



## AWS RADIOGRAPHIC INTERPRETER CERTIFICATION PROGRAM

The AWS Radiographic Interpreter Certification program is based upon requirements contained within AWS B5.15:2003, *Specification for the Qualification of Radiographic Interpreters*, and is designed to provide evidence of the ability of individuals to properly assess welding-related indications produced on radiographic film and related media.

The AWS Radiographic Interpreter program replaces the previous CSWIP-based program, while maintaining the high standards of performance contained within the previous program. Further details are contained within AWS QC-15-2008, *Specification for Certification of Radiographic Interpreters*. Candidates seeking certification will be required to successfully pass three examinations, one on general knowledge, one on specific knowledge related to the required quality and acceptance criteria as contained in the most common code books, and a practical examination requiring interpretation of actual radiographs. An AWS-approved training program is available that covers 40 hours of instruction.

Individuals who meet the examination, education, experience, and training requirements as specified in AWS B5.15 will be awarded the designation of AWS Radiographic Interpreter. The holders of this certification will have a valuable tool to demonstrate their qualifications to interpret radiographs of weldments. The AWS program for radiographic interpreters will be available only to those individuals who successfully pass the required examinations. No grandfathering or transitioning of existing practitioners will be allowed in order to maintain the highest standards of third-party certification.

The AWS B5.15 *Specification for the Qualification of Radiographic Interpreters* and AWS QC-15, *Specification for the Certification of Radiographic Interpreters* is available for free download at [AWS.org](http://AWS.org).

### Examination Requirements

Candidates shall meet all of the following examination requirements in order to determine their comprehension and retention of the materials presented during training courses established for the purpose of qualification.

**General Knowledge Examination.** Successfully complete (minimum 70% correct score) a multiple choice, written examination covering subjects related to welding processes, joint geometry, discontinuities, radiographic theory, film selection, film processing, film handling and storage, radiographic sensitivity and codes, specifications, and other standards.

**Code Knowledge Examination.** Successfully complete (minimum 70% correct score) a multiple choice, written, open-book examination covering the contents relating to radiographic quality and film interpretation of API 1104, AWS D1.1, ASME Section VIII: Division 1, ASME Section V, or others as listed below under Reference Standards.

**Practical (Film Interpretation) Examination.** Successfully complete (minimum 70% correct score) a multiple choice, written examination consisting of interpreting a minimum of 10 radiographs to a code, specification, or other standard for both radiographic quality and weld quality

There is a requirement of a passing composite score of a minimum of 80% based on simple averaging of the three examinations.

### Body of Knowledge

Students taking the AWS training course will receive instruction on the following subject areas:

#### Nature and Properties of X and Gamma Radiation

1. Penetration
2. Absorption
3. Scatter
4. Diffraction
5. Transmission
6. Rectilinear propagation
7. Photographic properties



## Photographic Aspects

1. Types of film and paper used in industrial radiography
2. Characteristic curves
3. Characteristics
  - a. Speed
  - b. Contrast
  - c. Definition
  - d. Density
  - e. Fog
  - f. Graininess
  - g. Inherent unsharpness
  - h. Latitude
4. Commercial films and their properties
  - a. Retention life
  - b. Long term storage
5. Filing and separation techniques
6. Dark room procedures
  - a. Layout
  - b. Light traps and entrance
  - c. Wet and dry benches
  - d. Film pass hatches
  - e. Processing units
  - f. Safe-lights and ancillary equipment
  - g. Storage, handling and loading
  - h. Film processing (automatic and manual)
  - i. Temperature control
7. Intensifying screens
8. Spurious indications
  - a. Light (and safe-light) fogging
  - b. Light leaks
  - c. Chemical fog
  - d. Stains
  - e. Air bubbles
  - f. Reticulation
  - g. Pressure marks
  - h. Static marks
  - i. Drying marks
  - j. Finger marks
  - k. Defective screens
  - l. Incomplete fixing
  - m. Film manufacturing faults

## Fundamental Aspects of Radiographic Quality

1. Quality of radiation
2. Optimum working densities
3. Radiographic contrast
  - a. Objective and subjective contrast
  - b. Methods of controlling radiographic contrast
  - c. Effects of scattered radiation
  - d. Use of filters, screens, masking and blocking media
  - e. Influence of processing conditions and viewing conditions on contrast
4. Radiographic definition
  - a. Objective and subjective
  - b. Poor definition
  - c. Geometric unsharpness
  - d. Inter-relationship of dimensions of focal spot or source
  - e. Source-to-object and source-to-film distances
  - f. Inherent unsharpness
  - g. Movement
  - h. Film screen contact
  - i. Summation of factors controlling definition
5. Control of radiographic sensitivity and its assessment by the use of image quality indicators

### **Radiation Safety Principles**

1. Controlling personnel exposure
2. Time, distance and shielding
3. ALARA (as low as reasonably achievable)
4. Radiation detection equipment
5. Exposure device operating characteristics

### **X-ray and Gamma ray equipment**

Knowledge of the effects on radiographic quality in the event of equipment change.

### **Geometry of Image Formation**

1. Geometric unsharpness
2. Control of source-to-object distance, object-to-film distance, source-to-film distance
3. Penetrameter sensitivity
4. Selection of beam angle

### **Exposure Calculations**

1. Effect of distance on exposure
2. Use of exposure charts and calculators for X and gamma radiography

### **Application to Welds**

1. Interpretation of radiographs of welds in different materials and joint geometries
2. Multiple-film techniques
  - a. Thickness-variation parameters
  - b. Film speed
  - c. Film latitude
3. Welds in small bore tubes
4. The determination of the depth of a flaw from one surface in a specimen by the practical use of the tube or source shift method (triangulation method)

### **Viewing Radiographs**

1. Film illuminator requirements
2. Background lighting
3. Multiple-composite viewing
4. Penetrameter placement
5. Personnel darkroom adaptation and visual acuity
6. Film identification
7. Location markers
8. Film density measurement
9. Film artifacts
10. Analyze the loss of sensitivity in order to rectify faulty techniques

### **Welding Technology**

1. Terminology for welds
2. Welded joints
3. Welding procedures
4. Weld discontinuities
5. Base metal discontinuities
6. Influence on techniques of geometry, size, surface condition, base metal composition, weld metal structure
7. Influence of surface cladding, heat treatments and weld repairs.
8. Basic principles of fusion welding processes
9. Types of discontinuities associated with particular base metal/welding process combinations.
10. Types of discontinuities in welds and base metals detectable by radiography
11. Defect characteristics which influence detectability
  - a. Size
  - b. Geometry
  - c. Distance from surface
  - d. Orientation
  - e. Reflectivity
  - f. Opacity/atomic number effects

## Reference Standards

Candidates taking the AWS Radiographic Interpreter training course and the certification examination will be loaned the AWS Book of Reference Standards for their individual use during the training and testing. The reference books will be returned to AWS upon the completion of their testing and will contain the following standards or excerpts of standards:

AWS D1.1/D1.1M:2008, *AWS Structural Welding Code – Steel*

API 1104, *Welding of Pipelines and Related Facilities*, 19th Edition

ASME Section V, Article 2, *Boiler & Pressure Vessel Code*, Nondestructive Examination (2007)

ASME Section V, Article 22 SE-94 (ASTM E 94-04) *Standard Guide for Radiographic Examination*

ASME Section VIII, Division 1, *Rules for Construction of Pressure Vessels*, UW-51 and UW-52 (2008a)

ASTM E94-04, *Standard Guide for Radiographic Examination*

ASTM E 747-04, *Standard Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology*

ASTM E 1025-05, *Standard Practice for Design, Manufacture and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology*

ASTM E 1032-06, *Standard Test Method for Radiographic Examination of Weldments*

ASTM E 1742-08a, *Standard Practice for Radiographic Examination*

Note: The above references will be available for temporary use by the students at the training course and by the candidates for certification. Users interested in purchasing these standards for their own use may do so at the places indicated at the end of this section.

## Reference Materials

The examination questions may be taken from and answerable from the following reference information.

American Society for Nondestructive Testing (ASNT). 2002. *Radiography and radiation testing*. Vol. 4 of *Nondestructive testing handbook*. 2nd ed. Vol. 3. Columbus, Ohio: American Society for Nondestructive Testing.

American Society for Nondestructive Testing (ASNT). 1983. *Making a radiograph*. Vol. IV of *Radiographic testing programmed instruction and classroom training books*. Columbus, Ohio: American Society for Nondestructive Testing.

American Society for Nondestructive Testing (ASNT). 1983. *Film handling and processing*. Vol. V of *Radiographic testing programmed instruction and classroom training books*. Columbus, Ohio: American Society for Nondestructive Testing.

American Society for Nondestructive Testing (ASNT). 1980. *NDE characteristics of pipe weld defects, EPRI. ASNT-1195*. Columbus, Ohio: American Society for Nondestructive Testing.<sup>4</sup>

Hellier, C., and Wheeler, G., 2004. *Radiographic interpretation*. : American Society for Nondestructive Testing, Columbus, OH

American Welding Society (AWS) Committee on Methods of Inspection. 2000. *Welding inspection handbook*, 3rd ed. Miami: American Welding Society.

Connor, L. P., ed. 1987. *Welding processes*. Vol.1 of *Welding handbook*. 8th ed. Miami: American Welding Society.

American Welding Society (AWS) Committee on Methods of Inspection. 1999. *Guide for the nondestructive examination of welds*. AWS B1.10:1999. Miami: American Welding Society.

Note: AWS, API, ASTM, and ASME standards are available through WEX, 2671 West 81<sup>st</sup> Street, Hialeah, FL, 33016. Telephone: 888-WELDING (888 935-3646). Website: [www.aws.org/standards](http://www.aws.org/standards)

ASNT documents are available from the American Society for Nondestructive Testing, PO Box 28518, 1711 Arlingate Lane, Columbus, Ohio 43228-0518. Telephone: 800-222-2768.

Website: [www.asnt.org](http://www.asnt.org)