 Certified Welders shall be recognized as having met the requirements for AWS QC12 Expert Welder performance qualifications, provided said certifications meet or exceed the requirements set forth in the AWS QC12 – Expert Welder Program and **4, Optional Welder Qualification – AWS QC7 – Certified Welders** of this guide.

### 3.2 Competency Based Program Outline

#### 3.2.1 Program: Level III – EXPERT WELDER TRAINING

##### 3.2.1.1 COURSE A: WELDING SAFETY and HEALTH

**Unit :** (no units this course)

**Learning Objectives**

- (1) Follow safe practices.
- (2) Recognize the effects of welding on health.

##### 3.2.1.2 COURSE B: SUPERVISION and MANAGEMENT

**Unit :** (no units this course)

**Learning Objectives**

- (1) Supervise other personnel during fabrication and welding operations.
- (2) Administer hands-on training.
- (3) Participate in the selection and specification of equipment purchases.
- (4) Estimate welding and material costs and quantities.

##### 3.2.1.3 COURSE C: DOCUMENTS GOVERNING WELDING AND WELDING INSPECTION

###### **Unit 1: WELDING CODES and OTHER STANDARDS**

**Learning Objectives**

- (1) Locate essential welding and inspection information from Welding Procedure Specifications (WPS's).
- (2) Locate essential welding and inspection information from AWS D1.1, *Structural Welding Code – Steel*.
- (3) Locate essential welding and inspection information from API Standard 1104, *Standard for Welding Pipelines and Related Facilities*.
- (4) Locate essential welding and inspection information from ASME, *Boiler and Pressure Vessel Code – Section IX*.

###### **Unit 2: WELDING INSPECTION**

**Learning Objectives**

- (1) Interpret destructive and nondestructive test results.
- (2) Prepare inspection reports.
- (3) Perform visual examination.
- (4) Perform bend testing.
- (5) Perform penetrant testing.
- (6) Perform magnetic particle testing.

**3.2.1.4 COURSE D: WELDED METAL FABRICATION****Unit :** (no units this course)**Learning Objectives**

- (1) Troubleshoot fabrication setups and processes.
- (2) Interpret welding, nondestructive examination and piping symbols.
- (3) Layout parts using advanced measurement practices.
- (4) Fabricate weldments from complex drawings.
- (5) Fabricate jigs and fixtures.

**3.2.1.5 COURSE E: WELDING METALLURGY****Unit:**(no units this course)**Learning Objectives**

- (1) Apply principles of welding metallurgy to welding, fabrication and inspection.
- (2) Apply principles of metal properties to welding, fabrication and inspection.
- (3) Apply principles related to residual stress and distortion to welding, fabrication and inspection.
- (4) Apply principles related to alloy weldability to welding, fabrication and inspection.

**3.2.1.6 COURSE F: ARC WELDING PRINCIPLES and PRACTICES****Unit 1: WELDING THEORY****Learning Objectives**

- (1) Apply principles of joint design and preparation to welding, fabrication and inspection.
- (2) Apply principles of material selection to welding, fabrication and inspection.
- (3) Apply principles of welding applications to welding, fabrication and inspection.
- (4) Apply principles of weld quality and repairs to welding, fabrication and inspection.

**Unit 2: SHIELDED METAL ARC WELDING (SMAW)****Learning Objectives**

- (1) Perform safety inspections of equipment and accessories.
- (2) Make minor external repairs to equipment and accessories.
- (3) Set up components and accessories of a complete shielded metal arc welding system.
- (4) Set up for shielded metal arc welding operations.
- (5) Operate shielded metal arc welding equipment.
- (6) Execute corrective actions to repair surface flaws on welds and base metals.
- (7) Perform a 6GR unlimited thickness range performance qualification test on carbon steel pipe.
- (8) Perform a 6G limited thickness range performance qualification test on carbon steel or 300 series stainless steel pipe using stainless steel electrodes.

**Unit 3: GAS METAL ARC WELDING (GMAW, GMAW-S)****Learning Objectives**

- (1) Perform safety inspections of equipment and accessories.
- (2) Make minor external repairs to equipment and accessories.
- (3) Set up components and accessories of a complete gas metal arc welding system.
- (4) Set up for gas metal arc welding operations.
- (5) Operate gas metal arc welding equipment.
- (6) Execute corrective actions to repair surface flaws on welds and base metals.

**Short circuit transfer**

- (7) Perform a 6G limited thickness range performance qualification test on carbon steel pipe.

**Pulsed spray transfer**

- (8) Perform a 6G limited thickness range performance qualification test on aluminum pipe.

**Unit 4: FLUX CORED ARC WELDING (FCAW-S, FCAW-G)****Learning Objectives**

- (1) Perform safety inspections of equipment and accessories.
- (2) Make minor external repairs to equipment and accessories.
- (3) Set up components and accessories of a complete flux cored arc welding system.
- (4) Set up for flux cored arc welding operations.
- (5) Operate flux cored arc welding equipment.
- (6) Execute corrective actions to repair surface flaws on welds and base metals.

**Self-Shielded**

- (7) Perform a 6G unlimited thickness range performance qualification test on carbon steel pipe.

**Gas-Shielded**

- (8) Perform a 6G unlimited thickness range performance qualification test on carbon steel pipe.

**Unit 5: GAS TUNGSTEN ARC WELDING (GTAW)****Learning Objectives**

- (1) Perform safety inspections of equipment and accessories.
- (2) Make minor external repairs to equipment and accessories.
- (3) Set up components and accessories of a complete gas tungsten arc welding system.
- (4) Set up for gas tungsten arc welding operations.
- (5) Operate gas tungsten arc welding equipment.
- (6) Execute corrective actions to repair surface flaws on welds and base metals.
- (7) Make 2F and 1G fillet and groove welds, on nickel alloys.
- (8) Make 2F and 1G fillet and groove welds, on copper alloys.
- (9) Make 2F and 1G fillet and groove welds, on magnesium and/or titanium alloys.
- (10) Perform a 6G limited thickness range performance qualification test on carbon steel round tubing or pipe.
- (11) Perform two 6G limited thickness range performance qualification tests on carbon steel or stainless steel round tubing or pipe using stainless steel filler metals.
- (12) Perform a 6G limited thickness range performance qualification test on aluminum round tubing or pipe.

### 3.3 LEARNING MODULES

#### 3.3.1 COURSE A: WELDING SAFETY AND HEALTH

##### LEARNING OBJECTIVE #1: Follow Safe Practices.\*

**PERFORMANCE CONDITIONS:** Provided with a period of instruction, orientation and demonstration about general welding safety, and given the necessary personal protective clothing and equipment, in the work area,

**DESIRED BEHAVIOR:** the trainee demonstrates safe practices.

**EVALUATION CRITERIA:** With regard to the trainee, proper protective clothing and equipment are worn, a safe work area is maintained and hazard warnings are communicated to other personnel in the immediate vicinity. The trainee performs the task on a continuous basis over the length of the program, in accordance with the institution's safety policy. Prior to any performance related activity in the institution's work area, the trainee shall pass with 100% accuracy, a written safety examination related to applicable sections of ANSI Z49.1 *Safety in Welding, Cutting and Allied Processes*, and the participating organization's internal safety policy. The trainee may retest until 100% accuracy is achieved. In accordance with the requirements of AWS QC12, the trainee shall pass the safety post-test portion of Part A - Welding Fundamentals and Safety (closed book written examination) [summative testing] with 90% accuracy.

##### LEARNING ACTIVITIES:

The instructor shall:

1. Ensure existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide a safety tour and orientation in the institution's welding work area.
3. Provide demonstrations related to ANSI Z49.1, *Safety in Welding, Cutting and Allied Processes*, 4. Protection of Personnel and the General Area.
4. Provide demonstrations related to ANSI Z49.1, *Safety in Welding, Cutting and Allied Processes*, 5. Ventilation.
5. Provide demonstrations related to ANSI Z49.1, *Safety in Welding, Cutting and Allied Processes*, 6. Fire Prevention and Protection.
6. Provide demonstrations related to ANSI Z49.1, *Safety in Welding, Cutting and Allied Processes*, 9. Precautionary Information.
7. Provide instruction related to ANSI Z49.1, *Safety in Welding, Cutting and Allied Processes*, Part I – General Aspects.
8. Administer safety examination prior to trainee performance in the institution's work area.
9. Administer safety examination retests as applicable.
10. Prepare trainee for the safety post-test portion of Part A - Welding Fundamentals and Safety (closed book written examination) [summative testing].
11. Keep training records reflecting results of safe practices training.

**\*Note:** Where the AWS QC1, Certified Welder Examination option is used to supercede AWS QC12 requirements for written examination, the test applicant shall be required to take a supplemental safety examination in addition to the AWS QC1 examination (see section 5).

**LEARNING OBJECTIVE #2: Recognize the effects of welding on health.**

**PERFORMANCE CONDITIONS:** Provided with a period of instruction, demonstration and appropriate welding health training materials, in the classroom or work area,

**DESIRED BEHAVIOR:** the trainee understands the effects of welding on health.

**EVALUATION CRITERIA:** The trainee understands welding health issues and applies precautionary measures to protect one's self and other welding personnel from hazardous health situations. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure existing or new training materials are in compliance with the AWS and other source documents specified for this learning objective.
2. Provide instruction related to the effects of welding on health from AWS EWH, *Effects of Welding on Health I - IX*.
3. Provide instruction related to the effects of welding and cutting fumes and gases from AWS FGW, *Fumes and Gases in the Welding Environment*, Part II, Arc Welding Fumes and Gases, Introduction, Equipment, Materials, Procedure and Discussion.
4. Provide instruction related to the effects of welding and cutting fumes and gases from AWS FGW, *Fumes and Gases in the Welding Environment*, Part III, Brazing Fumes and Gases, Introduction, Equipment, Materials, Procedure and Discussion.
5. Provide instruction related to the effects of welding and cutting fumes and gases from AWS FGW, *Fumes and Gases in the Welding Environment*, Part IV, Thermal Spray Fumes and Gases, Introduction, Equipment, Materials, Procedure and Discussion.
6. Provide instruction related to the effects of welding and cutting fumes and gases from AWS FGW, *Fumes and Gases in the Welding Environment*, Part V, Fumes and Gases from Oxygen Cutting, Introduction, Equipment, Materials, Procedure and Discussion.
7. Provide instruction related to welding fume control from ANSI/AWS F3.1, *Guide for Welding Fume Control*, 2. Welding Fume Hazards, 3. General and Dilution Ventilation, 4. Local Exhaust Ventilation Control, 6. Local Exhaust Ventilation Equipment.
8. Provide instruction related to product safety signs and labels from ANSI Z535.4, *Standard for Product Safety Signs and Labels*.
9. Provide instruction related to eye and face protection from ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection*.
10. Provide instruction related to respiratory protection from ANSI Z88.2, *Practices for Respiratory Protection*.
11. Provide instruction related to headgear from ANSI Z89.1, *Protective Headware for Industrial Workers*.
12. Develop and administer formative, diagnostic and summative tests relevant to the effects of welding on health.
13. Keep training records reflecting results of the effects of welding on health training.

### 3.3.1 COURSE B: MANAGEMENT AND SUPERVISION

#### LEARNING OBJECTIVE #1: Supervise other personnel during fabrication and welding operations.\*

**PERFORMANCE CONDITIONS:** Provided with a period of instruction, demonstration and experiential learning about supervision and management practices, a fabrication or welding assignment, in the work area,

**DESIRED BEHAVIOR:** the trainee demonstrates the ability to lead others while performing hands-on tasks.

**EVALUATION CRITERIA:** The fabrication or welding assignment is completed according to drawing or specification information. During the course of operations the trainee demonstrates the ability to plan, organize and delegate responsibility to others in the accomplishment of various fabrication and welding assignments. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

#### LEARNING ACTIVITIES:

The instructor shall:

1. Ensure existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to industrial psychology issues related to a broad understanding of human development and human actions and reactions in the work environment.
3. Provide instruction in basic management related to the five basic principles of management and how it relates to the welding industry.
4. Develop and administer formative, diagnostic and summative tests relevant welding industry supervision.
5. Keep training records reflecting results of welding industry supervision training.

The training facility should:

1. Provide trainee with experiential learning related to supervisor training in the welding industry (e.g. field studies, work study or cooperative agreements).

**\*Note:** Elements of experiential learning for supervisory training should include:  
 Time spent in; Welding Specialties, Production Areas (hands-on area), Inspection Areas (quality assurance)  
 Interpretation of welding procedures and required codes  
 Work with a proven, experienced supervisor  
 Exposure to productivity meetings where budgets, schedules and other management functions are issues  
 Attendance of industry sponsored management courses

**LEARNING OBJECTIVE #2: Administer hands-on training.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction, orientation and demonstration about training principles and practices, and given a training assignment, in the work area,

**DESIRED BEHAVIOR:** the trainee demonstrates the ability to deliver hands-on training.

**EVALUATION CRITERIA:** Expected training outcomes match the training assignment. The trainee is able to transfer learning to others. The trainee demonstrates the ability to recall/relate welding technology information and apply practical experience to a training assignment. The trainee chooses an appropriate training method. Training materials match the training assignment. The trainee is able to adjust personal training style to the learning styles of the students. The trainee has selected an appropriate method of student assessment or evaluation. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to training methods and materials.
3. Provide instruction related to training and learning styles.
4. Provide instruction related to training evaluation and assessment.
5. Provide demonstrations related to the use of lecture techniques in training.
6. Provide demonstrations related to the use of demonstration techniques in training.
7. Provide experiential learning related to hands-on welder training.
8. Develop and administer formative, diagnostic and summative tests relevant to the administration of hands-on training.
9. Keep training records reflecting results of the administration of hands-on training training.

The training facility should:

1. Provide trainee with experiential learning related to hands-on training (e.g. field studies, work study or cooperative agreements).

**\*Note:** This unit of instruction is designed to provide the trainee with practical application of his/her welding technology knowledge and practical welding experience. It is not necessary to provide education training on a B.S. level. Trainer education should consist of an introduction to the concepts listed in learning activities 1 - 4. These activities should be designed to give technically trained personnel a core set of competencies related to training.

Experiential learning activities could consist of teachers aide positions in which the trainee provides or assists in the instruction of less advanced trainees (i.e. Entry Level and Level II Welders.)

**LEARNING OBJECTIVE #3: Participate in the selection and specification of equipment purchases.**

**PERFORMANCE CONDITIONS:** Provided with a period of instruction, demonstration, and experiential learning about equipment selection and specification, in the work area or classroom,

**DESIRED BEHAVIOR:** the trainee demonstrates the ability to match equipment needs to the employers unique situation.

**EVALUATION CRITERIA:** The trainee accurately selects and specifies equipment needs. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to the selection and specification of equipment purchases.
3. Provide instruction related to the construction of a purchase order.
4. Provide demonstrations related to the selection and specification of equipment purchases.
5. Provide demonstrations related to the construction of a purchase order.
6. Provide training exercises related to the selection and specification of equipment purchases.
7. Provide training exercises related to the construction of a purchase order.
8. Develop and administer formative, diagnostic and summative tests relevant to equipment selection and specification for purchase training.
9. Keep training records reflecting results of equipment selection and specification for purchase training.

The training facility should:

1. Provide trainee with experiential learning related to the selection and specification of equipment purchases (e.g. field studies, work study or cooperative agreements).

**LEARNING OBJECTIVE #4: Estimate welding and material costs and quantities.**

**PERFORMANCE CONDITIONS:** Provided with a period of instruction, demonstration and experiential learning about welding and material cost and quantity estimation, in the work area,

**DESIRED BEHAVIOR:** the trainee demonstrates the ability to estimate welding and material costs and quantities.

**EVALUATION CRITERIA:** The trainee demonstrates knowledge of the competencies taught in learning activities 1 through 10 below. The trainee accurately prepares a sample estimation report. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to an introduction to estimation and the role of the estimator in the welding industry.
3. Provide instruction related to estimate preparation.
4. Provide instruction related to drawing interpretation for estimation.
5. Provide instruction related to specification package interpretation for estimation.
6. Provide instruction related to the review of joint designs for estimation.
7. Provide instruction related to the calculation of metal weight and cost for estimation.
8. Provide instruction related to the calculation of filler metal weight and cost for estimation.
9. Provide instruction related to the calculation of metal finishing and paint costs for estimation.
10. Provide instruction related to cost of finished product delivery for estimation.
11. Provide demonstrations related to the to the estimation of welding and material costs and quantities.
12. Provide training exercises related to the estimation of welding and material costs and quantities.

The training facility should:

1. Provide trainee with experiential learning related to estimation of welding and material costs and quantities. (e.g. field studies, work study or cooperative agreements).

### 3.3.3 COURSE C: DOCUMENTS GOVERNING WELDING AND WELDING INSPECTION

#### 3.3.3.1 UNIT #1: WELDING CODES AND OTHER STANDARDS\*

**LEARNING OBJECTIVE #1:** Locate essential welding and inspection information from welding procedure specifications (WPS).

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration and applicable welding procedure specification, in the training classroom,

**DESIRED BEHAVIOR:** the trainee locates essential welding procedure, performance qualification and inspection criteria information.

**EVALUATION CRITERIA:** The trainee demonstrates an understanding of essential welding procedure, performance qualification and inspection criteria variables found within a welding procedure specification. The objective is practiced on a routine basis over the length of the program. The instructor observes the trainee relating essential welding and inspection information to classroom assignments. The trainee correctly identifies welding and inspection criteria related to performance qualification requirements. In accordance with the requirements of AWS QC12, the trainee shall pass Part B - Practical Welding Procedure Specification Interpretation (visual examination of weld samples) [summative testing].

#### LEARNING ACTIVITIES:

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to welding procedure, performance qualification and inspection criteria information from AWS B2.1, *Standard for Welding Procedure and Performance Qualification*.
3. Provide demonstrations related to locating welding procedure, performance qualification and inspection criteria information from AWS B2.1, *Standard for Welding Procedure and Performance Qualification*.
4. Provide training exercises related to locating welding procedure, performance qualification and inspection criteria information from AWS B2.1, *Standard for Welding Procedure and Performance Qualification*.
5. Develop and administer formative or diagnostic tests relevant to welding procedure specifications.
6. Prepare trainee for Part B - Practical Welding Procedure Specification Interpretation (visual examination of weld samples) [summative testing].
7. Keep training records reflecting results of welding codes and other standards training.

**\*Note:** It is not expected that the trainee memorize the information found in AWS B2.1. This unit of instruction is designed to provide the trainee with an understanding of information that could be used to determine welding and inspection requirements for a particular job assignment. The open book examination for this unit will consist of a mock book of specifications constructed from portions of AWS B2.1. The trainee will be required to locate answers to questions from the book of specifications and visually examine weld specimens to determine acceptance. The book of specifications will consist of information that would be relevant to welding inspection criteria.

**LEARNING OBJECTIVE #2: Locate essential welding and inspection information from AWS D1.1, Structural Welding Code – Steel.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration and AWS D1.1, Structural Welding Code – Steel, in the training classroom,

**DESIRED BEHAVIOR:** the trainee locates essential welding procedure, performance qualification and inspection criteria information.

**EVALUATION CRITERIA:** The trainee demonstrates an understanding of essential welding procedure, performance qualification and inspection criteria variables found within AWS D1.1, *Structural Welding Code – Steel*. The objective is practiced on a routine basis over the length of the program. The instructor observes the trainee relating essential welding and inspection information to classroom assignments. The trainee correctly identifies welding and inspection criteria related to training assignments and performance qualification requirements. In accordance with the requirements of AWS QC12, the trainee shall pass Part C - Code Book Interpretation (open book examination) from the applicable sections of AWS D1.1, *Structural Welding Code – Steel* [summative testing].

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to welding procedure, performance qualification and inspection criteria information from AWS D1.1, *Structural Welding Code – Steel*.
3. Provide demonstrations related to locating welding procedure, performance qualification and inspection criteria information from AWS D1.1, *Structural Welding Code – Steel*.
4. Provide training exercises related to locating welding procedure, performance qualification and inspection criteria information from AWS D1.1, *Structural Welding Code – Steel*.
5. Develop and administer formative or diagnostic tests relevant to welding procedure specifications.
6. Prepare trainee for Part C - Code Book Interpretation (open book examination) from the applicable sections of AWS D1.1, *Structural Welding Code – Steel* [summative testing].
7. Keep training records reflecting results of welding codes and other standards training.

**\*Note:** All training shall be in accordance with the latest version of AWS D1.1 Structural Welding Code – Steel.

It is not expected that the trainee memorize the information found in AWS D1.1. This unit of instruction is designed to familiarize the trainee with the various sections found in AWS D1.1 and provide practical application of information that could be used to determine welding and inspection requirements for a particular job assignment from a code. The open book examination for this unit will require the trainee to locate answers to questions from AWS D1.1.

Industrial survey results indicate that the Level III – Expert Welder shall understand AWS D1.1, API 1104 and ASME Section IX. Training in all three codes is mandatory. However, on the final written examination the trainee or training facility may choose one of the codes for use in testing. AWS QC12 written examination requirements for Part C may be superseded if the training facility elects to have trainees test according to the AWS QC1, Welding Inspector Examination (see section 5).

**LEARNING OBJECTIVE #3: Locate essential welding and inspection information from API Standard 1104, Standard for Welding Pipelines and Related Facilities.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration and API Standard 1104, *Standard for Welding Pipelines and Related Facilities*, in the training classroom,

**DESIRED BEHAVIOR:** the trainee locates essential welding procedure, performance qualification and inspection criteria information.

**EVALUATION CRITERIA:** The trainee demonstrates an understanding of essential welding procedure, performance qualification and inspection criteria variables found within API Standard 1104, *Standard for Welding Pipelines and Related Facilities*. The objective is practiced on a routine basis over the length of the program. The instructor observes the trainee relating essential welding and inspection information to classroom assignments. The trainee correctly identifies welding and inspection criteria related to training assignments and performance qualification requirements. In accordance with the requirements of AWS QC12, the trainee shall pass Part C - Code Book Interpretation (open book examination) from the applicable sections of API Standard 1104, *Standard for Welding Pipelines and Related Facilities* [summative testing].

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to welding procedure, performance qualification and inspection criteria information from API Standard 1104, *Standard for Welding Pipelines and Related Facilities*.
3. Provide demonstrations related to locating welding procedure, performance qualification and inspection criteria information from API Standard 1104, *Standard for Welding Pipelines and Related Facilities*.
4. Provide training exercises related to locating welding procedure, performance qualification and inspection criteria information from API Standard 1104, *Standard for Welding Pipelines and Related Facilities*.
5. Develop and administer formative or diagnostic tests relevant to welding procedure specifications.
6. Prepare trainee for Part C - Code Book Interpretation (open book examination) from the applicable sections of API Standard 1104, *Standard for Welding Pipelines and Related Facilities* [summative testing].
7. Keep training records reflecting results of welding codes and other standards training.

**\*Note:** All training shall be in accordance with the latest version of API Standard 1104, *Standard for Welding Pipelines and Related Facilities*.

It is not expected that the trainee memorize the information found in API 1104. This unit of instruction is designed to familiarize the trainee with the various sections found in API 1104 and provide practical application of information that could be used to determine welding and inspection requirements for a particular job assignment from a code. The open book examination for this unit will require the trainee to locate answers to questions from API 1104.

Industrial survey results indicate that the Level III – Expert Welder shall understand AWS D1.1, API 1104 and ASME Section IX. Training in all three codes is mandatory. However, on the final written examination the trainee or training facility may choose one of the codes for use in testing. AWS QC12 written examination requirements for Part C may be superseded if the training facility elects to have trainees test according to the AWS QC1, Welding Inspector Examination (see section 5).

#### **LEARNING OBJECTIVE #4: Locate essential welding and inspection information from ASME, Boiler and Pressure Vessel Code – Section IX.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration and ASME, *Boiler and Pressure Vessel Code – Section IX*, in the training classroom,

**DESIRED BEHAVIOR:** the trainee locates essential welding procedure, performance qualification and inspection criteria information.

**EVALUATION CRITERIA:** The trainee demonstrates an understanding of essential welding procedure, performance qualification and inspection criteria variables found within ASME, *Boiler and Pressure Vessel Code – Section IX*. The objective is practiced on a routine basis over the length of the program. The instructor observes the trainee relating essential welding and inspection information to classroom assignments. The trainee correctly identifies welding and inspection criteria related to training assignments and performance qualification requirements. In accordance with the requirements of AWS QC12, the trainee shall pass Part C - Code Book Interpretation (open book examination) from the applicable sections of ASME, *Boiler and Pressure Vessel Code – Section IX* [summative testing].

#### **LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to welding procedure, performance qualification and inspection criteria information from ASME, *Boiler and Pressure Vessel Code – Section IX*.
3. Provide demonstrations related to locating welding procedure, performance qualification and inspection criteria information from ASME, *Boiler and Pressure Vessel Code – Section IX*.
4. Provide training exercises related to locating welding procedure, performance qualification and inspection criteria information from ASME, *Boiler and Pressure Vessel Code – Section IX*.
5. Develop and administer formative or diagnostic tests relevant to welding procedure specifications.
6. Prepare trainee for Part C - Code Book Interpretation (open book examination) from the applicable sections of ASME, *Boiler and Pressure Vessel Code – Section IX* [summative testing].
7. Keep training records reflecting results of welding codes and other standards training.

The training facility should:

1. Provide trainee with experiential learning related to welding inspection training in the welding industry (e.g. field studies, work study or cooperative agreements).

**\*Note:** All training shall be in accordance with the latest version of ASME, *Boiler and Pressure Vessel Code – Section IX*.

It is not expected that the trainee memorize the information found in ASME – Section IX. This unit of instruction is designed to familiarize the trainee with the various sections found in ASME – Section IX and provide practical application of information that could be used to determine welding and inspection requirements for a particular job assignment from a code. The open book examination for this unit will require the trainee to locate answers to questions from ASME – Section IX. Address only those areas of inspection and fabrication found in section IX but make the trainee aware of the other sections that make up ASME B31.1

Industrial survey results indicate that the Level III – Expert Welder shall understand AWS D1.1, API 1104 and ASME Section IX. Training in all three codes is mandatory. However, on the final written examination the trainee or training facility may choose one of the codes for use in testing. AWS QC12 written examination requirements for Part C may be superceded if the training facility elects to have trainees test according to the AWS QC1, Welding Inspector Examination (see section 5).

**3.3.3.2 UNIT #2: WELDING INSPECTION\*****LEARNING OBJECTIVE #1: Interpret destructive and nondestructive test results.**

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration, destructive and nondestructive testing guidelines from a code or other standard, protective clothing and equipment, visual examination tools and test specimens or radiographs, in the classroom,

**DESIRED BEHAVIOR:** the trainee interprets destructive and nondestructive test results.

**EVALUATION CRITERIA:** The trainee relates concepts and interprets destructive and nondestructive test results. The objective is performed as required during the length of the program. In accordance with the requirements of AWS QC12, the trainee shall pass Part A - Welding Fundamentals and Safety and Part B - Practical Welding Specification Interpretation (visual examination of weld samples) of a written examination (summative testing).

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction about nondestructive examination from AWS Welding Handbook, Vol. 1, 8th Ed., Chapter 15, *Inspection, Nondestructive Examination*, ANSI/AWS B1.11, *Guide for the Visual Inspection of Welds* and ANSI/AWS B 1.10, *Guide for the Nondestructive Inspection of Welds*.
3. Provide instruction about destructive tests from AWS Welding Handbook, Vol. 1, 8th Ed., Chapter 15, *Inspection, Destructive Tests* and ANSI/AWS B4.0, *Standard Methods for Mechanical Testing of Welds*.
4. Provide instruction about common cutting surface and edge discontinuities from AWS C4.1, *Criteria for Describing Oxygen-Cut Surfaces*.
5. Provide demonstrations related to the use of visual examination methods and tools.
6. Provide demonstrations related to calculations and measurement of tension test specimens.
7. Provide demonstrations related to the interpretation of bend test results.
8. Provide demonstrations related to the interpretation of penetrant test results.
9. Provide demonstrations related to the interpretation of magnetic particle test results.
10. Provide demonstrations related to the interpretation of ultrasonic test results.
11. Provide demonstrations related to the interpretation of radiographic test results.
12. Provide training exercises related to the use of visual examination methods and tools.
13. Provide training exercises related to calculations and measurement of tension test specimens.
14. Provide training exercises related to the interpretation of bend test results.
15. Provide training exercises related to the interpretation of penetrant test results.
16. Provide training exercises related to the interpretation of magnetic particle test results.
17. Provide training exercises related to the interpretation of ultrasonic test results.
18. Provide training exercises related to the interpretation of radiographic test results.
19. Observe trainee following safe visual examination practices.
20. Provide feedback to trainee about his/her interpretation diagnosis.
21. Develop and administer formative or diagnostic tests relevant to destructive and non destructive testing.

22. Prepare trainee for Part A - Welding Fundamentals and Safety and Part B - Practical Welding Specification Interpretation (visual examination of weld samples) of the written examination [summative testing].
23. Keep training records reflecting results of destructive and nondestructive testing training.

The training facility should:

1. Provide trainee with experiential learning related to welding inspection training in the welding industry (e.g. field studies, work study or cooperative agreements).

**\*Note:** Elements of experiential learning for welding inspection training should include:

- Time spent in Welding Specialties, Production Areas (hands-on area) and Inspection Areas (quality assurance)**
- Work with acceptance codes that are required by each job**
- Interpretation of welding procedures and required codes**
- Work with a proven, experienced inspector**
- Work at more than one area of inspection during experiential learning (e.g. piping, vessel, structural, etc.)**
- Performance of visual examination, bend testing, penetrant testing and magnetic particle testing**
- Monitoring and examining work performed by tackers, welding operators, or welders**
- Recording inspection results in such a way that the work personally inspected may be identified, and the inspection findings accurately reported**

**LEARNING OBJECTIVE #2: Prepare inspection reports.**

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration, inspection guidelines from a welding procedure specification, code or other standard, an appropriate form or report format, in the classroom and work area,

**DESIRED BEHAVIOR:** the trainee records data relevant to the interpretation of nondestructive and destructive test results.

**EVALUATION CRITERIA:** The trainee accurately records inspection information on a form or report. The information is reviewed and accepted by the instructor. The objective is performed as required during the length of the program. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to the use and importance of inspection forms and report formats found in the welding industry.
3. Provide instruction related to various inspection forms and report formats found in the welding industry.
4. Provide demonstrations related to the completion of various inspection forms and report formats found in the welding industry.
5. Provide training exercises related to the completion of various inspection forms and report formats found in the welding industry.
6. Provide feedback to trainee about his/her visual examination diagnosis.
7. Develop and administer formative or diagnostic and summative tests relevant to the preparation of inspection reports.
8. Keep training records reflecting results of inspection report preparation.

The training facility should:

1. Provide trainee with experiential learning related to welding inspection training in the welding industry (e.g. field studies, work study or cooperative agreements).

**LEARNING OBJECTIVE #3: Perform visual examination.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration, visual examination guidelines from a welding procedure specification, code or other standard, protective clothing and equipment, visual examination tools, cutting and welding specimens, in the work area,

**DESIRED BEHAVIOR:** the trainee performs visual examination of cutting and welding sample specimens.

**EVALUATION CRITERIA:** Sample specimens are visually examined by the trainee according to welding procedures specifications, code or other standard information. Results are reported by the trainee to the instructor who verifies accuracy of findings. The objective is performed on a routine basis during the length of the program. In accordance with the requirements of AWS QC12, the trainee shall pass Part B - Practical Welding Procedure Specification Interpretation (visual examination of weld samples) [summative testing].

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide demonstrations related to the visual examination of arc cut, oxyfuel gas cut and weld specimens.
3. Provide training exercises related to the visual examination of arc cut, oxyfuel gas cut and weld specimens.
4. Observe trainee following safe visual examination practices.
5. Observe trainee performing visual examination.
6. Provide feedback to trainee about his/her visual examination diagnosis.
7. Develop and administer formative or diagnostic tests relevant to visual examination of arc cut, oxyfuel gas cut and weld specimens.
8. Prepare trainee for AWS QC12, Part B - Practical Welding Procedure Specification Interpretation elements of written examination [summative testing].
9. Keep training records reflecting results of visual examination training.

The training facility should:

1. Provide trainee with experiential learning related to welding inspection training in the welding industry (e.g. field studies, work study or cooperative agreements).

**\*Note:** This unit of instruction is designed to provide the trainee with practical application of the concepts taught in 3.3.3.1 UNIT #1: WELDING CODES AND OTHER STANDARDS. The open book examination for this unit will consist of a mock book of welding procedure specifications. The trainee will be required to locate answers to questions from the book of specifications and visually examine weld specimens to determine acceptance. The book of specifications will consist of information that would be relevant to welding inspection criteria.

The instructor should incorporate visual examination into the training program and have Level III trainees routinely examine actual cutting and welding samples from the welding and cutting work area. Practice should include the use of a variety of acceptance criteria from various WPS's, codes and other standards.

AWS QC12 written examination requirements for Part B may be superseded if the training facility elects to have trainees test according to the AWS QC1, Welding Inspector Examination (see section 5).

**LEARNING OBJECTIVE #4: Perform bend testing.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration, bend testing acceptance criteria guidelines from a welding procedure specification, code or other standard, protective clothing and equipment, bend testing equipment, visual examination tools and welding specimens, in the work area,

**DESIRED BEHAVIOR:** the trainee prepares, bend tests and visually examines weld specimens according to the acceptance criteria of a welding procedure specification, code or other standard.

**EVALUATION CRITERIA:** Sample specimens are prepared, bend tested and visually examined by the trainee according to welding procedures specifications, code or other standard information. Results are reported by the trainee to the instructor who verifies accuracy of findings. The objective is performed as required during the length of the program. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to the preparation, bend testing and visual examination of weld specimens.
3. Provide demonstrations related to the preparation, bend testing and visual examination of weld specimens.
4. Provide training exercises related to the preparation, bend testing and visual examination of weld specimens.
5. Observe trainee following safe preparation, bend testing and visual examination of weld specimens.
6. Observe trainee performing preparations, bend testing and visual examination of weld specimens.
7. Provide feedback to trainee about his/her visual examination diagnosis.
8. Develop and administer formative or diagnostic and summative tests relevant to the preparation, bend testing and visual examination of weld specimens.
9. Keep training records reflecting results of bend test training.

The training facility should:

1. Provide trainee with experiential learning related to welding inspection training in the welding industry (e.g. field studies, work study or cooperative agreements).

**\*Note:** This unit of instruction is designed to provide the trainee with practical application of the concepts taught in 3.3.3.1 UNIT #1: WELDING CODES AND OTHER STANDARDS and 3.3.3.2 UNIT #2: WELDING INSPECTION, LEARNING OBJECTIVE #1: Perform visual examination. Practice should include the use of a variety of acceptance criteria from various WPS's, codes and other standards.

The instructor should incorporate bend testing and visual examination into the training program. Level III trainees should routinely prepare, bend test and visually examine weld specimens from the welding work area.

**LEARNING OBJECTIVE #5: Perform penetrant testing.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration, penetrant testing acceptance criteria guidelines from a welding procedure specification, code or other standard, protective clothing and equipment, penetrant testing equipment, visual examination tools and welding specimens, in the work area,

**DESIRED BEHAVIOR:** the trainee prepares, penetrant tests and visually examines weld specimens according to the acceptance criteria of a welding procedure specification, code or other standard.

**EVALUATION CRITERIA:** Sample specimens are prepared, penetrant tested and visually examined by the trainee according to welding procedures specifications, code or other standard information. Results are reported by the trainee to the instructor who verifies accuracy of findings. The objective is performed as required during the length of the program. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to the preparation, penetrant testing and visual examination of weld specimens.
3. Provide demonstrations related to the preparation, penetrant testing and visual examination of weld specimens.
4. Provide training exercises related to the preparation, penetrant testing and visual examination of weld specimens.
5. Observe trainee following safe preparation, penetrant testing and visual examination of weld specimens.
6. Observe trainee performing preparations, penetrant testing and visual examination of weld specimens.
7. Provide feedback to trainee about his/her visual examination diagnosis.
8. Develop and administer formative or diagnostic and summative tests relevant to the preparation, penetrant testing and visual examination of weld specimens.
9. Keep training records reflecting results of penetrant test training.

The training facility should:

1. Provide trainee with experiential learning related to welding inspection training in the welding industry (e.g. field studies, work study or cooperative agreements).
2. Provide trainee with experiential learning related to penetrant testing equipment operation (e.g. field studies, work study or manufacturer hands-on type demonstrations of various testing equipment used in welded metal fabrication).

**\*Note:** This unit of instruction is designed to provide the trainee with practical application of the concepts taught in 3.3.3.1 UNIT #1: WELDING CODES AND OTHER STANDARDS and 3.3.3.2 UNIT #2: WELDING INSPECTION, LEARNING OBJECTIVE #1: Perform visual examination. Practice should include the use of a variety of acceptance criteria from various WPS's, codes and other standards. Level III trainees should routinely prepare, penetrant test and visually examine weld specimens from the welding work area during this period of instruction.

**LEARNING OBJECTIVE #6: Perform magnetic particle testing.\***

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration, magnetic particle testing acceptance criteria guidelines from a welding procedure specification, code or other standard, protective clothing and equipment, magnetic particle testing equipment, visual examination tools and welding specimens, in the work area,

**DESIRED BEHAVIOR:** the trainee prepares, magnetic particle tests and visually examines weld specimens according to the acceptance criteria of a welding procedure specification, code or other standard.

**EVALUATION CRITERIA:** Sample specimens are prepared, magnetic particle tested and visually examined by the trainee according to welding procedures specifications, code or other standard information. Results are reported by the trainee to the instructor who verifies accuracy of findings. The objective is performed as required during the length of the program. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

**LEARNING ACTIVITIES:**

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the AWS documents specified for this learning objective.
2. Provide instruction related to the preparation, magnetic particle testing and visual examination of weld specimens.
3. Provide demonstrations related to the preparation, magnetic particle testing and visual examination of weld specimens.
4. Provide training exercises related to the preparation, magnetic particle testing and visual examination of weld specimens.
5. Observe trainee following safe preparation, magnetic particle testing and visual examination of weld specimens.
6. Observe trainee performing preparations, magnetic particle testing and visual examination of weld specimens.
7. Provide feedback to trainee about his/her visual examination diagnosis.
8. Develop and administer formative or diagnostic and summative tests relevant to the preparation, magnetic particle testing and visual examination of weld specimens.
9. Keep training records reflecting results of magnetic particle test training.

The training facility should:

1. Provide trainee with experiential learning related to welding inspection training in the welding industry (e.g. field studies, work study or cooperative agreements).
2. Provide trainee with experiential learning related to magnetic particle testing equipment operation (e.g. field studies, work study or manufacturer hands-on type demonstrations of various testing equipment used in welded metal fabrication).

**\*Note:** This unit of instruction is designed to provide the trainee with practical application of the concepts taught in 3.3.3.1 UNIT #1: WELDING CODES AND OTHER STANDARDS and 3.3.3.2 UNIT #2: WELDING INSPECTION, LEARNING OBJECTIVE #1: Perform visual examination. Practice should include the use of a variety of acceptance criteria from various WPS's, codes and other standards. Level III trainees should routinely prepare, magnetic particle test and visually examine weld specimens from the welding work area during this period of instruction.

### 3.3.4 COURSE D: WELDED METAL FABRICATION\*

#### LEARNING OBJECTIVE #1: Troubleshoot fabrication setups and processes.

**PERFORMANCE CONDITIONS:** Provided with a period of instruction and demonstration, troubleshooting guidelines, troubleshooting equipment and tools, a job assignment or practices exercises, in the classroom and work area,

**DESIRED BEHAVIOR:** the trainee analyzes and corrects performance problems during fabrication setup and process operation.

**EVALUATION CRITERIA:** The trainee's analysis and corrective measures solve the performance problem. The trainee is observed locating, analyzing and solving performance problems during the course of troubleshooting operations. The trainee's knowledge is tested according to the summative evaluation criteria of the training facility.

#### LEARNING ACTIVITIES:

The instructor shall:

1. Ensure that existing or new training materials are in compliance with the documents specified for this learning objective.
2. Provide instruction related to systematic approaches for troubleshooting fabrication setups and processes.
3. Provide demonstration related to systematic approaches for troubleshooting fabrication setups and processes.
4. Provide training exercises related to systematic approaches for troubleshooting fabrication setups and processes.
5. Develop and administer formative or diagnostic and summative tests relevant to troubleshooting fabrication setups and processes.
6. Keep training records reflecting results of troubleshooting fabrication setups and processes training.

The training facility should:

1. Provide trainee with experiential learning related to welded metal fabrication training in the welding industry (e.g. field studies, work study or cooperative agreements).

**\*Note:** Elements of experiential learning for welded metal fabrication training should include:  
 Time spent in Welding Specialties, Production Areas (hands-on area) and Inspection Areas (quality assurance)  
 Work with acceptance codes that are required by each job  
 Work performed from complex drawings (multiple page, multiple view) to fabricate weldments  
 Interpretation of welding procedures and required codes  
 Work with a proven, experienced layout or fitup person  
 Work at more than one area of fabrication during experiential learning (e.g. sheet metal, structural, pipe)  
 Layout and fitup duties that include: all previously attained competencies from Level I and Level II training, troubleshooting fabrication setups and processes, fabrication of jigs and fixtures; preparation of cutting lists, sequencing of parts for fabrication and compensation for distortion and shrinkage