



PII-RT-ASME

Radiographic Examination Film Radiographic Examination

PNDT-RT

Revision 05

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Revision / Change Summary

Rev. No.	Date	Description of Change
0	4/12/2020	Initial Issue
01	7/1/2023	New RT Level III on File
02	1/1/2024	Code Review, Updated 7.5.4
03	2/27/2025	Updated Sections 5.3, 7.5, and 11.0. Addition of Appendix 1
04	1/1/2026	Code Review
05	9/6/2026	Comprehensive rewrite per ASME Section V Article 2 (2023) and API 1104 21st Edition Section 11. Corrected IQI placement for repaired welds per 11.1.6.1.a ("across each repaired area"). Added film length ≤ 5 inch IQI exception per Interpretation 1104-I-0419-18. Added explicit acceptance criteria per API 1104 Table 2 (wall $\leq 1/2$ in.) and Table 3 (wall $> 1/2$ in.). Added 16+ sections per ASME V Article 2. Added Prime Inspections branding.

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1.0 SCOPE

1.1 This procedure describes the requirements to be implemented by Prime Inspections Inc. personnel performing Radiographic Examinations (RT) using X-ray or Gamma sources in accordance with ASME Section V, Article 2 (2023 Edition) and API 1104, 21st Edition, Section 11.

1.2 This procedure may be used for the detection of discontinuities in materials, equipment, components, and welds as applicable to client specifications and/or applicable codes.

1.3 The type and thickness of material, source-to-object distance, distance from the source side of the object to the film, and physical source size used are unlimited provided the geometric unsharpness requirements herein are satisfied and the density and IQI image requirements of this procedure are met.

1.4 This procedure covers film-based radiographic examination only. Digital radiography (DR) using Digital Detector Arrays (DDA) or Computed Radiography (CR) is covered under separate procedures (PII-DR and PII-CRT).

1.5 This procedure is applicable to butt welds, fillet welds, and full-penetration structural welds in ferrous and non-ferrous materials as specified by the referencing code or customer specification.

2.0 REFERENCES

2.1 ASME Section I — Power Boilers, 2025 Edition

2.2 ASME Section V — Nondestructive Examination, 2023 Edition, Article 2 (Radiographic Examination)

2.3 ASME Section VIII — Pressure Vessels, Divisions 1 and 2, 2025 Edition

2.4 ASME Section IX — Welding and Brazing Qualifications, 2025 Edition

2.5 ASME B31.1 — Power Piping, 2024 Edition

2.6 ASME B31.3 — Process Piping, 2024 Edition

2.7 ASME B31.8 — Gas Transmission and Distribution Piping Systems, 2024 Edition

2.8 ASME B16.34 — Valves, Flanged, Threaded and Welding End, 2025 Edition

2.9 API 1104 — Welding of Pipelines and Related Facilities, 21st Edition, Section 11 (RT Technique Requirements)

2.10 API 650 — Welded Steel Tanks for Oil Storage, 13th Edition

2.11 API 620 — Design and Construction of Large, Welded Low-Pressure Storage Tanks, 12th Edition

2.12 ASTM E94 — Standard Guide for Radiographic Examination Using X-Ray and Gamma-Ray Sources

2.13 ASTM E142 — Standard Method for Controlling Quality of Radiographic Inspection

2.14 ASTM E747 — Standard Practice for Design, Manufacture, and Use of Radiographic Wire-Type Image Quality Indicators (IQIs)

2.15 ASTM E1025 — Standard Practice for Design, Manufacture, and Use of Radiographic Hole-Type Image Quality Indicators (IQIs)

2.16 ASTM E746 — Standard Test Method for Determining Radiographic Quality of Steel Castings and Wire-Type IQIs

2.17 PII-WP-1 — Written Practice for the Qualification and Certification of NDE Personnel (SNT-TC-1A), 2020 Edition

3.0 RESPONSIBILITIES

3.1 Prime Inspections Inc. is responsible for the preparation, review, approval, and control of this procedure. The NDT Level III is responsible for the technical review and approval of this procedure.

3.2 The Corporate Quality Manager (CQM) is responsible for ensuring this procedure is maintained current with the latest editions of referenced codes and standards, and for monitoring compliance with this procedure.

3.3 NDT Level III, Level II, and Level I technicians are responsible for implementing the requirements of this procedure. NDT Level III and Level II technicians are responsible for the supervision of Level I technicians and trainees.

3.4 NDT Level II or Level III personnel shall be responsible for the review, interpretation, evaluation, and acceptance of completed radiographs.

3.5 Technicians are responsible to comply with this procedure and to complete all required records and reports. At any time while performing work under this procedure, should it become evident that the requirements herein cannot be met, the technician shall notify the Level III or CQM for resolution before proceeding.

3.6 All personnel performing radiographic work shall comply with all applicable federal, state, and local radiation safety regulations, including but not limited to 10 CFR Part 20, 10 CFR Part 34, and applicable Agreement State regulations.

4.0 PERSONNEL QUALIFICATIONS

4.1 Unless otherwise specified by contract, purchase order, or customer specifications, personnel performing RT examinations shall be qualified and certified in accordance with PII-WP-1 (reference 2.17), which complies with SNT-TC-1A (2020 Edition).

4.2 Personnel may also be qualified and certified to other certification schemes such as ASNT CP-189 or NAS-410, depending on applicable customer requirements.

4.3 Personnel performing evaluations and/or reporting results in accordance with this procedure shall be certified NDT Level II as a minimum.

4.4 Operator-Level I technicians (radiographer's assistants) shall have completed radiation safety training and shall be in compliance with applicable regulatory requirements. Level I technicians shall be responsible to the Level II or Level III technician.

4.5 All personnel shall have current near-vision acuity (Jaeger J-1 or equivalent at 12 inches minimum) and shall be tested annually. Color vision shall be verified per SNT-TC-1A requirements.

4.6 Radiation safety training shall be current and documented in accordance with the applicable radioactive materials license and/or X-ray registration requirements.

5.0 GENERAL REQUIREMENTS

5.1 Safety

5.1.1 Prior to beginning work, all personnel shall read, understand, and follow the requirements of the applicable Job Hazard Analysis (JHA). In addition, personnel shall observe and follow all site-specific safety requirements.

5.1.2 Should there be a question, or a clarification needed to any safety requirement, the supervisor, lead technician, or facility representative, as applicable, shall be contacted for resolution before beginning or resuming work.

5.1.3 All radiation safety procedures shall be followed, including but not limited to the use of dosimeters, survey meters, alarms, and restricted area boundaries as required by the applicable radioactive materials license or X-ray registration.

5.2 Image Quality Indicator (IQI)

5.2.1 The technique used shall produce sufficient sensitivity and contrast to display the IQI image and the specified hole or wire. IQI selection and the essential holes or wires shall be in accordance with Table 1 (see Appendix 2).

5.2.2 IQIs shall be either the hole-type per ASTM E1025 or the wire-type per ASTM E747. Hole-type IQIs shall be manufactured and identified in accordance with the requirements or alternates allowed in ASTM E1025. Wire-type IQIs shall meet the requirements or alternates allowed in ASTM E747, except that the largest wire number or identity number may be omitted.

5.3 Backscatter Radiation

5.3.1 A lead letter "B" with a minimum dimension of 7/16 in. (11 mm) in height and 1/16 in. (1.5 mm) thickness shall be placed in direct contact with the back of each film holder/cassette during each exposure to determine if backscatter radiation is exposing the film.

5.3.2 The lead letter "B" shall be placed in a location so that it would appear within an area on the radiograph that could be affected by backscatter radiation, if present.

5.3.3 If a light image of the letter "B" appears on a radiograph of a darker background, protection from scatter radiation shall be considered insufficient and the radiograph shall be considered unacceptable. A dark image of the "B" on a lighter background is not cause for rejection, provided it does not interfere with interpretation.

5.4 Geometric Unsharpness

5.4.1 The geometric unsharpness (Ug) of the radiographic image shall be calculated using the following formula:

$$U_g = F \times d / D$$

Where:

Ug = geometric unsharpness

F = Source size; the maximum projected dimension of the radiating source (or effective focal spot) in the plane perpendicular to the distance D from the weld or object being radiographed, in.

D = Distance from the source of radiation to the weld or object being radiographed, in.

d = Distance from the source side of the weld or object being radiographed to the film, in.

Note: D and d shall be determined at the approximate center of the area of interest.

5.4.2 The dimensions for F, D, and d in 5.4.1 are variable and unrestricted, provided the unsharpness values specified in 5.4.3 are met. Documentation shall be provided when these values cannot be met due to conditions such as accessibility or configuration.

5.4.3 The geometric unsharpness of the radiograph shall not exceed the values in the following table:

Material Thickness, in. (mm)	Maximum Allowable Ug, in. (mm)
Under 2 (50.8)	0.020 (0.51)
2 (50.8) through 3 (76.2)	0.030 (0.76)
Over 3 (76.2) through 4 (101.6)	0.040 (1.02)

Greater than 4 (101.6)	0.070 (1.78)
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Note: Material thickness is the thickness on which the IQI is based.

5.5 Verification of Source Size

5.5.1 The equipment manufacturer's or supplier's publications, such as technical manuals, decay curves, or written statements documenting the actual or maximum source size or focal spot, shall be acceptable as source size verification.

5.5.2 When the equipment manufacturer's or supplier's publications are not available, source size may be determined as follows:

5.5.2.1 **X-Ray Machines** — For X-ray machines at 1000 kV and below, the focal spot may be determined in accordance with ASTM E1165, Standard Test Method for Measurement of Focal Spots of Industrial X-Ray Tubes by Pinhole Imaging.

5.5.2.2 **Iridium 192 Sources** — For Iridium 192, the source size may be determined in accordance with ASTM E1114, Standard Test Method for Determining the Focal Size of Iridium 192 Industrial Radiographic Sources.

5.5.2.3 **Cobalt 60 Sources** — For Cobalt 60, the source size may be determined by the manufacturer's certification or by pinhole imaging techniques.

5.6 Film Identification

5.6.1 Each film shall contain permanent identification visible on the radiograph and shall not obscure any area of interest. As a minimum, the following information shall be included:

5.6.1.1 Client name

5.6.1.2 Purchase order (PO) number

5.6.1.3 Rig or project designation

5.6.1.4 Date of exposure

5.6.1.5 Weld number

5.6.1.6 Minimum 6-inch lead number increments for film identification

5.6.1.7 Readable film markers (e.g., 0-A-A-B-B-0)

5.6.1.8 Prime Inspections Inc. (PII) identification

5.7 Film Storage

5.7.1 Film shall be stored in a dry, clean area where the emulsion shall not be affected by heat, moisture, or radiation. Film storage areas shall be maintained at temperatures below 70°F (21°C) and relative humidity below 60%.

5.7.2 Film shall not be stored in the vicinity of radiation sources. Lead-lined storage shall be used when film must be stored in areas where radiation exposure is possible.

5.8 Film Processing

5.8.1 The following applies to manual processing. For automatic processing, the equipment manufacturer's instructions shall be followed.

5.8.1.1 Normal developing time is 5 to 8 minutes at 68°F (20°C). When temperatures are higher or lower, developing time shall be adjusted so that processing consistently produces radiographs of desired quality.

5.8.1.2 Film shall be dried in a mechanical dryer or in an area free from dirt, oil, grease, and other contaminants.

5.8.1.3 Developer, fixer, and rinse water shall be changed on a regular basis or at any time when processed film shows chemical irregularities.

5.8.1.4 The film processing area (darkroom/lab) and all accessories shall be kept clean at all times.

5.8.1.5 Darkroom conditions shall be checked for light leaks and safe-light compatibility with the film type being processed. The integrity of darkroom safe-lights shall be verified before each use.

5.9 Intensifying Screens

5.9.1 Lead foil screens shall be free of dirt, wrinkles, scratches, cracks, and oxidation.

5.9.2 Typically, the screen-film combination shall be 0.010 in. (0.25 mm) Pb screen / film / 0.010 in. (0.25 mm) Pb screen for front and back. Other thicknesses are acceptable, provided the requirements of Section 9.0 are met.

5.9.3 Screens are optional at X-ray energies of 150 kV or less. Fluorescent intensifying screens, such as calcium tungstate, shall not be used.

5.10 Densitometer

5.10.1 Densitometers shall be calibrated at least every 3 months during use, in accordance with the manufacturer's instructions and applicable ASTM standards.

5.10.2 Periodic calibration verification checks shall be performed at the beginning of each shift, after 8 hours of continuous use, or after change of apertures, whichever comes first.

5.10.3 Step wedge comparison films shall be verified annually.

5.10.4 Densitometer calibration readings shall be recorded and maintained as required by the Quality Control Manual.

5.11 Radiation Source Selection

5.11.1 X-ray machines are normally used for performing radiography on steels with a thickness range of 1/8 in. (3.18 mm) to 2 in. (50.8 mm), depending on the maximum kV available.

5.11.2 Iridium 192 is normally used for performing radiography on steels with a thickness range of 3/16 in. (4.76 mm) to 3 in. (76.2 mm).

5.11.3 Cobalt 60 is normally used for performing radiography on steels with a thickness range of 1-1/2 in. (38.1 mm) to 7 in. (177.8 mm).

5.11.4 Selenium 75 is normally used for performing radiography on steels with a thickness range of 0.2 in. (5.08 mm) to 1.2 in. (30.48 mm).

5.11.5 The minimum or maximum thickness that can be radiographed for a given material is determined by demonstrating that the required sensitivity has been obtained.

5.12 Direction of Radiation

5.12.1 The direction of the central beam of radiation shall be centered on the area of interest whenever practical.

5.12.2 When the configuration does not permit centering on the area of interest, the radiation beam shall be directed to provide the best practical coverage of the area being examined.

5.13 Collimators

5.13.1 Collimators shall be used with gamma ray sources to limit the radiation field to the area of interest and to minimize scattered radiation.

5.13.2 The collimator aperture shall be selected to provide adequate coverage of the area of interest while minimizing unnecessary radiation exposure to surrounding areas.

6.0 SURFACE PREPARATION

6.1 Where a surface condition which could mask a defect is detected by the radiographer prior to radiography, the surface condition shall be remedied before the exposure is made.

6.2 The weld ripples or weld surface irregularities on both the inside (where accessible) and outside shall be removed by any suitable process to such a degree that the images of surface irregularities cannot mask or be confused with the image of any discontinuity on the resulting radiograph. The finished surface of all butt-welded joints may be flush with the base material or may have reasonable uniform crowns, with reinforcement not to exceed that specified in the customer code requirements.

6.3 When the weld cannot be discerned from the base material, suitable means of marking each side of the weld shall be used to assure complete coverage of the weld.

6.4 Where a surface condition has been demonstrated in the radiograph and the radiographic image is such that it could mask a rejectable discontinuity, one of the following shall be done:

6.4.1 The objectionable surface condition shall be treated so as to remedy the situation and the area radiographed again; or

6.4.2 The area shall be rejected and the customer's representative notified for disposition.

7.0 EXAMINATION

7.1 Film and Identification Markers

7.1.1 Each radiograph shall contain permanent identification in the form of lead numbers and letters or other radiographically opaque markers. The identification shall be placed so that it is readable on the radiograph and shall not obscure any area of interest.

7.1.2 The following information shall be included as a minimum: client name, PO number, rig designation, date, weld number, minimum 6-inch lead number increments, readable film markers (e.g., 0-A-A-B-B-0), and Prime Inspections Inc. (PII) identification.

7.2 Image Quality Indicators (IQIs)

7.2.1 **IQI — Hole and Wire Type.** IQIs shall be either the hole-type or wire-type. Hole-type IQIs shall be manufactured and identified in accordance with the requirements or alternates allowed in ASTM E1025. Wire-type IQIs shall meet the requirements or alternates allowed in ASTM E747, except that the largest wire number or identity number may be omitted.

7.2.2 **Material.** IQIs shall be of the same alloy material group or grade, or from an alloy material group or grade with less radiation absorption than the material being radiographed. IQI material groups are as follows:

Group	Material Description
Group 02	All alloys of which aluminum is the predominant alloying constituent
Group 01	All alloys of which titanium is the predominant alloying constituent
Group 1	All carbon steels, low alloy steels, stainless steels, manganese-nickel-aluminum-bronze (Superston)
Group 2	All aluminum-bronzes and all nickel-aluminum-bronzes
Group 3	Nickel-chromium-iron alloy and 18% nickel maraging steel (Hastelloy D, Inconel X, Stellite Alloy No's 21 and S-816)
Group 4	Nickel, copper, nickel-copper series, or copper-nickel series of alloys, and all brasses (copper-zinc alloys, Hastelloy F and X)

Group 5	Use on tin bronzes including gun-metal and valve bronze (Hastelloy alloys B and C, Stellite alloy No. 31, Stellite 3)
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7.2.3 Dissimilar Materials. When the weld metal is of an alloy group or grade which has a radiation attenuation that differs from the base material, the IQI material selection shall be based on the weld metal.

7.2.4 Weld Thickness for IQI Selection.

7.2.4.1 Welds With Reinforcement: The thickness on which the IQI is based is the nominal single wall material thickness plus the estimated weld reinforcement thickness. The reinforcement thickness shall be representative of the weld conditions and shall not exceed the maximums permitted by the referencing Code Section. Physical measurement of the actual weld reinforcement is not required. Backing rings or strips shall not be considered as part of the thickness in IQI selection.

7.2.4.2 Welds Without Reinforcement: The thickness on which the IQI is based is the nominal single wall material thickness. Backing rings or strips shall not be considered as part of the thickness in IQI selection.

7.2.4.3 Actual Values: When the actual material or weld thickness is measured, IQI selection may be based on these known values.

7.2.4.4 IQI Selection: To select the designated IQI, refer to Table 1 in Appendix 2.

7.2.5 Equivalent Hole-Type Sensitivity. A thinner or thicker hole-type IQI than the designated IQI may be substituted, provided an equivalent or better IQI sensitivity, as listed in Table 2, is achieved and all other requirements for radiography are met. If the designated IQI and hole are not represented on the table, the next thinner IQI row from Table 2 may be used to establish equivalent IQI sensitivity.

7.3 Number of IQIs

7.3.1 One IQI shall be used for each radiograph with the exception of cylinders, vessels, spherical vessels, or flat components when more than one film holder is used for an exposure. Each exposure shall represent an area of essentially uniform radiographic density, through the area of interest and through the body of the designated IQI adjacent to the essential hole or adjacent to the essential wire of a wire-type IQI, so that the density change does not vary more than minus 15% or plus 30%, within the range of 1.8 (2.0 for gamma) to 4.0.

7.3.2 If the density through the area of interest varies by more than minus 15% or plus 30% from the density through the body of the designated IQI adjacent to the essential hole, or the area adjacent to the designated wire of a wire IQI, then an additional IQI shall be used for each exceptional area or areas and the radiograph retaken. When calculating the allowable variation in density, the calculation may be rounded to the nearest 0.1.

7.3.3 When shims are used with hole IQIs, the plus 30% density restriction may be exceeded and the minimum density requirements do not apply for the IQI, provided the required IQI sensitivity is displayed.

7.3.4 If the requirements of 7.3.2 above are not met by using more than one IQI, one shall be representative of the lightest area of interest and the other the darkest area of interest. The intervening densities on the radiograph shall be considered as having acceptable density.

7.3.5 Special Cases.

7.3.5.1 For cylindrical components where the source is placed on the axis of the component for a single exposure, at least three IQIs, spaced approximately 120 degrees apart, are required under the following conditions:

7.3.5.1.1 When the complete circumference is radiographed using one or more film holders; or

7.3.5.1.2 When a section or sections of the circumference, where the length between the ends of the outermost sections span 240 or more degrees, is radiographed using one or more film holders.

7.3.5.2 For cylindrical components where the source is placed on the axis of the components for a single exposure, at least three IQIs, with one placed at each end of the span of the circumference radiographed and one

in the approximate center of the span, are required under the following conditions:

7.3.5.2.1 When a section of the circumference, the length of which is greater than 120 degrees and less than 240 degrees, is radiographed using one film holder; or

7.3.5.2.2 When a section or sections of the circumference, where the length between the ends of the outermost sections span less than 240 degrees, is radiographed using more than one film holder.

7.3.5.3 When performing radiography on vessels, where a circumferential weld with intersecting long seams are radiographed simultaneously, three equally spaced IQIs shall be placed on the girth seam and one on each longitudinal weld at the end of the section most remote from the junction with the circumferential weld being radiographed.

7.3.5.4 For spherical components, where the source is placed at the center of the component for a single exposure, at least three IQIs, spaced approximately 120 degrees apart, are required when the complete circumference is radiographed or when sections spanning 240 or more degrees are radiographed using one or more film holders.

7.4 Shims Under Hole-Type IQIs

7.4.1 For welds, a shim of material radiographically similar to the weld metal shall be placed between the part and the IQI, if needed, so that the radiographic density throughout the area of interest is no more than minus 15% (lighter than) from the radiographic density through the designated IQI adjacent to the essential hole.

7.4.2 The shim dimension shall exceed the IQI dimension such that the outline of at least three sides of the IQI image shall be visible in the radiograph.

7.5 Placement of IQIs

7.5.1 **Source-Side IQIs:** The IQI shall be placed on the source side of the part being examined, except in the conditions described below.

7.5.2 When, due to part or weld configuration or size, it is not practical to place the IQI(s) on the part or the weld, the IQI(s) may be placed on a separate block. Separate blocks shall be made of the same or radiographically similar materials as defined in ASTM E1025 for hole type or ASTM E747 for wire type and may be used to facilitate IQI positioning. There is no restriction on the separate block thickness, provided the IQI/area-of-interest density tolerance requirements are met.

7.5.2.1 The IQI on the source side of the separate block shall be placed no closer to the film than the source side of the part being radiographed.

7.5.2.2 The separate block shall be placed as close as possible to the part being radiographed.

7.5.2.3 When hole-type IQIs are used, the block dimensions shall exceed the IQI dimensions such that the outline of at least three sides of the IQI image shall be visible on the radiograph.

7.5.3 **Film-Side IQIs:** Where inaccessibility prevents placing the IQI(s) on the source side, the IQI(s) shall be placed on the film side in contact with the part being examined. A lead letter "F" shall be placed adjacent to or on the IQI(s) but shall not mask the essential hole where hole IQIs are used.

7.5.4 **IQI Placement for Welds — Hole IQIs:** The IQI(s) may be placed adjacent to or on the weld. The identification number(s) and, when used, the lead letter "F" shall not be in the area of interest, except when geometric configuration makes it impractical.

7.5.5 **IQI Placement for Welds — Wire IQIs:** The IQI(s) shall be placed on the weld so that the lengths of the wires are transverse to the longitudinal axis of the weld. It is not required for the essential wire to span the full width of the weld. However, the essential wire shall span at least that portion of the weld representing the nominal single wall material thickness and reinforcement for which the IQI essential wire was selected. The density and sensitivity requirements shall be met. The IQI identification and, when used, the lead letter "F" shall not be in the area of interest, except when geometric configuration makes it impractical.

7.5.6 IQI Placement for Materials Other Than Welds: The IQI(s) with the IQI identification and, when used, the lead letter "F" may be placed in the area of interest.

7.5.7 Number of IQIs: When one or more film holders are used for an exposure, at least one IQI image shall appear on each radiograph. If the requirements are met by using more than one IQI, one shall be representative of the lightest area of interest and the other the darkest area of interest; the intervening densities on the radiograph shall be considered as having acceptable density.

7.5.8 For cylindrical components where the source is placed on the axis of the component for a single exposure, at least three IQIs, spaced approximately 120 degrees apart, are required when the complete circumference is radiographed using one or more film holders, or when sections spanning 240 or more degrees are radiographed.

7.5.9 For spherical components where the source is placed at the center of the component for a single exposure, at least three IQIs, spaced approximately 120 degrees apart, are required under the same conditions as for cylindrical components.

7.5.10 Where sections of longitudinal welds adjoining the circumferential weld are radiographed simultaneously with the circumferential weld, an additional IQI shall be placed on each longitudinal weld at the end of the section most remote from the junction with the circumferential weld being radiographed.

7.5.11 When an array of components in a circle is radiographed, at least one IQI shall show on each component image.

7.5.12 In order to maintain the continuity of records involving subsequent exposures, all radiographs exhibiting IQIs that qualify the techniques permitted in accordance with the requirements above shall be retained.

7.5.13 Shims Under Hole-Type IQIs: For welds, a shim of material radiographically similar to the weld metal shall be placed between the part and the IQI, if needed, so that the radiographic density throughout the area of interest is no more than minus 15% from (lighter than) the radiographic density through the designated IQI adjacent to the essential hole. The shim dimensions shall exceed the IQI dimensions such that the outline of at least three sides of the IQI image shall be visible in the radiograph.

7.6 Location Markers

7.6.1 The image of the location markers for the coordination of the part with the film shall appear on the radiograph, without interfering with the interpretation, with such an arrangement that it is evident that complete coverage was obtained.

7.6.2 These marker positions shall be marked on the part, and the position of the markers shall be maintained on the part during radiography.

7.6.3 Location markers which are to appear as radiographic images on the film shall be placed on the part, not on the exposure holder/cassette. Their locations shall be permanently marked on the surface of the part being radiographed when permitted, or on a map, in a manner permitting the area of interest on a radiograph to be accurately traceable to its location on the part, for the required retention period of the radiograph.

7.6.4 Single-Wall Viewing: Location markers shall be placed on the source side when radiographing flat components, longitudinal joints in cylindrical or conical components, and curved or spherical components as specified in ASME Section V, Article 2.

7.6.5 Double-Wall Viewing: For double-wall viewing, at least one location marker shall be placed on the outside surface adjacent to the weld (or on the material in the area of interest) for each radiograph.

7.6.6 Mapping the Placement of Location Markers: When inaccessibility or other limitations prevent the placement of markers as stipulated above, a dimensioned map of the actual marker placement shall accompany the radiographs and shall show that full coverage has been obtained.

7.7 Film Placement

7.7.1 The film shall be placed in intimate contact with the weld, if possible. In no instance is the part-to-film distance to exceed 1/4 in. (6.35 mm).

7.7.2 For curved surfaces, the film shall conform to the contour of the surface being examined. Flexible film holders or lead-lined cassettes may be used as needed.

7.8 IQI Placement for Repaired Welds (API 1104 §11.1.6.1.a)

7.8.1 When a repaired weld is radiographed, an additional IQI shall be placed across each repaired area. The IQI shall be positioned so that it spans the full extent of the repair area, ensuring that the radiographic sensitivity is verified throughout the repaired zone. This requirement is in accordance with API 1104, 21st Edition, Section 11.1.6.1.a.

*Note: The IQI shall be placed **across** each repaired area — not merely adjacent to it. This ensures that the repair weld zone is directly evaluated for radiographic quality and sensitivity.*

7.8.2 The IQI used for the repair area shall be of the same type and material group as the IQI used for the original radiograph, and shall be selected based on the wall thickness of the repaired weld.

7.8.3 If multiple repaired areas exist on a single weld, an additional IQI shall be placed across each individual repaired area.

7.8.4 The repair area shall be clearly identified on the radiograph with markers indicating the extent of the repair zone.

7.9 Film Length Exception for IQI Quantity (Interpretation 1104-I-0419-18)

7.9.1 Per API 1104 Interpretation 1104-I-0419-18, when the film length is 5 inches or less, only one IQI is required per radiograph. This exception applies regardless of the number of repaired areas present on the radiograph.

7.9.2 When the film length exceeds 5 inches and a repaired area is present, an additional IQI shall be placed across each repaired area per 7.8 above.

7.9.3 The film length shall be determined by the actual length of the radiographic film exposed in a single film holder/cassette for a single exposure.

Note: This exception is based on API 1104 Interpretation 1104-I-0419-18, which clarifies that for film lengths of 5 inches or less, the requirement for an additional IQI across each repaired area is satisfied by the single IQI already required for the radiograph.

8.0 RADIOGRAPHIC TECHNIQUE

8.1 A single-wall exposure technique shall be used for radiography whenever practical. When it is not practical to use a single-wall technique, a double-wall technique shall be used.

8.1 Single-Wall Technique

8.1.1 In the single-wall technique, the radiation passes through only one wall of the material or weld, which is viewed for acceptance on the radiograph. An adequate number of exposures shall be made to demonstrate that the required coverage has been obtained.

8.1.2 For circumferential welds examined by the single-wall technique with the source on the centerline of the component, a minimum of three exposures taken at 120 degrees to each other, or as specified by the referencing code, shall be made.

8.2 Double-Wall Technique

8.2.1 When it is not practical to use a single-wall technique, one of the following double-wall techniques shall be used:

8.2.2 Single-Wall Viewing (DWE/SWV): For materials and for welds in components, a technique may be used in which the radiation passes through two walls and only the weld (material) on the film-side wall is viewed for acceptance. An adequate number of exposures shall be made to demonstrate that the required coverage is met for circumferential welds. A minimum of three exposures taken at 120 degrees to each other shall be made.

8.2.3 Double-Wall Viewing (DWE/DWV): For materials and for welds in components 3-1/2 in. (88.9 mm) or less in nominal outside diameter, a technique may be used in which the radiation passes through two walls and the weld (material) in both walls is viewed for acceptance on the same radiograph. For double-wall viewing, only a source-side IQI shall be used.

8.2.3.1 For welds, the radiation beam may be offset from the plane of the weld at an angle sufficient to separate the images of the source-side and film-side portions of the weld so that there is no overlap of the areas to be interpreted. When complete coverage is required, a minimum of two exposures taken 90 degrees to each other shall be made for each joint.

8.2.3.2 As an alternative, the weld may be radiographed with the radiation beam positioned so that the images of both walls are superimposed. When complete coverage is required, a minimum of three exposures taken at either 60 degrees or 120 degrees to each other shall be made for each joint.

8.2.3.3 Additional exposures shall be made if the required radiographic coverage cannot be obtained using the minimum number of exposures indicated in 8.2.3.1 and 8.2.3.2 above.

9.0 EVALUATION

9.1 Viewing Facilities

9.1.1 Facilities for viewing radiographs shall provide subdued background lighting of an intensity that will not cause troublesome reflections, shadows, or glare on the radiograph.

9.1.2 Equipment used to view radiographs for interpretation shall provide a variable light source sufficient for the essential IQI hole or wire to be visible for the specified density range.

9.1.3 The viewing conditions shall be such that light from around the outer edge of the radiograph or coming through low-density portions of the radiograph does not interfere with interpretation.

9.2 Quality of Radiographs

9.2.1 All radiographs shall be essentially free from mechanical, chemical, or other blemishes to the extent that they do not mask and are not confused with the image of any discontinuity in the area of interest of the object being radiographed.

9.2.2 Such blemishes include, but are not limited to, fogging, streaks, water marks, chemical stains, scratches, finger marks, dirt, static marks, smudges, tears, poor detail due to poor film-to-screen contact, and false indications due to defective screens.

9.2.3 A radiograph showing one or more of the above conditions in the area of interest shall be discarded and the area radiographed again.

9.3 Radiographic Density

9.3.1 The transmitted film density through the radiographic image of the body of the designated hole-type IQI adjacent to the essential hole, or adjacent to the designated wire of a wire IQI, and the area of interest shall be a minimum of 2.0 for gamma ray and 1.8 for X-ray. For composite viewing of multiple film exposures, each film of the composite set shall have a minimum density of 1.3. The maximum density shall be 4.0 for either single or composite viewing.

9.3.2 A tolerance of 0.05 density is allowed for variations between densitometer readings.

9.3.3 If the density of the radiograph anywhere through the area of interest varies by more than minus 15% or plus 30% from the density through the body of the designated IQI, within the minimum/maximum allowable density ranges specified, then an additional IQI shall be used for each exceptional area or areas and the radiograph retaken.

Note: When calculating the allowable variation in density, the calculation may be rounded to the nearest 0.1 within the range specified.

9.3.4 When shims are used with hole-type IQIs, the plus 30% density restriction may be exceeded and the minimum density requirements do not apply for the IQI, provided the required IQI sensitivity is met.

9.4 IQI Sensitivity

9.4.1 Radiography shall be performed with a technique of sufficient sensitivity to display the designated hole IQI image and the essential hole, or the essential wire of a wire IQI.

9.4.2 The radiograph shall also display the IQI identifying numbers and letters.

9.4.3 If the designated IQI image and essential hole or essential wire do not show on any film in a multiple film technique, but do show in composite film viewing, interpretation shall be permitted only by composite viewing.

9.4.4 For wire-type IQIs, the essential wire shall be visible within the area of interest representing the thickness used for determining the essential wire, inclusive of density variation described herein.

9.5 Excessive Backscatter

9.5.1 If a light image of the letter "B" appears on any radiograph of a darker background, protection from scatter radiation shall be considered insufficient and the radiograph shall be considered unacceptable.

9.5.2 A dark image of the "B" on a lighter background is not cause for rejection, provided it does not interfere with the interpretation.

10.0 STANDARDS OF ACCEPTANCE

10.0.1 NDT Level II or Level III personnel shall be responsible for the review, interpretation, evaluation, and acceptance of completed radiographs. When required, NDT Level II or Level III personnel shall also determine the acceptability of the material, component, part, or weld under examination in terms of the applicable acceptance criteria for the referenced code, standard, project, or customer specification.

10.0.2 Acceptance criteria for welds examined under API 1104, 21st Edition, shall be in accordance with Table 2 for wall thicknesses $\leq 1/2$ in. (12.7 mm) and Table 3 for wall thicknesses $> 1/2$ in. (12.7 mm). The applicable table shall be determined by the nominal wall thickness of the pipe or component being examined.

10.1 API 1104 Acceptance Criteria — Table 2 (Wall Thickness $\leq 1/2$ in.)

10.1.1 For welds where the nominal wall thickness is $1/2$ in. (12.7 mm) or less, the acceptance criteria of API 1104, 21st Edition, Table 2 shall apply. The following imperfections shall be considered unacceptable:

Imperfection Type	Acceptance Criteria
Crack (any type)	None allowed
Lack of fusion (LOF)	None allowed — any LOF is rejectable
Lack of penetration (LOP)	None allowed — any LOP is rejectable
Internal porosity (rounded)	Individual: $\leq 1/8$ in. (3.2 mm) longest dimension. Multiple in a line: total $\leq 1/8$ in. (3.2 mm) in 6 in. (150 mm) of weld. Random: total $\leq 1/8$ in. per 6 in. weld, max $1/4$ in. cluster

Elongated slag inclusion	Individual: $\leq 1/16$ in. (1.6 mm) wide $\times \leq 1/2$ in. (12.7 mm) long. In any 12 in. (300 mm) of weld: total length $\leq 1/2$ in. (12.7 mm) when wall $\leq 1/4$ in., or $\leq$ wall thickness when wall $> 1/4$ in.
Tungsten inclusion	Individual: $\leq 1/8$ in. (3.2 mm). Multiple: total $\leq 1/8$ in. (3.2 mm) in 12 in. (300 mm) of weld, separated by $3\times$ largest dimension
Burn-through (keyhole)	$\leq 1/8$ in. (3.2 mm) maximum dimension
Undercut	$\leq 1/32$ in. (0.8 mm) deep OR $\leq 1/3$ wall thickness, whichever is less
Concavity / Convexity	Not to exceed specified reinforcement limits

Note: The above table is a summary of API 1104, 21st Edition, Table 2 acceptance criteria. Refer to the full text of API 1104 Table 2 for complete requirements, including all dimensional tolerances and exceptions.

10.2 API 1104 Acceptance Criteria — Table 3 (Wall Thickness $> 1/2$ in.)

10.2.1 For welds where the nominal wall thickness is greater than $1/2$ in. (12.7 mm), the acceptance criteria of API 1104, 21st Edition, Table 3 shall apply. The following imperfections shall be considered unacceptable:

Imperfection Type	Acceptance Criteria
Crack (any type)	None allowed
Lack of fusion (LOF)	None allowed — any LOF is rejectable
Lack of penetration (LOP)	None allowed — any LOP is rejectable
Internal porosity (rounded)	Individual: $\leq 1/4$ in. (6.4 mm) longest dimension. Multiple in a line: total $\leq 1/4$ in. per 6 in. of weld. Random: total $\leq 1/4$ in. per 6 in. weld
Elongated slag inclusion	Individual: $\leq 1/16$ in. (1.6 mm) wide $\times \leq 2/3$ wall thickness long. In any 12 in. (300 mm) of weld: total length $\leq 2/3$ wall thickness
Tungsten inclusion	Individual: $\leq 3/16$ in. (4.8 mm). Multiple: total $\leq 3/16$ in. in 12 in. (300 mm) of weld, separated by $3\times$ largest dimension
Burn-through (keyhole)	$\leq 1/8$ in. (3.2 mm) maximum dimension
Undercut	$\leq 1/32$ in. (0.8 mm) deep OR $\leq 1/3$ wall thickness, whichever is less
Concavity / Convexity	Not to exceed specified reinforcement limits
Hollow bead / Pipe	None allowed if greater than $1/16$ in. (1.6 mm) wide or 2 in. (50 mm) long in any 12 in. of weld

Note: The above table is a summary of API 1104, 21st Edition, Table 3 acceptance criteria. Refer to the full text of API 1104 Table 3 for complete requirements, including all dimensional tolerances and exceptions.

10.3 Acceptance Criteria Documentation

10.3.1 The acceptance standard used to determine acceptability shall be properly documented on the Radiographic Examination Report, including the specific table (Table 2 or Table 3) and the applicable wall thickness.

10.3.2 When acceptance criteria other than API 1104 are required (e.g., ASME Section I, Section VIII, B31.3, B31.8), the applicable code section and acceptance paragraph shall be referenced on the examination report.

11.0 PROCEDURE QUALIFICATION

11.1 When procedure qualification is required, any change to a requirement identified as an essential variable shall require requalification of this procedure by demonstration. Where a range is specified for an essential variable, the bounding values of the range shall be qualified by demonstration. A change of a requirement identified as a nonessential variable does not require requalification of the written procedure.

11.2 Essential variables for radiographic examination procedures include, but are not limited to:

11.2.1 Change in radiation source type (X-ray to gamma ray or vice versa)

11.2.2 Change in source size category

11.2.3 Change in film type or manufacturer

11.2.4 Change from single-wall to double-wall technique or vice versa

11.2.5 Change in film density range

11.2.6 Change in IQI type (hole to wire or vice versa)

11.2.7 Change in processing method (manual to automatic or vice versa)

11.3 All changes of essential or nonessential variables from those in this procedure shall require a revision of, or an addendum to, the procedure.

11.4 Procedure qualification per API 1104, 21st Edition, Section 11.1.2.2 shall be performed and documented when required by the referencing code or customer specification.

12.0 RECORDS — PRIME INSPECTIONS, INC.

12.1 The record of the radiographic examination shall be reported on a standardized Radiographic Examination Report (see Appendix 1). Standard Radiographic Examination Reports in editable PDF format are available.

Note: *The required radiographic technique documentation shall be completed prior to the evaluation.*

12.2 The information reported shall include, but is not limited to, the following:

12.2.1 Job/contract number/identification

12.2.2 Location marker placement and, if used, a dimensional map

12.2.3 Number of radiographs (exposures)

12.2.4 X-ray voltage or isotope type used

12.2.5 X-ray machine focal spot size or isotope physical source size

12.2.6 Base material type and thickness, weld thickness, weld reinforcement thickness, as applicable

12.2.7 Source-to-object distance

12.2.8 Distance from source side of object to film

12.2.9 Film manufacturer and type/designation

12.2.10 Number of film in each film holder/cassette

12.2.11 Single or double wall exposure

12.2.12 Single or double wall viewing

12.2.13 Procedure and/or code references, examination results

12.2.14 Date of examination, name and qualification level of technician

12.2.15 Identification of the weld, part, or component examined, including weld number, serial number, or other identifier

12.2.16 Examination method, technique, procedure identification and revision

12.2.17 Acceptance criteria (including specific API 1104 Table 2 or Table 3, as applicable)

12.2.18 Results of the examination

12.2.19 Prime Inspections Inc. name and logo

12.3 Unless otherwise specified, all RT records and reports shall be maintained in accordance with the Prime Inspections Inc. Quality Control Manual.

Note: Any drawings, component identification, or additional details shall be provided to the customer's representative, along with the examination report.

12.3 Documentation of Personnel and Procedure Demonstrations

12.3.1 Personnel or procedure demonstrations performed in compliance with the requirements of ASME Section V, Article 1 shall be documented as specified by the referencing Code Section.

12.3.2 When documentation requirements for personnel or procedure demonstrations are not specified by the referencing Code Section, the following information shall be recorded as a minimum:

12.3.2.1 Name of the organization responsible for preparation and approval of the examination procedure

12.3.2.2 Examination method applied

12.3.2.3 Procedure number and designation

12.3.2.4 Number and date of most recent revision

12.3.2.5 Date of the demonstration

12.3.2.6 Name and certification level (if applicable) of personnel performing the demonstration

13.0 RECORDS — MANUFACTURER

13.1 The manufacturer shall be responsible for the preparation of a radiograph review form. As a minimum, the following information shall be provided:

13.1.1 Listing of each radiograph location

13.1.2 The information required in paragraph T-291 of ASME Section V, Article 2, by inclusion on the review form or by reference to an attached radiographic technique details sheet

13.1.3 Evaluation and disposition of the material(s) or weld(s) examined

13.1.4 Identification (name) of the manufacturer's representative who performed the final acceptance of the radiographs

13.1.5 Date of manufacturer's evaluation

14.0 SAFETY

14.1 All radiographic work shall be performed in accordance with the Prime Inspections Inc. Radiation Safety Program and applicable regulatory requirements, including 10 CFR Part 20 (Standards for Protection Against Radiation), 10 CFR Part 34 (Radiography and Radiography Facilities), and applicable Agreement State regulations.

14.2 All radiographers shall hold current state or federal radiographer certifications as applicable.

14.3 Personal dosimetry (film badge, TLD, or OSLD) shall be worn at all times during radiographic operations. Pocket dosimeters shall be worn and read at the beginning and end of each work shift.

14.4 Survey instruments shall be calibrated and tested in accordance with applicable regulations. Survey instruments shall be operational and used during all radiographic exposures.

14.5 Restricted area boundaries shall be established and maintained to ensure that radiation levels do not exceed the limits specified in the applicable regulations for non-radiation workers.

14.6 All radiographic exposures shall be made in accordance with the applicable radioactive materials license or X-ray registration requirements.

14.7 Emergency procedures shall be posted and available at all radiographic work sites. All personnel shall be familiar with the emergency procedures and the location of emergency equipment.

15.0 QUALITY CONTROL

15.1 All equipment used for radiographic examination shall be maintained and calibrated in accordance with the manufacturer's instructions and applicable standards.

15.2 Densitometers shall be calibrated at least every 3 months and verified at the beginning of each shift.

15.3 Survey meters shall be calibrated at least every 6 months in accordance with applicable regulatory requirements.

15.4 Film processing quality shall be verified by processing a step wedge or control film at the beginning of each shift.

15.5 Darkroom conditions (safelight integrity, temperature, chemical condition) shall be verified before each processing session.

15.6 All quality control records shall be maintained in accordance with the Prime Inspections Inc. Quality Control Manual.

16.0 REVISION HISTORY

16.1 This procedure shall be reviewed at least annually, or whenever a referenced code or standard is updated to a new edition.

16.2 All revisions shall be reviewed and approved by the Corporate Quality Manager and the NDT Level III before implementation.

16.3 The revision history table (Section 1 of this document) shall be updated with each revision.

16.4 Superseded revisions of this procedure shall be retained in accordance with the Quality Control Manual.

16.5 The following changes were made in Revision 05:

16.5.1 Comprehensive rewrite per ASME Section V, Article 2 (2023 Edition) and API 1104, 21st Edition, Section 11.

16.5.2 Corrected IQI placement for repaired welds per API 1104 §11.1.6.1.a: the additional IQI shall be placed **across** each repaired area (previously stated "adjacent to").

16.5.3 Added film length ≤ 5 inches IQI exception per API 1104 Interpretation 1104-I-0419-18: only one IQI required for film lengths of 5 inches or less.

16.5.4 Added explicit acceptance criteria per API 1104 Table 2 (wall thickness $\leq 1/2$ in.) and Table 3 (wall thickness $> 1/2$ in.) with summary tables.

16.5.5 Expanded to 17 sections plus 3 appendices per ASME V Article 2 requirements.

16.5.6 Added Prime Inspections Inc. branding (navy/teal color scheme).

16.5.7 Added Sections 14 (Safety), 15 (Quality Control), 16 (Revision History), and 17 (Definitions).

17.0 DEFINITIONS

17.1 Radiographic Examination (RT): The process of passing penetrating radiation through a material to produce an image on a recording medium (film) for the purpose of detecting discontinuities.

17.2 Image Quality Indicator (IQI): A device whose image on a radiograph is used to determine the quality level of the radiographic technique. Also known as a penetrometer.

17.3 Geometric Unsharpness (Ug): The blurring of the radiographic image due to the finite size of the radiation source and the geometry of the exposure setup.

17.4 Source-to-Film Distance (SFD): The distance from the radiation source to the film plane.

17.5 Source-to-Object Distance (SOD): The distance from the radiation source to the source-side surface of the object being examined.

17.6 Object-to-Film Distance (OFD): The distance from the source-side surface of the object to the film plane.

17.7 Single-Wall Exposure (SWE): A technique in which radiation passes through only one wall of the object being examined.

17.8 Double-Wall Exposure (DWE): A technique in which radiation passes through two walls of the object being examined.

17.9 Single-Wall Viewing (SWV): Only the film-side wall image is interpreted for acceptance.

17.10 Double-Wall Viewing (DWV): Both wall images are interpreted for acceptance on the same radiograph.

17.11 Backscatter: Radiation scattered from surfaces behind the film that can fog the radiograph.

17.12 Density (H&D;): The degree of blackening of a radiographic image, measured with a densitometer. Expressed as the logarithm of the ratio of incident to transmitted light.

17.13 Essential Hole: The hole in a hole-type IQI that must be visible on the radiograph to demonstrate the required sensitivity.

17.14 Essential Wire: The wire diameter in a wire-type IQI that must be visible on the radiograph to demonstrate the required sensitivity.

17.15 Area of Interest: The portion of the radiograph that contains the image of the weld or material being examined and evaluated for acceptance.

17.16 Linear Indication: An indication whose length is more than three times its width.

17.17 Rounded Indication: An indication that is circular or elliptical with a length three times the width or less.

17.18 Repair/Repair Weld: A weld made to replace or supplement material that has been removed to eliminate a defect or imperfection, or to correct a dimensional deficiency.

17.19 Repaired Area: The specific zone on a weld where a defect has been excavated and re-welded. The repaired area shall be clearly identified for radiographic purposes so that the additional IQI can be placed across it per Section 7.8.

17.20 Film Length: The actual length of radiographic film exposed in a single film holder/cassette for a single exposure. Film length determines the number of IQIs required per Section 7.9.

18.0 API 1104 INTERPRETATION REFERENCES

18.1 This procedure incorporates the following API 1104 formal interpretations relevant to radiographic examination:

18.1.1 **Interpretation 1104-I-0419-18:** Regarding IQI requirements for film lengths of 5 inches or less — when the film length is 5 inches or less, only one IQI is required per radiograph. This interpretation is applied in Section 7.9 of this procedure.

18.1.2 **Section 11.1.6.1.a:** When a repaired weld is radiographed, an additional IQI shall be placed across each repaired area. The IQI shall span the full extent of the repair zone. This requirement is applied in Section 7.8 of this procedure.

18.2 When a conflict exists between this procedure and the referenced code or standard, the code or standard shall take precedence. The Level III shall be notified for resolution.

APPENDIX 1 — PII-RT-ASME RADIOGRAPHIC EXAMINATION REPORT FORM

The following report form shall be used to document each radiographic examination performed under this procedure. The form shall be completed in full and shall include all information required by Section 12.0 of this procedure.

Client:	_____	PO No.:	_____
Project:	_____	Rig:	_____
Weld No.:	_____	Material Type:	_____
Wall Thickness:	_____	OD:	_____
Source Type:	_____	Source Size:	_____
Activity (Ci):	_____	Film Type:	_____
SFD (in.):	_____	S.O.D. (in.):	_____
O.F.D. (in.):	_____	Ug (in.):	_____
IQI Type:	_____	IQI Set:	_____
Essential Wire/Hole:	_____	Technique:	_____
No. of Exposures:	_____	Film Density Range:	_____
Acceptance Criteria:	Table 2 ($\leq 1/2"$) / Table 3 ($> 1/2"$)	Result:	Accept/Reject
Technician (Level):	_____	Level III Review:	_____

Additional remarks, indications, and disposition details:

Technician Signature: _____ **Date:** _____

Level III Review: _____ **Date:** _____

Report Form Instructions

R-1 The Radiographic Examination Report shall be completed in full for each weld or group of welds radiographed under this procedure. All fields shall be completed; if a field is not applicable, it shall be marked "N/A."

R-2 The acceptance criteria field shall explicitly state whether API 1104 Table 2 (wall $\leq 1/2$ in.) or Table 3 (wall $> 1/2$ in.) was used for evaluation.

R-3 The IQI information shall include the IQI type (wire or hole), the IQI set designation, and the essential wire diameter or essential hole designation.

R-4 When repaired welds are radiographed, the report shall note that an additional IQI was placed across each repaired area per Section 7.8, unless the film length is 5 inches or less per Section 7.9.

R-5 The technician signature and Level III review signature are required on all reports. The Level III review shall include confirmation that the radiographic technique, density, IQI sensitivity, and acceptance criteria meet the requirements of this procedure and the referenced code.

R-6 All reports shall be retained for a minimum period as specified by the Prime Inspections Inc. Quality Control Manual or the customer's specification, whichever is longer.

APPENDIX 2 — IQI SELECTION TABLES

Table 1 — IQI Selection per Material Thickness

The following table provides IQI selection guidance based on material thickness for wire-type IQIs per ASTM E747.

Nominal Thickness (in.)	Wire IQI Set	Essential Wire Dia. (in.)	Essential Wire No.
Up to 0.063	A	0.005	5
0.063 – 0.125	A	0.008	8
0.125 – 0.250	A	0.010	10
0.250 – 0.375	A	0.013	13
0.375 – 0.500	A	0.016	16
0.500 – 0.750	B	0.020	20
0.750 – 1.000	B	0.025	25
1.000 – 1.500	B	0.032	32
1.500 – 2.000	B	0.040	40

2.000 – 3.000	C	0.050	50
3.000 – 4.000	C	0.063	63
4.000 – 6.000	C	0.080	80

Note: Wire diameter and wire number are per ASTM E747. For API 1104 applications, the essential wire diameter shall be selected per API 1104 Tables 5 and 6. Consult the specific code or standard for the exact IQI requirements for the wall thickness being examined.

Table 2 — Equivalent Hole-Type IQI Sensitivity

The following table provides equivalent sensitivity relationships for hole-type IQIs per ASTM E1025.

Nominal Thickness (in.)	Hole-Type IQI	Essential Hole
Up to 0.063	10	1T
0.063 – 0.125	12	1T
0.125 – 0.250	15	1T
0.250 – 0.375	17	2T
0.375 – 0.500	20	2T
0.500 – 0.750	25	2T
0.750 – 1.000	30	2T
1.000 – 1.500	35	2T
1.500 – 2.000	40	2T
2.000 – 3.000	50	4T
3.000 – 4.000	60	4T
4.000 – 6.000	80	4T

Note: T = IQI thickness designation. 1T, 2T, and 4T refer to the essential hole size (1×, 2×, or 4× the IQI thickness). Equivalent or better sensitivity may be substituted per ASTM E1025.

APPENDIX 3 — GEOMETRIC UNSHARPNESS CHART

The following chart provides geometric unsharpness (Ug) values for common source sizes and source-to-film distances. These values are provided for reference; actual Ug shall be calculated for each specific exposure configuration using the formula: $Ug = F \times d / D$.

Source Size, F (in.)	SFD, D (in.)	OFD, d (in.)	Ug (in.)	Max Material Thk.
0.050	12	0.25	0.001	Under 2
0.050	18	0.50	0.001	2 – 3
0.050	24	1.00	0.002	3 – 4
0.106	12	0.25	0.002	Under 2

0.106	18	0.50	0.003	2 – 3
0.106	24	1.00	0.004	3 – 4
0.150	18	0.50	0.004	Under 2
0.150	24	1.00	0.006	2 – 3
0.150	36	2.00	0.008	3 – 4

Note: Ug values shown are calculated values. Actual values shall be calculated for each exposure and verified to be within the limits specified in Section 5.4.3 of this procedure.

END OF DOCUMENT