

AWS B5.15:2003
An American National Standard



Specification for the Qualification of Radiographic Interpreters



American Welding Society



Key Words—Interpreter, radiograph, inspector,
qualification

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Specification for the Qualification of Radiographic Interpreters

Prepared by
AWS Subcommittee on NDE Personnel

Under the Direction of
AWS Personnel and Facility Qualification Committee

Approved by
AWS Board of Directors

Abstract

This specification defines the requirements for the qualification of Radiographic Interpreters. The qualification of radiographic interpreters requires experience, knowledge, and skills unique to the interpretation of radiographic media and the determination of acceptance criteria for weldments and adjacent base metal. Training and work experience in radiographic theory, procedures, weld and adjacent base metal defect recognition, radiographic processing, handling, storage, and code requirements relating to radiographic acceptance criteria are essential to ensuring the competence of individuals engaged in radiographic interpretation.



American Welding Society

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

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Foreword

(This Foreword is not a part of AWS B5.15:2003, *Specification for the Qualification of Radiographic Interpreters*, but is included for informational purposes only.)

The purpose of radiographic interpretation is to properly assess indications produced on radiographic media during the process of weldment or adjacent base metal evaluation. The Radiographic Interpreter must be thoroughly familiar with the process of radiography as well as the welding processes. This includes, but may not be limited to: welding processes, materials, limitation of various testing methods, drawings, procedures, specifications, behavior of different types of radioactivity (particles and photons), film construction, behavior of energy sensitive imaging systems, mathematics, radiographic film selection, handling and storage. For Radiographic Interpreters to be effective, they must not only be technically competent, but also consistent and ethically principled in their dealings with clients and employers.

This specification was developed by the Personnel and Facility Qualification Committee in response to an industry demand for a qualification document for radiographic interpreters. This specification establishes the qualification requirements from which a central certification agency or an employer may develop a certification program for radiographic interpreters. This is the first issue of this specification.

This specification provides the basis for establishing the method and requirements of qualifying persons engaged in the profession of radiographic interpretation. Personnel seeking qualification to this specification should be prepared to receive instruction by their employers with regard to specific duties required for employment. In addition to the competence level and areas specified herein, each employer must provide job orientation and/or training to ensure the competence of their employees.

Comments and suggestions for the improvement of this standard are welcomed. They should be sent to the Secretary, Personnel and Facility Qualification Committee, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

Official interpretations of any of the technical requirements of this standard may be obtained by sending a request, in writing, to the Managing Director, Technical Services Division, American Welding Society. A formal reply will be issued after it has been reviewed by the appropriate personnel following established procedures.

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Specification for the Qualification of Radiographic Interpreters

1. Scope

1.1 General. This specification establishes the requirements for qualification of radiographic interpreters. It describes how these personnel shall be qualified, establishes training requirements, defines experience requirements, and establishes areas and levels of knowledge required to perform the functions related to radiographic interpretation.

1.2 Training. The employer shall be responsible for providing job-specific training and/or orientation of the radiographic interpreter to ensure his/her understanding of the special requirements of the employer.

1.3 Personal Capabilities. It shall be the responsibility of the employer to determine if the radiographic interpreter is physically and mentally capable of performing the duties involved in the work assignment. Visual acuity requirements are specified in this specification. Mental capabilities shall include, but not be limited to, an ability to render fair and unbiased judgment and communicate said judgments to others in a manner which is helpful and well understood.

1.4 Rights of Employers. This specification is intended to supplement the requirements of an employer, standard, or other documents and shall not be construed as a pre-emption of the employer's rights and responsibilities for the quality of work provided under contract to others.

1.5 Terminology. As used in this specification, the word *shall* denotes a requirement; the word *should* denotes a guideline; and the word *may* denotes a choice.

2. Referenced Documents

(1) API 1104, *Welding of Pipelines and Related Facilities*¹

1. API standards are published by the American Petroleum Institute, 1220 L Street NW, Washington, DC 20005-4070.

- (2) ASME B31.1, *Power Piping*²
- (3) ASME B31.3, *Process Piping*
- (4) ASME BPVC Section VIII, Div I, *Rules for Construction of Pressure Vessels*
- (5) ASME BPVC Section I, *Power Boilers*
- (6) ASME BPVC Section V, *Nondestructive Examination*
- (7) AWS A3.0, *Standard Welding Terms and Definitions*³
- (8) AWS D1.1, *Structural Welding Code—Steel*
- (9) AWS D15.1, *Railroad Welding Specification—Cars and Locomotives*

3. Qualification

3.1 A radiographic interpreter meeting the requirements of Sections 6, 7, and 8 shall be considered qualified as a Radiographic Interpreter (RI).

3.2 Qualification of Radiographic Interpreters tested to the requirements of this specification shall remain in effect unless the Radiographic Interpreter has not been engaged in interpretation for a period exceeding six months.

4. Definitions

Specialized terms used in this specification are defined as follows. All other terms used in this specification are defined in AWS A3.0, *Standard Welding Terms and Definitions*.

2. ASME standards are published by ASME International, Information Central, P.O. Box 2300, Fairfield, NJ 07007-2300.

3. AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

acceptance criteria. Specified limits placed on characteristics of an item, process, or service defined in codes, other standards or other documents.

candidate. An individual seeking qualification.

media. Mechanisms used to display a radiographic image (e.g., film, digital images, or real-time displays).

Radiographic Interpreter (RI). A person capable by training and/or experience to perform the duties and responsibilities of radiographic interpretation.

5. Functions

The capabilities and duties of the RI shall be as follows:

5.1 Capabilities

5.1.1 The RI shall be physically and mentally able to perform radiographic interpretations and maintain records conforming to the requirements of the applicable standards and other documents.

5.1.2 The RI shall be able to assess the quality of radiographic media to verify its conformance with quality standards published in appropriate codes, specifications, or other standards.

5.1.3 The RI shall be capable of assessing images as well as the appearances of artifacts upon the radiographic media.

5.1.4 The RI shall be able to evaluate discontinuities in relation to standards or other mandatory requirements.

5.1.5 The RI shall be capable of evaluating the results of various radiographic exposure techniques including double wall view, single wall view, film side, source side, and double wall exposure. The RI shall be capable of understanding how the radiograph was processed in order to perform accurate interpretations.

5.1.6 The RI shall be capable of discussing his or her evaluations with others in order to permit their verification of results including physical excavation and visual confirmation, if necessary.

5.2 Duties. The radiographic interpreter's specific duties for an employer are defined by the employer; however, RIs shall be able to demonstrate an understanding of and the ability to perform the following duties:

5.2.1 Interpret drawings and other documents related to the film interpretation.

5.2.2 Verify proper selection, handling, and storage of the radiographic film prior to use.

5.2.3 Verify all required information for radiographic traceability and an image quality indicator is present and readable on the radiographic media.

5.2.4 Evaluate the radiographic images to the required acceptance criteria.

5.2.5 Document the acceptance or rejection of the work using the forms provided or developed for radiographic interpreter.

5.2.6 Mark repair/reject areas when required.

5.2.7 Produce clear and concise documented records of interpretations and radiographic media quality.

5.2.8 Discuss findings in order to permit corrective action and in order to permit root cause and corrective action.

6. Education, Training, and Experience Requirements

Each candidate for qualification as a Radiographic Interpreter shall meet the following minimum requirements:

6.1 Education Requirements. To be qualified as a Radiographic Interpreter, each individual shall hold a valid high school diploma, or General Equivalency Diploma (GED).

6.2 Training Requirements. Shall have a minimum of 40 hours of organized training in radiographic interpretation/examination. The training should include the topics contained in Section 9, Body of Knowledge.

6.3 Experience Requirements. Shall have a minimum of one year experience as a company or nationally certified individual in radiographic interpretation of media or under the direct supervision of such an individual. A maximum of six months experience may be substituted by one or a combination of the following:

6.3.1 Every month of post high school NDE or weld inspection education may be substituted for an equal number of months of radiographic interpretation experience; however, such substitution shall be acceptable by the employer. This acceptance shall be documented in the RI candidate's qualification record.

6.3.2 Every four months of experience as a certified (company or nationally) weld inspector using NDE methods other than radiography may be substituted for one month of radiographic interpretation experience.

6.3.3 Every four months of NDE weld inspection teaching experience may be substituted for one month of radiographic interpretation experiences, provided the

teaching experience is documented by the educational institution or organization employing the teacher.

Note: When substitution of 6 months experience is requested, NDE weld inspection experience, course participation or teaching experience may not accumulate concurrently in such a manner that the total number of months being substituted exceeds the number of months in the calendar interval in which it was accumulated. Under no circumstances will more than six months be substituted toward the experience requirements listed in 6.3.

6.3.4 Radiographic interpretation and/or NDE weld inspection experience shall have been gained under direct supervision of an individual who is company or nationally certified in radiographic interpretation (i.e., Radiographic Level II or III Inspector, NAVSEA Inspector or Examiner, Certified AWS Radiographic Interpreter). Direct supervision, for the purposes herein, means under the visual and audible control of another person.

7. Examination Requirements

7.1 General 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.

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

7.1.2 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, ASME B31.3, ASME B31.1, AWS D1.1, AWS D15.1, ASME Section VIII: Division 1, ASME Section I, ASME Section V, or others as new tests are developed.

7.1.3 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.

7.1.4 Composite Score Examination Requirements. A composite score based on simple averaging of the

three scores listed in 7.1.1, 7.1.2, and 7.1.3 shall be a minimum of 80% to successfully pass.

7.2 Examination Equipment. Equipment used to permit participants to view radiographic specimens shall be checked prior to use to ensure their proper operation. Other devices used to verify film density, etc., shall be calibrated and in good operating condition. Equipment shall be of a type and model which, as closely as possible, matches that needed to view and interpret production radiographs.

8. Visual Acuity

Good near-vision is necessary to perform the functions of the radiographic interpreter. The inability to differentiate relatively small indications on radiographic film may result in allowing weldments or adjacent base metal with rejectable defects to be placed into service. It is therefore important to ensure radiographic interpreters are capable of seeing adequately in the near field of 12 in. (305 mm) as this is typically the distance from the face to the viewed image.

8.1 Near Vision Acuity. Radiographic interpreters shall have the ability to read a minimum of Jaeger Number 2 letters at a minimum of 12 in. (305 mm) or better, in each eye.

9. Body of Knowledge

The following information should be used to create the course outline.

9.1 Nature and Properties of X and Gamma Radiation

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

9.2 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

9.3 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

9.4 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

9.5 X-Ray and Gamma Ray Equipment

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

9.6 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

9.7 Exposure Calculations

- (1) Effect of distance on exposure
- (2) Use of exposure charts and calculators for X and gamma radiography

9.8 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)

9.9 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

9.10 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, and 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

Course Duration: 40 Hours minimum

10. Examination Structure

10.1 Examination Basis Documents. The examination questions may be taken from and answerable from the following reference information.

1. American Society for Nondestructive Testing (ASNT). 1985. *Radiography and radiation testing*. Vol. 3 of *Nondestructive testing handbook*. 2nd ed. Vol. 3. Columbus, Ohio: American Society for Non-destructive Testing.⁴
2. American Society for Nondestructive Testing (ASNT). 1959. *Nondestructive testing handbook*. 1st

4. ASNT standards are published by the American Society for Nondestructive Testing, Inc., 1711 Arlingate Lane, Columbus, OH 43228-0518.

ed. Columbus, Ohio: American Society for Non-destructive Testing.

3. 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.
4. 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.
5. American Society for Nondestructive Testing (ASNT). 1980. *NDE characteristics of pipe weld defects*, EPRI. ASNT-1195. Columbus, Ohio: American Society for Nondestructive Testing.
6. Hellier, C., and S. Wenk, 1984. *Radiographic interpretation*. ASTN-008. Columbus, Ohio: American Society for Nondestructive Testing.
7. American Welding Society (AWS) Committee on Methods of Inspection. 2000. *Welding inspection handbook*, 3rd ed. Miami: American Welding Society.⁵
8. American Welding Society (AWS). 1995. *Practical reference guide to radiographic interpretation acceptance criteria*. Miami: American Welding Society.
9. Connor, L. P., ed. 1987. *Welding processes*. Vol. 1 of *Welding handbook*. 8th ed. Miami: American Welding Society.
10. American Welding Society (AWS) Committee on Methods of Inspection. 1999. *Guide for the non-destructive examination of welds*. AWS B1.10:1999. Miami: American Welding Society.

5. AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

Nonmandatory Annex

Annex A

Guidelines for Preparation of Technical Inquiries for AWS Technical Committees

(This Annex is not a part of AWS B5.15:2003, *Specification for the Qualification of Radiographic Interpreters*, but is included for informational purposes only.)

A1. Introduction

The AWS Board of Directors has adopted a policy whereby all official interpretations of AWS standards will be handled in a formal manner. Under that policy, all interpretations are made by the committee that is responsible for the standard. Official communication concerning an interpretation is through the AWS staff member who works with that committee. The policy requires that all requests for an interpretation be submitted in writing. Such requests will be handled as expeditiously as possible but due to the complexity of the work and the procedures that must be followed, some interpretations may require considerable time.

A2. Procedure

All inquiries must be directed to:

Managing Director Technical Services
American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

All inquiries must contain the name, address, and affiliation of the inquirer, and they must provide enough information for the committee to fully understand the point of concern in the inquiry. Where that point is not clearly defined, the inquiry will be returned for clarification. For efficient handling, all inquiries should be typewritten and should also be in the format used here.

A2.1 Scope. Each inquiry must address one single provision of the standard, unless the point of the inquiry involves two or more interrelated provisions. That provision must be identified in the scope of the inquiry, along

with the edition of the standard that contains the provisions or that the inquirer is addressing.

A2.2 Purpose of the Inquiry. The purpose of the inquiry must be stated in this portion of the inquiry. The purpose can be either to obtain an interpretation of a standard requirement, or to request the revision of a particular provision in the standard.

A2.3 Content of the Inquiry. The inquiry should be concise, yet complete, to enable the committee to quickly and fully understand the point of the inquiry. Sketches should be used when appropriate and all paragraphs, figures, and tables (or the Annex), which bear on the inquiry must be cited. If the point of the inquiry is to obtain a revision of the standard, the inquiry must provide technical justification for that revision.

A2.4 Proposed Reply. The inquirer should, as a proposed reply, state an interpretation of the provision that is the point of the inquiry, or the wording for a proposed revision, if that is what the inquirer seeks.

A3. Interpretation of Provisions of the Standard

Interpretations of provisions of the standard are made by the relevant AWS Technical Committee. The secretary of the committee refers all inquiries to the chairman of the particular subcommittee that has jurisdiction over the portion of the standard addressed by the inquiry. The subcommittee reviews the inquiry and the proposed reply to determine what the response to the inquiry should be. Following the subcommittee's development of the response, the inquiry and the response are presented to the entire committee for review and approval. Upon approval

by the committee, the interpretation will be an official interpretation of the Society, and the secretary will transmit the response to the inquirer and to the *Welding Journal* for publication.

A4. Publication of Interpretations

All official interpretations will appear in the *Welding Journal*.

A5. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning AWS standards should be limited to questions of a general nature or to matters directly related to the use of the standard. The Board of Directors' policy requires that all AWS Staff members respond to a telephone request for an official interpretation of any AWS standard with the information that such an interpretation can be obtained

only through a written request. The Headquarters staff cannot provide consulting services. The staff can, however, refer a caller to any of those consultants whose names are on file at AWS Headquarters.

A6. The AWS Technical Committee

The activities of AWS Technical Committees in regard to interpretations, are limited strictly to the Interpretation of provisions of standards prepared by the Committee or to consideration of revisions to existing provisions on the basis of new data or technology. Neither the committee nor the staff is in a position to offer interpretive or consulting services on: (1) specific engineering problems; or (2) requirements of standards applied to fabrications outside the scope of the document or points not specifically covered by the standard. In such cases, the inquirer should seek assistance from a competent engineer experienced in the particular field of interest.

