



# **Checklist for the Qualification of Digital Detector Array Systems**

1 February 2012

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**Federal Working Group on Industrial Digital Radiography (FWGIDR)** - The FWGIDR is a self-chartered organization consisting of federal and government contract employees and endorsed by the Defense Working Group on Nondestructive Testing (DWGNDT). This working group provides a platform for identifying common concerns and critical issues facing the federal industrial radiographic community as it transitions from film to digital radiography (DR). The FWGIDR, utilizing expertise from within the community, organizes and coordinates technical committees that formulate positions, guidance, and/or solutions for the community's common concerns and issues.

**Background** – Recognizing significant difficulties in addressing technical advances in the digital radiographic field, several engineers from the Department of Energy (DOE) and Department of Defense (DoD) organized the FWGIDR in 2007 to address the problems and concerns faced by the industrial radiographic community in transitioning to DR. Digital X-ray systems are revolutionizing medical radiology, as digital cameras revolutionized the photographic community, and similarly have an ever-increasing role in radiographic nondestructive testing. Medical radiology backed by significant development and funding, and digital photography, with rapid public acceptance; have demonstrated the advantages that digital systems offer in image intensive applications. The FWGIDR is focused on a vision for the future radiographic inspection facility, and that vision is digital radiography.

The rapid growth in DR has created transitional issues difficult for the industrial community to assimilate while transitioning from film to digital techniques. These issues include personnel training; data formatting, storage and retrieval; technique development and qualification; equipment qualification and monitoring; process control; and development and acquisition of equipment suitable for industrial applications.

Participants in the FWGIDR are organizations that employ nondestructive testing in support of government contracts. DOE, DoD, prime government contractors, along with other government and contractor personnel are actively contributing to and supporting the efforts of this working group.

## 1. Scope

1.1. This document is intended as a tool to aid activities qualifying Digital Radiography (DR) systems and to assist personnel who are responsible for the qualifying, approving and/or auditing the application of DR systems.

1.2. *Applicability*-- Digital Radiography (DR) is broadly interpreted by the Federal Working Group on Industrial Digital Radiography (FWGIDR) and this document to include any system that converts a radiographic image to a digitized/pixelized computer imaging format. This can include but is not limited to systems using the following detectors: photostimulable luminescence (PSL) plates, amorphous silicon flat panels, amorphous selenium flat panels, complementary metal-oxide-semiconductor (CMOS) flat panels, CMOS cameras, charge-induction device (CID) cameras, charge-coupled device (CCD) cameras, linear diode arrays (LDA), computed tomography (CT), film digitizers (FD), etc. For the purpose of this document, DR systems using flat panel electronic detectors will be referred to as Digital Detector Radiography (DDR) systems and those using photoluminous plates will be referred to as Computed Radiography (CR) systems respectively.

1.3. This document does not purport to address all of the safety, quality or contractual concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety, health and quality practices and determine the applicability of regulatory or contractual limitations prior to use.

## 2. Terminology

2.1. Unless otherwise specified, terminology in this guide relating to radiographic examination is as defined by ASTM E1316 or other ASTM specifications.

## 3. Significance and Use

3.1. This checklist addresses the evaluation of a Digital Detector Radiography (DDR) system to highlight potential issues and areas for improvement. Areas assessed include system configuration, performance characterization, long term stability monitoring, qualification plans, sensitivity demonstrations, techniques and process controls.

3.2. This checklist is applicable to DDR systems. A separate checklist is being generated for CR systems. Future efforts of the FWGIDR may address computed tomography and film digitizers if there is a clearly identified need and interest from members of the working group. This checklist can be used by NDT facilities or their customers to assess their systems and processes. Some of the items on the checklist are requirements specified by ASTM specifications and are referenced as such. Additional items included in the checklist are based upon best practices and should be viewed as recommendations. Use of this checklist by auditors for the purposes of approving systems for use should only be done in cooperation with a customer representative of the Cognizant Engineering Organization (CEO) with knowledge and experience with Digital Radiographic systems. Auditors should evaluate compliance with the required items on the checklist in addition to evaluating compliance with the recommendations and working with the customer representative to determine if the system will meet the needs of the customer. The suitability of best practices will vary significantly due to differences in system configuration and the requirements of the inspection; therefore, a knowledgeable customer representative of the Cognizant Engineering Organization (CEO) will need to determine if failure to meet these recommendations will negatively affect the system's ability to meet the user needs.

#### 4. Background

4.1. This checklist was developed by the System Qualification Task Group of the Federal Working Group for Industrial Digital Radiography (FWGIDR). The System Qualification Task Group was established to develop a system qualification guideline for the application of industrial digital radiography systems. It was also to identify and pursue the resolution of American Society of Testing & Materials (ASTM International) Standards in digital radiographic modalities and promote the adoption of these standards by government agencies and government contractors. The System Qualification Task Group published the Guide for Qualification of Digital Radiography Systems and Processes in September 2009. Revision 1 of the Guide is being released concurrently with this checklist to further assist with the system qualification processes.

#### 5. Reference Documents

5.1. The following documents are referenced in this checklist.

5.2. *ASTM Standards:*

- E 94 Standard Guide for Radiographic Examination
- E 543 Standard Specification for Agencies Performing Nondestructive Testing
- E 747 Standard Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology
- E 1025 Standard Practice for Design, Manufacture and Material Grouping Classification of Hole-Type Image Quality Indicators (IQI) Used for Radiology
- E 1316 Standard Terminology for Nondestructive Examinations
- E 1453 Standard Guide for Storage of Media that Contains Analog or Digital Radioscopic Data
- E 1475 Standard Guide for Data Fields for Computerized Transfer of Digital Radiological Examination Data
- E 1647 Standard Practice for Determining Contrast Sensitivity in Radiology
- E 1742 Standard Practice for Radiography Examination
- E 1817 Standard Practice for Controlling Quality of Radiological Examination by Using Representative Quality Indicators (RQIs)
- E 2002 Standard Practice for Determining Total Image Unsharpness in Radiology
- E 2339 Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE)
- E 2597 Standard Practice for Manufacturing Characterization of Digital Detector Arrays
- E 2698 Standard Practice for Radiological Examination Using Digital Detector Arrays
- E 2736 Standard Guide for Digital Detector Radiology
- E 2737 Standard Practice for Digital Detector Array Performance Evaluation and Long-Term Stability Monitoring

5.3. *SMPTE Specification:*

- RP 133 Specifications for Medical Diagnostic Imaging Test Pattern for Television Monitors and Hard-Copy Recording Cameras

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	Question	Yes	No	N/A	Remarks
<b>0</b>	<b>Purchaser - Supplier Agreement</b>				
0.1	If required, does the PSA specify that the NDT agency be qualified and evaluated in accordance with ASTM E 543? <b>Requirement: ASTM E2698-10: 5.1.2</b>				
0.2	Does the PSA specify the practice or standard that personnel must be certified to? <b>Requirement: ASTM E2698-10: 5.1.1</b>				
<b>1</b>	<b>Facility</b>				
<b>1.1</b>	<b>General</b>				
1.1.1	If specified in the contractual agreement, has the NDT agency been qualified and evaluated as described in ASTM E543? <b>Requirement: ASTM E2698-10: 5.1.2</b>				
1.1.2	Is the facility controlled for temperature and humidity to meet the DDA manufacturer requirements? <b>Requirement: ASTM E2698-10: 7.4.2</b>				
<b>1.2</b>	<b>Image Viewing Area</b>				
1.2.1	Does the viewing room lighting preclude objectionable glare on the surface of the image? <b>Requirement: ASTM E2698-10: 11.3</b>				
1.2.1.1	Is the viewing room lighting equipped with variable control to accommodate the needs of each user? <b>Requirement: ASTM E2698-10: 11.3</b>				
<b>2</b>	<b>Equipment and Hardware</b>				
<b>2.1</b>	<b>General</b>				
2.1.1	If required for scatter control, is the x-ray source equipped with a diaphragm in front of the tube to mask out all radiation which would not penetrate the region of interest in the object? <b>Requirement: ASTM E2698-10: 10.13.2</b>				
2.1.2	If required for scatter control, are filters used to meet the image quality level? <b>Requirement: ASTM E2698-10: 10.13.5</b>				
2.1.2.1	Are filters in good condition? <b>Advisory Note: Poor filter condition will degrade image quality.</b>				

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	Question	Yes	No	N/A	Remarks
2.1.3	Are IQIs and RQIs in accordance with a recognized standard or approved by the Cognizant Engineering Organization? <b>Requirement: ASTM E2698-10: 7.6.1</b>				
2.1.3.1	If required, are alternate IQIs and RQIs documented in the written practice or on a drawing referenced in the procedure? <b>Requirement: ASTM E2698-10: 7.6.3</b>				
2.1.3.2	If required, has the acceptance level of Alternative Gages/IQI's been approved by the CEO and the MFG? <b>Requirement: ASTM E2737-10: 1.4</b>				
2.1.4	Is the location of the source adjustable? If so, specify the range. <b>Information Only: Affects options available for radiographic technique development.</b>				
2.1.5	Is the cabinet/enclosure/room exclusively used for digital radiography? <b>Information Only: Affects process controls that may be needed to ensure image quality.</b>				
2.1.5.1	If not, is the digital detector protected from x-rays during film or CR operations? <b>Advisory Note: Reducing unnecessary exposure to radiation will increase the usable life of the digital detector.</b>				
2.1.6	Is the digital detector protected from x-rays during tube warm-up? <b>Advisory Note: Reducing unnecessary exposure to radiation will increase the usable life of the digital detector.</b>				
2.1.7	Are the electronics of the detector protected from x-rays during the exposure? <b>Advisory Note: Reducing unnecessary exposure to radiation will increase the usable life of the digital detector.</b>				
<b>2.2</b>	<b>Maintenance and Repair</b>				
2.2.1	Is recertification policy in place to document when equipment must be recharacterized or techniques must be requalified when repairs or replacements are done? <b>Requirement: ASTM E2737-10: 6.2 &amp; 6.17</b>				

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	Question	Yes	No	N/A	Remarks
<b>3</b>	<b>Software</b>				
<b>3.1</b>	<b>General</b>				
3.1.1	Is the viewing software capable of manual adjustment of Window/Level <b>Requirement: ASTM E2698-10: 7.3</b>				
3.1.2	Is the viewing software capable of manual adjustment of Zoom <b>Requirement: ASTM E2698-10: 7.3</b>				
3.1.3	Is the viewing software capable of generating a histogram of an ROI? <b>Requirement: ASTM E2698-10: 7.3</b>				
3.1.3.1	Is there a "Statistics Window" that can calculate the mean and standard deviation of the ROI? <b>Requirement: ASTM E2698-10: 7.3</b>				
3.1.4	Is the viewing software capable of generating a line profile? <b>Requirement: ASTM E2698-10: 7.3</b>				
3.1.4.1	Is the line profile tool capable of integrating a line of variable widths? <b>Recommendation: FWGIDR 002-12: 8.2.1.1</b>				
3.1.5	Is the software capable of multiple frame averaging? If so, specify range in remarks. <b>Requirement: ASTM E2698-10: 7.2.1</b>				
3.1.6	When required, is the software capable of "correcting" for bad pixels using neighboring pixel data as defined in ASTM E2597? <b>Requirement: ASTM E2698-10: 7.2.2</b>				
3.1.6.1	Is the evaluation of bad pixels done as recommended by the manufacturer and is the bad pixel map stored as an image? <b>Requirement: ASTM E2737-10: 8.2.8.1</b>				
3.1.6.2	Alternatively, are the locations of the bad pixels stored in a text file? <b>Requirement: ASTM E2737-10: 8.2.8.1</b>				
3.1.6.3	When several energy levels are used in production testing, is the highest energy level and complete settings used for the correction of bad pixels? <b>Requirement: ASTM E2737-10: 5.3</b>				
3.1.6.4	Can bad pixel correction be easily toggled on/off while viewing an image? <b>Recommendation: FWGIDR 002-12: 8.2.1.2</b>				
3.1.7	Is the image initially displayed without enhancements and can the user apply filters, edge enhancements or contrast enhancements as necessary? <b>Recommendation: FWGIDR 002-12: 8.2.1.3</b>				

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	Question	Yes	No	N/A	Remarks
3.1.7.1	Is the original image data retained? <b>Recommendation: FWGIDR 002-21: 8.2.1.4</b>				
<b>3.2</b>	<b>File Format and Storage</b>				
3.2.1	Are examination results recorded and kept on file in accordance with the contract or purchase order? <b>Requirement: ASTM E2698-10: 11.2</b>				
3.2.2	Can the image be saved in a DICOM compliant file format? <b>Recommendation: FWGIDR 002-12: 8.2.2.1</b>				
3.2.3	Is the full bit depth of the image, as read from the panel, retained in the saved images? <b>Recommendation: FWGIDR 002-12: 8.2.2.1</b>				
3.2.4	Is the image saved in a lossless format? <b>Recommendation: FWGIDR 002-12: 8.2.2.1</b>				
3.2.5	Is the system capable of saving data to DVDs? <b>Recommendation: FWGIDR 002-12: 8.2.2.2</b>				
3.2.6	Are original examination images archived for a minimum duration specified in the contractual documents? <b>Recommendation: FWGIDR 002-12: 8.2.2.4</b>				
3.2.7	Are original examination images stored on write protected media? <b>Recommendation: FWGIDR 002-12: 8.2.2.2</b>				
3.2.8	If digital labeling is used, does it not permanently alter the nature of the image or hinder interpretation of an area within the image? <b>Recommendation: FWGIDR 002-12: 8.2.2.5</b>				
3.2.9	Is all information being stored in the DICOM headers as agreed upon by the CEO? <b>Recommendation: FWGIDR 002-12: 8.2.2.3</b>				
<b>4</b>	<b>Personnel</b>				
<b>4.1</b>	<b>Certification</b>				
4.1.1	Are personnel qualified in accordance with a nationally or internationally recognized NDT personnel qualification practice or standard as identified in the contractual agreement? Specify the practice or standard in remarks. <b>Requirement: ASTM E2698-10: 5.1.1</b>				
4.2.1	Are personnel certified by the employer or certifying agency? Specify the certifier in remarks. <b>Requirement: ASTM E2698-10: 5.1.1</b>				



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	Question	Yes	No	N/A	Remarks
4.1.2	Is a Level III radiographer employed by the inspecting activity? <b>Information Only: Affects the approval of certain documents.</b>				
4.1.3	Is an company or individual been contracted to provide Level III radiography services to the inspecting activity? <b>Information Only: Affects the approval of certain documents.</b>				
4.1.3.1	Is the outside Level III radiographer familiar with the product lines inspected? <b>Advisory Note: An outside Level III must have sufficient familiarization with the specifics of an inspection performed by an inspection activity to adequately perform their duties as a responsible Level III.</b>				
4.1.4	Is the Level III radiographer certified by ASNT for Level III RT? <b>Advisory Note: ASNT certification provides additional confidence in the qualifications of a Level III radiographer.</b>				
<b>4.2</b>	<b>Training</b>				
4.2.1	Has the Level III radiographer received training in the specific DR system in use? <b>Recommendation: FWGIDR 002-12: 8.6</b>				
4.2.2	Has the Level III radiographer received 40 hours of classroom training in DR/CR theory? <b>Recommendation: FWGIDR 002-12: 8.6.1</b>				
4.2.3	Have the Level I/II radiographers received training in the specific DR system in use? <b>Recommendation: FWGIDR 002-12: 8.6</b>				
4.2.4	Have the Level I/II radiographers received 40 hours of classroom training in DR/CR theory? <b>Recommendation: FWGIDR 002-12: 8.6.2</b>				
4.2.5	Have the Level I radiographers received training in the specific DR system in use? <b>Recommendation: FWGIDR 002-12: 8.6</b>				
4.2.6	Have the Level I radiographers received 20 hours of classroom training in DR/CR theory? <b>Recommendation: FWGIDR 002-12: 8.6.3</b>				

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	Question	Yes	No	N/A	Remarks
<b>5</b>	<b>Process Controls</b>				
<b>5.1</b>	<b>Operating Procedures</b>				
5.1.1	Has a detailed procedure(s) delineating the technique and procedure requirements been established for the application and control of the digital radiographic method? Specify the procedure number in remarks. <b>Requirement: ASTM E2698-10: 9.1</b>				
5.1.2	Has the procedure(s) been approved by a Level III radiographer from the inspecting activity? <b>Requirement: ASTM E2698-10: 9.2.2</b>				
5.1.3	Has the procedure been approved by the Cognizant Engineering Organization(CEO)? <b>Requirement: ASTM E2698-10: 4.1, 9.1</b>				
5.1.5	Has a system of measurement verification been established and documented? <b>Requirement: ASTM E2698-10: 9.2.13</b>				
5.1.5.1	If any physical standards are used to verify the accuracy of a measurement, are the standards certified annually using standards traceable to NIST (or recognized standardizing body)? <b>Requirement: ASTM E2698-10: 9.2.13</b>				
5.1.6	Does the operating procedure specify to visually inspect IQIs for damage and cleanliness prior to use? <b>Requirement: ASTM E2698-10: 7.6.4</b>				
5.1.7	Does each image carry the identification or serial number of the component, identification of the NDT facility and date of the exposure? <b>Requirement: ASTM E2698-10: 10.2</b>				
5.1.7.1	If digital labeling is used, does it not permanently alter the nature of the image or hinder interpretation of an area within the image? <b>Requirement: ASTM E2698-10: 10.2</b>				
5.1.8	Does the operating procedure specify that the detector be recalibrated in the event that any non-uniformities or artifacts appear in an image? <b>Requirement: ASTM E2698-10: 8.4.1</b>				
5.1.8.1	Does the operating procedure specify that the detector be retested in accordance with ASTM E2737 in the event that any non-uniformities or artifacts remain after calibration? <b>Requirement: ASTM E2698-10: 8.4.2</b>				

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	Question	Yes	No	N/A	Remarks
5.1.9	Does the operating procedure specify that a new bad pixel map be created in the event that, between recommended intervals, new bad pixels appear in an image, in the area of interest, and interfere with interpretations? <b>Requirement: ASTM E2698-10: 8.5</b>				
5.1.9.1	Does the operating procedure specify that the detector be retested in accordance with ASTM E2737 in the event that bad pixels remain after the new bad pixel map has been generated? <b>Requirement: ASTM E2698-10: 8.5.1</b>				
5.1.10	Does the operating procedure state that interpreters shall wait sufficient time after entering the viewing area before interpreting the radiographic image? <b>Requirement: ASTM E2698-10: 11.4</b>				
5.1.11	Does the procedure adopt the manufacturer's methodology of gain offset, and pixel calibration, frequency thereof and alterations as needed defined by the CEO? <b>Requirement: ASTM E2698-10: 8.4</b>				
<b>5.2</b>	<b>DDA Calibration Procedures</b>				
5.2.1	Is the frequency and method of DDA calibration in accordance with manufacturer recommendation? Specify the frequency in the remarks? <b>Requirement: ASTM E2698-10: 7.4.3</b>				
5.2.2	Are the DDA calibration procedures used in normal production the same as used through the periodic testing of the DDA? <b>Requirement: ASTM E2737-10: 5.2</b>				
<b>5.3</b>	<b>Image Display (Monitor) Performance</b>				
5.3.1	Is image display performance checked on a daily basis? <b>Requirement: E2698-10: 7.5.6 / X1</b>				
5.3.2	Is an SMPTE RP133 or equivalent test pattern used for image display testing? <b>Requirement: E2698-10: 7.5.6</b>				
5.3.2.1	Has the test pattern been configured for the system display resolution and aspect ratio? <b>Requirement: E2698-10: 7.5.6</b>				

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5.3.3	Does the procedure specify that the minimum brightness at the maximum DDL shall be measured on a monthly basis and specify a minimum of 250 cd/m <sup>2</sup> ? <b>Requirement: E2698-10: 7.5.1</b>				
5.3.4	Is a calibrated light meter used to check the display brightness? <b>Requirement: E2698-10: X1</b>				
5.3.4.1	Is the meter calibrated every six months? <b>Requirement: E2698-10: X1</b>				
5.3.5	Does the procedure specify that the minimum contrast from the minimum DDL to the maximum DDL shall be a minimum of 250:1? <b>Requirement: E2698-10: 7.5.2</b>				
5.3.6	Does the procedure specify checking for display of linear patterns of alternating pixels at full contrast in both the horizontal and vertical directions without aliasing? <b>Requirement: E2698-10: 7.5.3</b>				
5.3.7	Does the procedure specify that the display shall be free of discernable geometric distortion? <b>Requirement: E2698-10: 7.5.4</b>				
5.3.8	Does the procedure specify that the display shall be free of screen flicker, characterized by high frequency fluctuations of high contrast image details? <b>Requirement: E2698-10: 7.5.5</b>				
5.3.9	Does the procedure specify to check for visual discrimination of 0/5 percent and 95/100 percent contrast squares on the test pattern? <b>Requirement: E2698-10: 7.5.6</b>				
5.3.10	Does the procedure specify checking for the discrimination of 1% modulation patterns at low contrast in both the horizontal and vertical directions at the display center and each of the four corner locations? <b>Requirement: E2698-10: 7.5.7</b>				
5.3.11	Is the image display face cleaned often to prevent interference with interpretation? <b>Requirement: ASTM E2698-10: 6.3</b>				
<b>6</b>	<b>System Performance Tests</b>				
6.1	Has the Baseline System Performance Test been conducted in accordance with ASTM E2737-10? <b>Requirement: ASTM E2698-10: 8.3</b>				
6.2	Has the Baseline System Performance Test been documented in accordance with Table II? <b>Requirement: ASTM E2737-10: 6.1.5</b>				

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6.3	Has the Bad Pixel information from the Baseline System Performance Test been documented in accordance with Table III? <b>Requirement: ASTM E2737-10: 6.1.5</b>				
6.4	Does the procedure specify the maximum deviations from the "Result" (new) as tolerances and limits are they documented in Table II and Table III? <b>Requirement: ASTM E2737-10: 6.1.6</b>				
6.5	Are intervals for performing the performance checks specified in operating procedures and not to exceed 10 days? <b>Requirement: ASTM E2737-10: 6.3</b>				
6.6	Is the interval for checking for bad pixels done daily and the image stored, specified in the operating procedures and documented? <b>Requirement: ASTM E2737-10: 6.3, 10.1, 10.3</b>				
6.7	Are the focal spot detector distance (FDD), object detector distance (ODD), kV, mA and focal spot size the same as will be used for inspection? <b>Requirement: ASTM E2737-10: 8.2</b>				
6.8	Is the DDA calibrated in accordance with the manufacturer recommendations for offset, gain and bad pixel calibration prior to System Performance Testing? <b>Requirement: ASTM E2737-10: 8.2.2</b>				
6.9	Have images taken during the Baseline System Performance Test been stored for future reference? <b>Advisory Note: Images from the baseline testing should be retained in the event that issues are raised in regards to the results obtained during that testing.</b>				
<b>6.10</b>	<b>Apparatus for System Performance Tests</b>				
6.10.1	Are System Performance Tests conducted using the 5-groove wedge, Duplex Plate Phantom or other gauge approved by the CEO? Specify in remarks. <b>Requirement: ASTM E2737-10: 7.1</b>				
6.10.2	Are the minimum and maximum material thicknesses for the System Performance Tests representative of the full range required for the inspection? <b>Requirement: ASTM E2737-10: 7.1.2, 8.1.2.1</b>				
6.10.3	Are the materials used for the System Performance Tests representative of the full range required for the inspection? <b>Requirement: ASTM E2737-10: 7.1.2</b>				

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<b>6.11</b>	<b>Spatial Resolution</b>				
6.11.1	Has the spatial resolution been determined based on the 5-groove wedge by using a line profile with a 11 pixel width? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.3.1</b>				
6.11.2	Has the spatial resolution been determined based on the duplex phantom by using a line profile with a width of approximately 60% of the width of the wires? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.4.1</b>				
6.11.3	Has the spatial resolution been determined by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				
<b>6.12</b>	<b>Contrast Sensitivity</b>				
6.12.1	Has the contrast sensitivity been determined based on the 5-groove wedge method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.3.2</b>				
6.12.2	Has the contrast sensitivity been determined based on the IQI method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.4.2</b>				
6.12.3	Has the contrast sensitivity been determined by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				
<b>6.13</b>	<b>Material Thickness Range</b>				
6.13.1	Has the material thickness range been determined based on the 5-groove wedge method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.3.3</b>				
6.13.2	Is the maximum material thickness range verified by the dual IQI method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.4.3</b>				
6.13.3	Has the maximum material thickness range been determined by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				

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<b>6.14</b>	<b>Signal to Noise Ratio</b>				
6.14.1	Has the signal to noise ratio been measured using the 5-groove wedge method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.3.4</b>				
6.14.2	Has the signal to noise ratio been measured using the Duplex Plate method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.4.4</b>				
6.14.3	Has the signal to noise ratio been measured by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				
<b>6.15</b>	<b>Signal Level</b>				
6.15.1	Has the signal level been measured using the 5-groove wedge method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.3.5</b>				
6.15.2	Is the signal level been measured using the Duplex Plate method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 9.4.5</b>				
6.15.3	Has the signal level been measured by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				
<b>6.16</b>	<b>Image Lag</b>				
6.16.1	Was image lag measured using the method specified in ASTM E2737-10? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 8.2.5</b>				
6.16.2	Was the image lag test performed with offset and gain correction disabled? <b>Requirement: ASTM E2737-10: 8.2.5</b>				
6.16.3	Has the image lag been measured by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				

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	Question	Yes	No	N/A	Remarks
<b>6.17</b>	<b>Burn In</b>				
6.17.1	Was burn-in measured using the method specified in ASTM E2737-10? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 8.2.6</b>				
6.17.2	Has burn-in been measured by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				
<b>6.18</b>	<b>Offset Level</b>				
6.18.1	Was offset level measured using the method specified in ASTM E2737-10? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 8.2.7</b>				
6.18.2	Has the offset level been measured by some other method approved by the CEO? Specify N/A if using a different approved method. <b>Requirement: ASTM E2737-10: 7.1</b>				
6.18.3	Has the user defined the intervals at which the offset level will be checked. <b>Requirement: ASTM E2737-10: 8.1.4</b>				
<b>7</b>	<b>Qualification Plan</b>				
	<b>Note: The Qualification Plan is the recommended method of documenting the qualification process based on the experience of the FWGIDR.</b>				
<b>7.1</b>	<b>System Configuration</b>				
7.1.1	Does the qualification plan include a detailed listing of hardware?				
7.1.2	Does the qualification plan include a listing of critical software?				
<b>7.2</b>	<b>Procedures</b>				
7.2.1	Does the qualification plan provide a listing of Procedures including operation, calibration and maintenance?				
<b>7.3</b>	<b>Process Controls</b>				
7.3.1	Does the qualification plan provide a description of the process controls that will be used to ensure a consistent inspection?				



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	Question	Yes	No	N/A	Remarks
7.3.2	Does the qualification plan describe the ASTM specification requirements that are being waived or modified with concurrence of the customer?				
<b>7.4</b>	<b>Operator Certification</b>				
7.4.1	Does the qualification plan specify the standards that will be followed for personnel certification?				
7.4.2	Does the qualification plan specify the number of hours of equipment specific training that will be provided to radiographers?				
7.4.3	Does the qualification plan specify the number of hours of classroom Digital Radiography theory training that will be provided to radiographers?				
<b>7.5</b>	<b>Range of Items</b>				
7.5.1	Does the qualification plan provide a description of the Range of Items, Devices, etc covered?				
<b>7.6</b>	<b>Defects Covered</b>				
7.6.1	Does the qualification plan provide a listing of the defects that will be inspected for in this product line?				
7.6.2	Does the qualification plan provide minimum dimensions of the defects to be inspected for?				
<b>7.7</b>	<b>Sensitivity Demonstration</b>				
7.7.1	Does the qualification describe the items and defects that were inspected to determine the ability to inspect for the defects covered by this qualification plan?				
7.7.2	Has the Sensitivity Demonstration covered the range of items and defects covered in sufficient detail to demonstrate the ability of the system to see likely defects in this product line?				
<b>7.8</b>	<b>Approach for Meeting Inspection Criteria</b>				
7.8.1	Does the qualification plan describe the basic approach for ensuring that the acceptance criteria can be inspected for?				
<b>7.9</b>	<b>Technique Verification</b>				
7.9.1	Does the qualification plan describe the technique verification process?				
7.9.2	Does the Technique Verification requirements emphasize the use of Representative Quality Indicators (RQIs)?				

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	Question	Yes	No	N/A	Remarks
<b>7.10</b>	<b>Qualification Exposures</b>				
7.10.1	Does the qualification plan address qualification exposures?				
<b>7.11</b>	<b>Data Format and Storage</b>				
7.11.1	Does the qualification plan address data format and storage?				
7.11.2	Does the Qual Plan section specify that images shall be stored in a DICONDE format?				
7.11.3	Does the Qual Plan specify that images shall not be stored using a lossy data compression format such as JPG?				
7.11.4	Does the Qual Plan section specify that images shall be submitted to the customer in DICONDE format?				
<b>7.12</b>	<b>Approval</b>				
7.12.1	Has the Qualification Plan be approved by the inspecting activity Level III radiographer?				
7.12.2	Has the Qualification Plan be approved by the Cognizant Engineering Organization?				
<b>8</b>	<b>Techniques</b>				
<b>8.1</b>	<b>Viewing Parameters</b>				
8.1.1	Do the item specific techniques specify a fixed window width to be used? <i>Requirement: ASTM E2698-10: 10.20.1</i>				
8.1.2	Do the item specific techniques specify a fixed image zoom to be used? <i>Requirement: ASTM E2698-10: 10.21.1</i>				
<b>8.2</b>	<b>Normalized Image Unsharpness</b>				
8.2.1	Is maximum normalized image unsharpness calculated for each technique and checked against the requirements of ASTM E2698-10? <i>Requirement: ASTM E2698-10: 10.19.2</i>				
<b>8.3</b>	<b>Image Quality Indicator Visibility</b>				
8.3.1	Is the hole-type IQI visibility checked visually? <i>Requirement: ASTM E2698-10: 10.19.3.1</i>				
8.3.1.1	Is the required hole clearly visible? <i>Requirement: ASTM E2698-10: 10.19.3.1</i>				

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	Question	Yes	No	N/A	Remarks
8.3.2	If not clearly visible, is the hole-type IQI visibility checked for each item using the Contrast-to-Noise ratio (CNR) method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2698-10: 10.19.3.2</b>				
8.3.2.1	Is the CNR at least 2.5 unless a lower threshold has been approved by the CEO? Specify the approved value in the notes if applicable. <b>Requirement: ASTM E2698-10: 10.19.3.2</b>				
8.3.3	If not clearly visible, is wire-type IQI visibility checked for each item using the Contrast-to-Noise ratio (CNR) method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2698-10: 10.19.3.3</b>				
8.3.3.1	Is the CNR at least 2 unless a lower threshold has been approved by the CEO? Specify the approved value in the notes if applicable. <b>Requirement: ASTM E2698-10: 10.19.3.3</b>				
8.3.4	If CNR is not accessible, is Signal to Noise Ratio (SNR) used in place of the Contrast-to-Noise ratio (CNR) method? Specify N/A if using a different approved method. <b>Requirement: ASTM E2698-10: 10.19.3.4</b>				
8.3.4.1	If applicable, Is the SNR in the area of interest at least 130 for 2% sensitivity or 250 for 1% sensitivity? <b>Requirement: ASTM E2698-10: 10.19.3.4</b>				
8.3.5	Is another method of evaluating IQI visibility used and approved by the CEO? <b>Requirement: ASTM E2698-10: 10.19.3.1</b>				
<b>8.4</b>	<b>Technique Documentation</b>				
8.4.1	Are the following items addressed in the written procedure? <b>Requirement: ASTM E2698-10: 9.2</b>				
8.4.1.1	Name and address of the NDT facility, the date and revision of the procedure				
8.4.1.2	Radiological Image Identification scheme to correlate exposures to parts.				
8.4.1.3	The thickness and type of material				
8.4.1.4	A drawing, sketch, or photograph of a component showing the location of the part and IQI with respect to the radiation source.				

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	Question	Yes	No	N/A	Remarks
8.4.1.5	The nominal exposure of the x-ray machine, voltage, milliamps, filter, exposure time, frame averages, beam or detector collimation and effective focal spot size.				
8.4.1.6	The make, model and manufacturer of the DDA				
8.4.1.7	The geometric magnification factor, including source to object and object to detector distances.				
8.4.1.8	The IQI size and type, required radiographic quality level and minimum quality level.				
8.4.1.9	Thickness and type of material for shims or blocks.				
8.4.1.10	The window width and level used to visualize the image as well as any digital image zoom.				
8.4.1.11	Any image processing parameters used to obtain the required image quality or improve fine detail detection.				
8.4.1.12	The acceptance limits and the applicable zones or sections of the part to which they apply or is the criteria document, if separate, made available to the interpreters?				
8.4.2	Are the following items addressed in the written procedure? <b>Recommendation: FWGIDR 002-12: 7.1</b>				
8.4.2.1	Filter thickness and material				
8.4.2.2	Collimator settings or position				
<b>9</b>	<b>Additional Requirements</b>				
	<b>Note: Additional Requirements listed below have been added at the discretion of the Customer and have not been studied or endorsed by the FWGIDR.</b>				