

RADIOGRAPHY EXAMINATION PROCEDURE FOR ASME BOILER, PRESSURE VESSEL AND PIPING

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1. SCOPE

- 1.1 This procedure shall be applied for the performance of Radiographic Examination on full penetration groove welding joints of steel material and their Heat Affected Zone area with thicknesses of 3 to 75 mm or equivalent thicknesses for material other than steel.
- 1.2 The materials, shapes, or sizes to be examined and the extent of the examination shall be as specified by the contracting documents (e.g. NDE Plan, Customer Specification, etc.)

2. CODES AND REFERENCES

- 2.1 ASME B & PV Code Section V Article 2 and Article 22, 2004 Edition Addenda July 1, 2006.
- 2.2 ASME B & PV Code Section VIII Div. 1 and 2, 2004 Edition Addenda July 1, 2006.
- 2.3 ASME B & PV Code Section I, 2004 Edition Addenda July 1, 2006.
- 2.4 ASME B & PV Code Section IX, 2004 Edition Addenda July 1, 2006.
- 2.5 ASME Pressure Piping Code B31.1, Power Piping, 2004 Edition.
- 2.6 ASME Pressure Piping Code B31.3, Process Piping, 2004 Edition.
- 2.7 Inspektindo Pratama's NDE Personnel Qualification and Certification Procedure Doc. No.: IPP-WP-01 Rev. 0 which is in compliance with SNT-TC-1A 2006 Edition

3. PERSONNEL QUALIFICATION

All personnel carry out Radiography Examination under this procedure shall be qualified and certified in accordance with Inspektindo Pratama's NDE Personnel Qualification and Certification Procedure Doc. No.: IPP-WP-01 Rev. 0 which is in compliance with SNT-TC-1A 2006 Edition. Alternatively, personnel certified by National Nuclear Energy Agency of Indonesia as in accordance to the requirements of SNI 19-6364-2000 may also perform Radiography Examination. These Personnel shall be subjected to customer's approval prior to mobilization.

4. SURFACE PREPARATION

The weld ripples or surface irregularities on both the inside (where accessible) and outside shall be removed by suitable process to such a degree that the resulting radiographic image due to any surface irregularities cannot mask or be confused with the image of any discontinuity. The finished surface of welding joints may be flushed with the base material or may have reasonably uniform crowns with reinforcement no to exceed that specified in the referencing Code Section.

5. EQUIPMENTS AND MATERIAL

- 5.1 Radiation Energy
Radiation energy utilized shall be Gamma-ray and shall **obtain the required density and IQI image requirements of this procedure**. As guidance in selecting radiation source together with their typical range for application in steel are given below.

Gamma-Ray Source	Radioactive Isotope	Typical range for application in steel
	Selenium-75	3 to 19 mm
	Iridium-192	6.4 to 75 mm

- 5.2 Intensifying Screen
Only **Lead Intensifying Screens** shall be used when performing radiography examination under this procedure. Lead intensifying screens 0.005 in. (0.125 mm) thick, both front and back placement shall be used. The lead screens shall be free of oxide coatings, wrinkles, dirt, grease, lint, and scratches. The lead intensifying screen shall be adjusted in intimate contact with the film during exposure.
- 5.3 Image Quality Indicator (IQI)
IQI(s) shall be of the wire type. IQI(s) shall be manufactured and identified in accordance with the requirements allowed in SE-747 ASME Section V Article 22.

5.4 Facilities for Viewing of Radiographs

Viewing facilities shall provide subdued background of an intensity lighting that will not cause some kind of traceable reflections, shadows, or glare on the radiograph. Viewer equipment used to view radiographs for the interpretation shall provide variable light source sufficient for the designated wire to be visible for the specified density range. The viewing conditions shall be such that any light from the outer edge of the radiograph or coming through low-density portions of the radiograph would not interfere with the interpretation.

5.5 Densitometer

Only a calibrated densitometer shall be used for judging film density. Calibration of densitometer and its documentation shall be in accordance with Par. 6.2 of this procedure.

5.6 Radiographic Film

Radiographs shall be made by using industrial radiographic films. **Type of film used and other constraints defined in this procedure shall achieve the density and IQI image requirements.** Film shall have sufficient length and shall be placed to provide at least 25 mm of film beyond the projected edge of the weld. Film widths shall be sufficient to depict all portions of the weld joint, including the HAZs, and shall provide sufficient additional space for the required wire IQI and film identification without infringing upon the area of interest in the radiograph. Film brands, types, should be as follow:

Iridium-192		
TRADEMARK	Film Type	Intended Fabrication Purposes
AGFA GEVEART	D7	Welds with thicknesses above 6.4 mm to 38 mm.
	D4	Welds with thickness below 6.4 mm or above 38 mm.
KODAK INDUSTREX	AA-400	Welds with thicknesses above 6.4 mm to 38 mm.
	MX-125	Welds with thickness below 6.4 mm or above 38 mm.
FUJI	IX-100	Welds with thicknesses above 6.4 mm to 38 mm.
	IX-50	Welds with thickness below 6.4 mm or above 38 mm.

Selenium-75		
TRADEMARK	Film Type	Intended Fabrication Purposes
AGFA GEVEART	D7	Welds with thicknesses above 5 mm to 12.7 mm.
	D4	Welds with thickness below 5 mm or above 12.7 mm.
KODAK INDUSTREX	AA-400	Welds with thicknesses above 5 mm to 12.7 mm.
	MX-125	Welds with thickness below 5 mm or above 12.7 mm.
FUJI	IX-100	Welds with thicknesses above 5 mm to 12.7 mm.
	IX-50	Welds with thickness below 5 mm or above 12.7 mm.

6. CALIBRATION

6.1 Source Size Verification

Supplier's technical specification, such as decay curves/charts, or written statements documenting the actual or maximum source size shall be acceptable as source size verification and shall be available at all times.

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6.2 Densitometers

Densitometers shall be calibrated within the last 90 days according to the following sequence:

1. A National standard step tablet or step wedge calibration film, traceable to a national standard step tablet and having at least 5 steps with neutral densities from at least 1.0 through 4.0 shall be used. The step wedge itself shall have been verified within the last year by comparison with a national standard step tablet.
2. The densitometer manufacturer's step-by-step instructions for the operation of the densitometer shall be followed.
3. The density steps closest to 1.0, 2.0, 3.0, and 4.0 on the national standard step tablet or step wedge calibration film shall be read.
4. The densitometer is acceptable if the density readings do not vary by more than ± 0.05 density units from the actual density stated on the national standard step tablet or step wedge calibration film.

This densitometer calibration reading shall be recorded in appropriate calibration log (see **Exhibit C**). At the minimum, the last calibration reading from the one that is presently applicable shall be maintained on file.

6.3 Periodic Calibration Verification of Densitometer

Periodic calibration verification checks of densitometer shall be performed as defined in Par. 6.2, at the beginning of each shift, after 8 hours of continuous use, or after change of apertures, whichever comes first. This periodic verification doesn't have to be recorded and maintained on file.

7. EXAMINATION PROCEDURE

7.1 Radiographic Techniques

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 exposure technique may be used. An adequate number of exposures shall be made to demonstrate that the required coverage has been obtained.

7.1.1 Single Wall Technique

In the single wall technique, the radiation passes through only one wall of the weld (material), which is viewed for acceptance on the radiograph.

7.1.2 Double Wall Technique

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

7.1.2.1 Single Wall Viewing. For materials and for weld in components with a nominal outside diameter greater than 3½ inches (89 mm), 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 on the radiograph. When complete coverage is required for circumferential welds (material), a minimum of three exposures taken 120° to each other shall be made.

7.1.2.2 Double Wall Viewing. For materials and welds which has 3½ inches (89 mm) or less in nominal outside diameter, a technique may be used in which the radiation pass 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. Care should be exercised to ensure that the allowable Geometric Unsharpness is not exceeded. If the Geometric Unsharpness requirement can not be met, then single wall viewing shall be used.

- (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 there is no overlap of the areas to be interpreted, in which case a minimum of two exposure taken at 90 degree to each other shall be made for each joint.

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- (2) Alternatively, the weld may be radiographed with the radiation beam positioned so that the image of both walls is superimposed. When complete coverage is required, a minimum of three exposures taken at either 60° or 120° to one another shall be made for each joint.
- (3) Additional exposure shall be made if the required radiographic coverage cannot be obtained using minimum number of exposure indicated in point (1) and (2) above.

7.2 Direction of Radiation

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

7.3 Minimum Source to Object Distance

The minimum source-to-object distance shall not be exceeded for any radiography examination under this procedure. It is based on the assumption that the required value for Ug (Geometric Unsharpness) stated in Table 1 below will not be exceeded. The formula of calculating the minimum source-to-object is as follow:

$$SOD_{min} = \frac{F \times SSOF}{Ug}$$

- Where:
- Ug = Geometric Unsharpness, in. (mm)
 - F = the maximum projected dimension of the radiating source in the plan perpendicular to the distance SOD from the weld or object being radiographed, in. (mm)
 - SOD_{min} = minimum distance from source of radiation to weld or object being radiographed, in. (mm)
 - SSOF = distance from the source side of weld or object being radiographed to the film, in. (mm)
 - SOD_{min} and SSOF shall be determined at the approximate center of the area of interest.

Unless a more restrictive specification is to be applied, Geometric Unsharpness of the radiograph shall not exceed the following:

Table 1 – Maximum Geometric Unsharpness

Material Thickness, in. (mm)	Ug max, in. (mm)
Under 2 (<50.8)	0.020 (0.51)
2 through 3 (50.8 - 75)	0.030 (0.76)

Note: Material thickness is the thickness on which the IQI is based

7.4 IQI Selection

7.4.1 Material

IQI(s) shall be selected from either the same alloy material group or grade as defined in Par. 5.3 or from an alloy material group or grade with less radiation absorption than the material being radiographed.

7.4.2 Size

IQI(s) shall be selected based on the single wall thickness of the part or component being radiographed. The essential wire shall be as specified in **Exhibit A**.

- a. For welds with reinforcement, the thickness on which the IQI is selected shall be based on the nominal single wall thickness plus estimated weld reinforcement not to exceed the as permitted by the referencing Code Section. Backing rings or strips shall not be considered as part of the thickness in IQI selection. The actual measurement of the weld reinforcement is not required.
- b. Welds without reinforcements, the thickness on which the IQI is based is the nominal single wall thickness. Backing rings or strips shall not be considered as part of the weld thickness in IQI selection.

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7.4.3 Welds joining Dissimilar Materials or With Dissimilar Filler Metal

When the weld metal is of an alloy group or grade that has a radiation attenuation that differs from the base metal, the IQI material selection shall be based on the weld metal and be in accordance with Par. 7.4.1. When density limits of Par. 9.3.1 cannot be met with one IQI and the exceptional density area is at the interface of the weld metal and base metal, the material selection for the additional IQI(s) shall be based on the base material and be accordance with Par. 7.4.1.

7.5 Placement of IQI

The IQI(s) shall be placed on the weld so that the length of the wire is perpendicular to the length of the weld. The IQI(s) shall be placed on the source side of the weld being examined except where inaccessibility prevents hand placing the IQI(s) on the source side. When placing the IQI(s) on the film side, the IQI(s) shall be in contact with the weld being examined and a lead letter "F" shall be placed adjacent to or on the IQI(s).

The identification numbers and, when used, the lead letter "F" shall not be in the area of interest, except when geometric configuration makes it impractical.

7.6 Number of IQI(s)

When one or more film holders are used for an exposure, at least one IQI image shall appear on each film except as outlined in Par. 7.6.2.

7.6.1 Multiple IQI(s). If the requirements of Par. 9.3.1 and 9.3.2 are met by using more than one IQI, one shall be representative of the lightest area of interest and the other for the darkest area of interest, the intervening densities on the radiographic film shall be considered to have acceptable density.

7.6.2 Special Cases.

(i) Where the source is placed on the axis of the component (for cylindrical components) or placed at the center of the component (for spherical components) for single exposure, at least three IQI(s) spaced approximately 120° apart are required under the following conditions:

- (1) When the complete circumference is radiographed using one or more film holders, or;
- (2) When a section or sections of the circumference, where the length between the ends of the outermost sections span 240° or more is radiographed using one or more film holders. Additional film locations may be required to obtain necessary IQI spacing.

(ii) Where the source is placed on the axis of the component (for cylindrical components) or placed at the center of the component (for spherical components) for single exposure, at least three IQI(s) with one placed at each end of the radiographic span of the circumference to be radiographed and one in the approximate center of the span are required under the following conditions:

- (1) When a section of the circumference, the length of which is greater than 120° and less than 240°, is radiographed using just one film holder, or;
- (2) When a section or sections of the circumference, where the length between the ends of the outermost sections span less than 240°, is radiographed using more than one film holder.

(iii) In (i) and (ii) above 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 of the circumferential weld being radiographed.

(iv) When an array of component objects in a circle is radiographed, at least one IQI shall show on each component image.

(v) In order to maintain the continuity of records involving subsequent exposures, all radiographs exhibiting IQI(s) which qualify the techniques permitted in accordance with (i), (ii) and (iii) shall be retained.

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7.7 Film System Identification

A system shall be used to produce permanent identification on the radiograph. In any case, this information shall not obscure the area of interest. The information as a minimum shall include the following:

- a. Manufacturers name, Logo or symbol.
- b. Date of exposure.
- c. The project and/or contract identification.
- d. Components, thickness, weld joint or part numbers as appropriate.
- e. Welder identification number.
- f. Whether original or subsequent exposure (R for repair and followed by R1, R2, R3 if required).

7.8 Backscatter Radiation Indicator

A lead symbol "B" with minimum dimension of 13 mm in height and 1.5 mm in thickness shall be attached to the back of each film holder during each exposure to determine if backscatter radiation is exposing the film.

7.9 Radiography Exposure Calculations

Exposure time for radiography examination shall be obtained by utilizing an exposure chart or calculator. The essential elements of an exposure chart must relate the following:

- a. Isotope type and it's radioactive activity.
- b. Material type and thickness.
- c. Film type and their relative speed
- d. Source to film distance
- e. Intensifying screen type and thickness
- f. Time-temperature development for hand processing; access time for automatic processing.

Deviation in the exposure time performed than the one obtained from calculation is acceptable provided **the finished radiograph obtain the required density and IQI image requirements of this procedure.**

7.10 Film Processing

Standard Guide for Controlling the Quality of Industrial Radiographic Film Processing SE-999, or Paragraph 23 through 26 of Standard Guide for Radiographic Examination SE-94 of ASME Section V or Film Manufacturer's Recommendation shall be used as a guide for processing film. Film processing shall be done manually.

8. LOCATION MARKERS

Location markers (see **Exhibit B**) shall appear as radiographic images on the film and 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 using low stress stamp or dot stamp. If it is impractical to mark the surface of the part being radiographed, a map may be used in a manner that permits the area of interest on a radiograph to be accurately traceable to its location on the part for a retention period required. Evidence shall also be provided on the radiograph that the required coverage of the region being examined has been obtained. Location markers shall be placed as follows.

8.1 Single Wall Viewing

8.1.1 Source Side Markers. Location Markers shall be placed on the source side when radiographing the following:

- a. Flat components or longitudinal joints in cylindrical or conical components.
- b. Curved or spherical components which concave side is toward the source and when the source to material distance is less than the inside radius of the components.
- c. Curved or spherical components which convex side is toward the source.

8.1.2 Film Side Markers.

- a. Film side markers shall be used when radiographing curved or spherical components which concave side is toward the source and when the "source-to-material" distance greater than the inside radius.

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b. As an alternate for source side markers in Par. 8.1.1 point (a), film side markers may be used when the radiograph shows coverage beyond the location markers to the extent demonstrated by **Exhibit B**, sketch (e). This alternate shall be documented in the Radiographic Examination Report.

8.1.3 Either Side Markers. Location markers may be placed on either the source side of film side when radiographing either curved or spherical component which concave side is toward the source and the "source-to-material" distance equals the inside radius of the component.

8.2 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 material of in the interest area) for each exposure.

8.3 Location Marking With a Map

When inaccessibility or other limitations prevent the location of markers as stipulated in Par. 8.1 and 8.2, a dimensioned map of the actual marker placement shall accompany the radiographs and shall show that full coverage has been obtained.

9. EVALUATION OF RADIOGRAPH

9.1 Radiograph's Area of Interest

Area of interest in a radiograph shall be the area of interpretation and evaluation. For weld radiography, the area of interest shall include the whole weld image and 6 mm area from each weld sides in all finished radiographs. Any cause of confusion or restriction in evaluating and interpreting the area of interest shall be considered unacceptable and the radiograph be retaken.

9.2 Radiograph Artifacts

All finished radiographs shall be free from mechanical, chemical or other blemishes to the extent that they do not mask or confused with the image of any discontinuity in the area of interest of the object being radiographed, such as, but not limited to:

- Fogging.
- Processing defects such as streaks, water mark, or chemical stains.
- Scratches, finger marks, crimps, dirtiness, static marks, smudges or tears.
- False indications due to defective screens.

9.3 Radiographic Density

9.3.1 Density Limitation

The transmitted film density through the radiographic image adjacent to the designated wire of a wire IQI and the area of interest shall be the minimum of 2.0. 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 viewing or composite viewing. A variation of ± 0.05 density unit in densitometer reading is allowed.

9.3.2 Density Variations

An additional IQI(s) shall be used for each exceptional area(s) and the radiograph retaken if the density of radiograph anywhere through the area of interest varies by more than minus 15% or plus 30% from the density adjacent to the essential wire of wire IQI within the maximum/minimum allowable density ranges specified on in Par. 9.3.1. Density variation calculation may be rounded to the nearest 0.1 value.

9.4 Excessive Backscatter Radiation

If a light image of "B", as described in Par. 7.8 appears on a darker background of the finished radiograph than it shall be concluded that the protection from backscatter radiation is insufficient and the radiograph shall be unacceptable and retaken. A dark image of the "B" on a lighter background is not cause for rejection.

9.5 IQI Sensitivity

The essential wire of a wire IQI and its identifying numbers or letters shall be displayed in the radiographs as required. If essential wire do not show on any film in a multiple film

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technique but do show in composite film viewing, evaluation and interpretation shall be permitted only by composite film viewing.

10. ACCEPTANCE STANDARDS

Weld joints radiographed in accordance with this procedure shall be evaluated against the following acceptance standards.

10.1 Radiography of Welded Joints

Welds and their heat affected zone shall be free from:

- a. Any indication characterized as a crack, zone of incomplete fusion or penetration, regardless of length.
- b. Any individual elongated indication characterized as inclusions or cavities which has a length greater than:
 - 6 mm for T up to 19 mm, incl.
 - $\frac{1}{3}T$ for T from 19 mm to 57 mm, incl.
 - 19 mm for T over 57 mm

T is the thickness of the material excluding any allowable reinforcement. For a butt weld joining two members having different thickness at the weld, T is the thinner of these two thicknesses. If a full penetration weld includes a fillet weld, the thickness of the throat of fillet shall be included in T .

- c. Any group of aligned indications that have an aggregate length greater than T in a length of $12T$, except when the distance between the successive imperfections exceeds $6L$ where L is the length of the longest imperfection in the group.
- d. Rounded indications exceeding those specified in **Appendix 4 of Section VIII Div. 1** for welds in accordance with **ASME Sect. VIII Div. 1**.
- e. Rounded indications exceeding those specified in **Par. 7.5.3.2.(b) of ASME Section VIII Div. 2** for welds in accordance with **ASME Sect. VIII Div. 2**.
- f. Rounded indications exceeding those specified in **Appendix A-250 of Section I** for welds in accordance with **ASME Sect. I** and **ASME B31.1**.
- g. Rounded indications exceeding those specified in **Paragraph QW-191.2.2.(b) of Section IX** for welds in accordance with **ASME Sect IX**.
- h. Root concavity when there is an abrupt change in density as indicated on the radiograph for welds in accordance with **ASME B31.1**.

10.2 Spot Radiography of Welded Joints

For welds in accordance with **ASME Sect VIII Div. 1** that is subjected to Spot Radiography, radiography examination is to be performed only on section(s) of the weld length. The acceptability of welds examined by spot radiography shall be judged by the following standards.

- a. Welds in which indications are characterized as cracks or zones of incomplete fusion or penetration shall be unacceptable.
- b. Welds in which indications are characterized as slag inclusions or cavities shall be unacceptable if the length of any such indication is greater than $\frac{2}{3}T$ where T is the thickness of the weld excluding any allowable reinforcement. For a butt weld joining two members having different thicknesses at the weld, T is the thinner of these two thicknesses. If a full penetration weld includes a fillet weld, the thickness of the throat of the fillet shall be included in T . If several indications within the above limitations exist in line, the welds shall be judged acceptable if the sum of the longest dimensions of all such indications is not more than T in a length of $6T$ (or proportionately for radiographs shorter than $6t$) and if the longest indications considered are separated by at least $3L$ of



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acceptable weld metal where L is the length of the longest indication. The maximum length of acceptable indications shall be 19 mm. Any such indications shorter than 6 mm shall be acceptable for any plate thickness.

- c. Rounded indications are not a factor in the acceptability of welds not required to be fully radiographed.

10.3 Acceptance Standard for weld parts and their base metal fabricated according to **ASME B31.3** shall be as defined in **Table 341.3.2** of **ASME B31.3** for each relevant types of weld and service condition.

11. EXAMINATION REPORT

All finished and approved radiographs shall be stored together with their report form for a period as specified in the referencing code section, customer's specification or contract. All relevant and rejectable indications shall be recorded on Radiographic Examination Report as shown in **Exhibit D** of this procedure.

12. SAFETY

- 12.1 Radiographers shall always wear a film badge or TLD. A fully charged pocket dosimeter may also be used whenever in or near a radiation area.
- 12.2 An operable survey meter shall always be available in conducting radiography.
- 12.3 The area where radiography is being carried out shall be barricaded and signs posted in English and Indonesian to prevent accidental entry from any unauthorized personnel.
- 12.4 Applicable radiation safety procedure shall be referenced and complied with.

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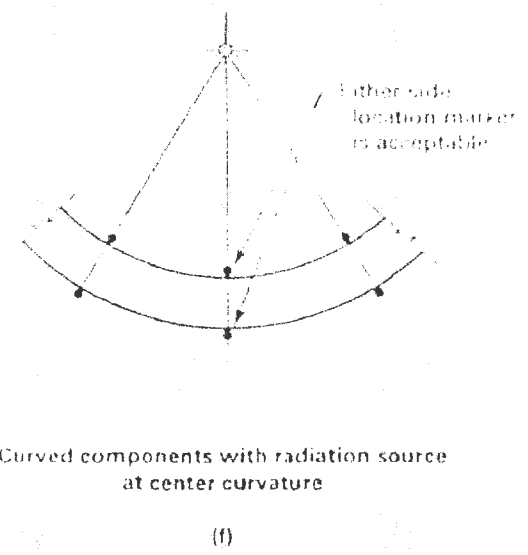
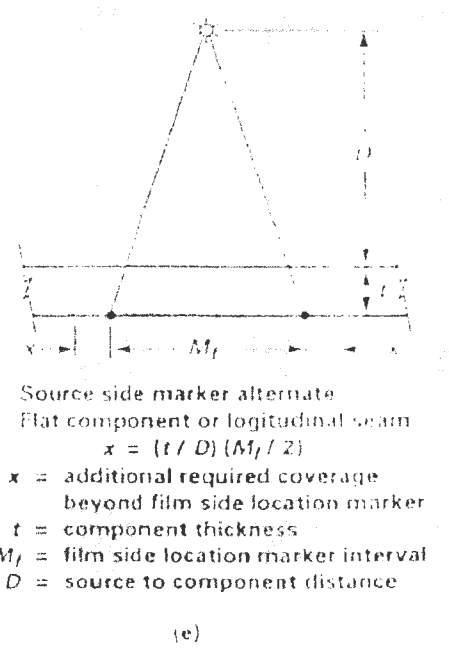
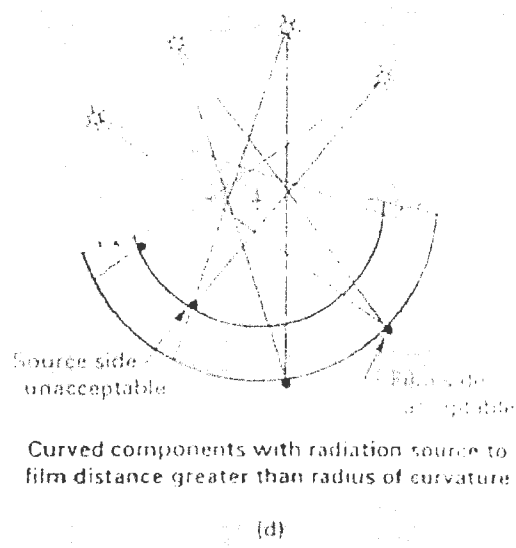
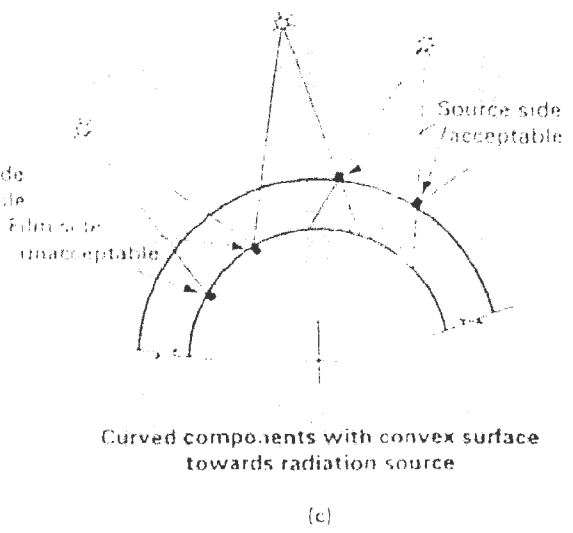
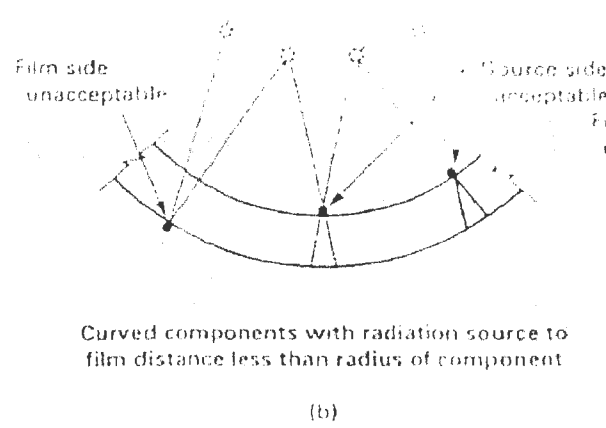
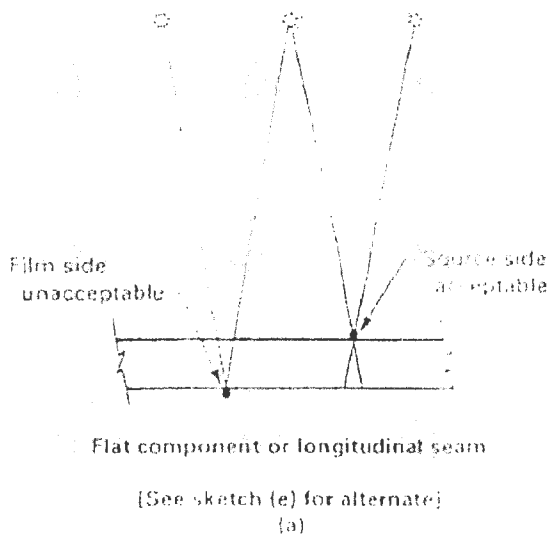
Revision No. :

Exhibit A – ESSENTIAL WIRE AND DIMENSIONAL PROPERTIES OF WIRE TYPE IQI

Nominal Single Wall Material Thickness inch/mm	Image Quality Indicator			
	Source Side		Film Side	
	Essential Wire Diameter inch/mm	I.Q.I. Series	Essential Wire Diameter inch/mm	I.Q.I. Series
		ASTM E-747		ASTM E-747
Up to 0.25 Up to 6.4	0.008 0.20	A	0.0063 0.16	A
> 0.25 trough 0.375 > 6.4 trough 9.5	0.010 0.25	A or B	0.008 0.20	A
> 0.375 trough 0.50 > 9.5. trough 12.7	0.013 0.33	B	0.010 0.25	A or B
> 0.50 trough 0.75 >12.7 trough 19.0	0.016 0.41	B	0.013 0.33	B
> 0.75 trough 1.00 >19.0 trough 25.4	0.020 0.51	B	0.016 0.41	B
>1.00 trough 1.50 > 25.4 trough 38.1	0.025 0.64	B	0.020 0.51	B
> 1.50 trough 2.00 > 38.1 trough 50.8	0.032 0.81	B or C	0.025 0.64	B
> 2.00 trough 2.50 > 50.8 trough 63.5	0.040 1.02	C	0.032 0.81	B or C
> 2.50 trough 3.0 > 63.5 trough 75	0.05 1.27	C	0.040 1.02	C

Set A			Set B			Set C		
Ø Wire (in.)	Ø Wire (mm)	Wire Identity	Ø Wire (in.)	Ø Wire (mm)	Wire Identity	Ø Wire (in.)	Ø Wire (mm)	Wire Identity
0.0032	0.08	1	0.010	0.25	6	0.032	0.81	11
0.004	0.10	2	0.013	0.33	7	0.040	1.02	12
0.005	0.13	3	0.016	0.41	8	0.050	1.27	13
0.0063	0.16	4	0.020	0.51	9	0.063	1.60	14
0.008	0.20	5	0.025	0.64	10	0.080	2.03	15
0.010	0.25	6	0.032	0.81	11	0.100	2.54	16

Exhibit B - LOCATION MARKER SKETCHES



LEGEND:
 Radiation source --- ☼
 Location marker --- ●
 Component center --- +



Exhibit C – DENSITOMETER CALIBRATION REPORT FORM

DENSITOMETER CALIBRATION REPORT

Referenced Calibration Procedure :				
Instrument's Manufacturer :				
Instrument's Model & Type :				
Instrument's Serial No. :				
Instrument's Range Scale :				
Referenced Calibration Standard :				
Referenced Standard's Serial No. :				
Referenced Density Scale	Observed Reading	Deviation	Permissible Deviation	Result
Date of Calibration :				
Calibration Valid Until :				
Calibrated by :				

