



# Checklist for the Qualification of Computed Radiography Systems

1 February 2012

**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 Computed Radiography (CR) systems and to assist personnel who are responsible for the qualifying, approving and/or auditing the application of CR 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 Computed Radiography (CR) 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 CR systems. A separate checklist is being generated for Digital Detector Array 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 2007** Standard Guide for Computed Radiology (Photostimulable Luminescence (PSL) Method)

**E 2033** Practice for Computed Radiology (PSL Method)

**E 2339** Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE)

**E 2445** Standard Practice for Qualification and Long-Term Stability of Computed Radiology Systems

**E 2446** Standard Practice for Classification of Computed Radiology Systems

5.3. *SMPTE Specification:*

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

	Question	Yes	No	N/A	Remarks
<b>0</b>	<b>Purchaser - Supplier Agreement</b>				
0.1	Does the PSA specify the practice or standard that personnel must be certified to? <b>Requirement: ASTM E2033-99: 6.1.8</b>				
0.2	Does the PSA specify the Image file format used for inspection images <b>Requirement: ASTM E2033-99: 7.1.1.11</b>				
0.3	Does the PSA specify the performance measurement method (IQIs, RQIs, etc) to determine image quality? <b>Requirement: ASTM E2033-99: 7.2</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 E1742: 5.1.2</b>				
1.1.2	Is the facility controlled for temperature and humidity to meet the CR manufacturer requirements? <b>Recommendation: FWGIDR 002-12: 8.3.1.1</b>				
1.1.3	Is the area where imaging plates will be handled illuminated with subdued background lighting, free from any source of ambient red light, including convectional darkroom safelights and sodium vapor lights? <b>Recommendation: FWGIDR 002-12: 8.3.1.2</b>				
1.1.4	Is the time that imaging plates are exposed to light during handling minimized? <b>Recommendation: FWGIDR 002-12: 8.3.1.2</b>				
<b>1.2</b>	<b>Image Viewing Area</b>				
1.2.1	Is the ambient light in the image display area subdued to facilitate image interpretation and minimize eye strain? <b>Requirement: ASTM E2033-99: 7.2.5</b>				
1.2.2	Does the operating procedure state that interpreters shall wait sufficient time after entering the viewing area before interpreting the radiographic image? <b>Recommendation: FWGIDR 002-12: 8.3.1.3</b>				
<b>2</b>	<b>Equipment and Hardware</b>				
<b>2.1</b>	<b>General</b>				
2.1.1	Is the location of the source adjustable? If so, specify the range. <b>Information Only: Affects options available for radiographic technique development.</b>				

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	Question	Yes	No	N/A	Remarks
2.1.2	Are IQIs and RQIs in accordance with a recognized standard or approved by the Cognizant Engineering Organization? <b>Requirement: ASTM E2033-99: A1.4.4</b>				
<b>2.2</b>	<b>Scatter Control</b>				
2.2.1	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>Recommendation: FWGIDR 002-12: 8.3.2.1</b>				
2.2.2	Is the x-ray source equipped to allow filters to be installed at the source? <b>Recommendation: FWGIDR 002-12: 8.3.2.2</b>				
2.2.3	Are Filter screens in intimate contact with the imaging plate with the exception of a thin layer or coating to prevent damage to the imaging plate? <b>Recommendation: FWGIDR 002-12: 8.3.2.3</b>				
2.2.4	Is a back filter screen used for protection from backscattered radiation? <b>Recommendation: FWGIDR 002-12: 8.3.2.4</b>				
2.2.5	Is lead or other suitable material used behind the imaging plate holder to prevent scattered radiation? <b>Recommendation: FWGIDR 002-12: 8.3.2.4</b>				
<b>2.3</b>	<b>Image Quality Indicators and Standards</b>				
2.3.1	For radiography of materials not covered by E94, are plaque penetrometers of the same material used? <b>Recommendation: FWGIDR 002-12: 8.3.2.5</b>				
2.3.2	Are IQIs used sufficient to represent the area of interest? This is defined as having the area of interest within +30 to -15% of the linear pixel value through the body of the IQI. Two IQIs may be used to bound the thickest and thinnest parts of the area of interest. <b>Recommendation: FWGIDR 002-12: 8.3.2.6</b>				
<b>2.4</b>	<b>Imaging Plate Handling and Storage</b>				
2.4.1	Are all imaging plates uniquely identified? <b>Requirement: ASTM E2445-05: 6.2.7.2</b>				
2.4.2	Are imaging plates stored in a manner such that they are protected from sources of ionizing background exposure? <b>Advisory Note: Will increase the life of the imaging plate.</b>				

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	Question	Yes	No	N/A	Remarks
2.4.4	Are imaging plates handled with soft gloves and kept free from any source of contamination? <b>Advisory Note: Will increase the life of the imaging plate.</b>				
<b>2.5</b>	<b>Maintenance, Repair and Changes</b>				
2.5.1	Is a requalification policy in place to document when equipment must be requalified when repairs or replacements are done on any part of the computed radiography system? <b>Requirement: ASTM E2033-99 A1.5.6</b>				
<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>Recommendation: FWGIDR 002-12: 8.3.3.1</b>				
3.1.2	Is the viewing software capable of manual adjustment of Zoom <b>Recommendation: FWGIDR 002-12: 8.3.3.2</b>				
3.1.3	Is the viewing software capable of reading the gray value of individual pixels? <b>Recommendation: FWGIDR 002-12: 8.3.3.3</b>				
3.1.4	Is the viewing software capable of generating a histogram of an area? <b>Recommendation: FWGIDR 002-12: 8.3.3.4</b>				
3.1.4.1	Can software calculate the mean and standard deviation of this area? <b>Recommendation: FWGIDR 002-12: 8.3.3.4</b>				
3.1.5	Is the viewing software capable of generating a line profile? <b>Recommendation: FWGIDR 002-12: 8.3.3.5</b>				
3.1.5.1	Is the line profile tool capable of integrating a line of variable widths? <b>Recommendation: FWGIDR 002-12: 8.3.3.5</b>				
3.1.6	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: 8.3.3.6</b>				
3.1.6.1	Is the original image data retained? <b>Recommendation: FWGIDR 002-12: 8.3.3.7</b>				

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	Question	Yes	No	N/A	Remarks
<b>3.2</b>	<b>File Format and Storage</b>				
3.2.1	Can the image be saved in a DICOM compliant file format? <b>Recommendation: FWGIDR 002-12: 8.3.4.1</b>				
3.2.2	Is the full bit depth of the image, as read from the panel, retained in the saved images? <b>Recommendation: FWGIDR 002-12: 8.3.4.1</b>				
3.2.3	Is the images saved in a lossless format? <b>Recommendation: FWGIDR 002-12: 8.3.4.1</b>				
3.2.4	Is the system capable of saving data to DVDs? <b>Recommendation: FWGIDR 002-12: 8.3.4.2</b>				
3.2.5	Is data archived in a secure location? <b>Recommendation: FWGIDR 002-12: 8.3.4.4</b>				
3.2.6	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>				
3.2.7	Are original CR examination images archived for a minimum duration specified in the contractual documents? <b>Recommendation: FWGIDR 002-12: 8.2.2.4</b>				
3.2.8	Are original CR examination images stored on write protected media? <b>Recommendation: FWGIDR 002-12: 8.2.2.4</b>				
3.2.9	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: 8.3.4.5</b>				
3.2.10	Is the unique identifier of the imaging plate associated with all images taken with this imaging plate? <b>Recommendation: FWGIDR 002-12: 8.3.4.3</b>				
<b>4</b>	<b>Personnel</b>				
<b>4.1</b>	<b>Certification</b>				
4.1.1	Are personnel qualified in accordance with NAS 410 or other 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 E2033-99: 6.1.8</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 CR 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 II radiographers received training in the specific CR system in use? <b>Recommendation: FWGIDR 002-12: 8.6</b>				
4.2.4	Have the Level 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 CR 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>				
<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 E2033-99: 6.1 /A1.5.2</b>				

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	Question	Yes	No	N/A	Remarks
5.1.2	Has the procedure(s) been approved by the Level III of the responsible NDT agency? <b>Requirement: ASTM E2033-99: A1.5.2</b>				
5.1.3	Has the procedure been approved by the Cognizant Engineering Organization(CEO)? <b>Requirement: ASTM E2033-99: 6.1/ A1.5.2</b>				
5.1.4	Are the following CR system items addressed in the written procedure?				
5.1.4.1	CR system manufacturer and model <b>Requirement: ASTM E2033-99: 6.1</b>				
5.1.4.2	Inspection software identification and version number <b>Requirement: ASTM E2033-99: 6.1</b>				
5.1.4.3	Image processing methods/techniques employed (i.e. contrast, brightness, magnification, filter types) <b>Requirement: ASTM E2033-99: 6.1</b>				
5.1.4.4	Calibration methods and intervals for inspection monitor (i.e. brightness, contrast, gamma) <b>Requirement: ASTM E2033-99: 6.1</b>				
5.1.4.5	Evaluation methods for use of SMPTE test pattern and periodicity <b>Recommendation: FWGIDR 002-12: 8.3.5.1 &amp; 8.3.5.2</b>				
5.1.4.6	Method(s) employed to store required information in DICONDE fields <b>Recommendation: FWGIDR 002-12: 8.3.5.3</b>				
5.1.4.7	Method(s) employed to archive digital image files <b>Recommendation: FWGIDR 002-12: 8.3.5.4</b>				
5.1.4.8	Methods employed to electronically or physically transfer digital examination images <b>Recommendation: FWGIDR 002-12: 8.3.5.4</b>				
5.1.5	Are the following radiation source items addressed in the written procedure? <b>Requirement: ASTM E2033-99: 6.1.2</b>				
5.1.5.1	Model and type				
5.1.5.2	Manufacturer				
5.1.5.3	Focal spot size(s) used				

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	Question	Yes	No	N/A	Remarks
5.1.5.4	Maximum voltage rating				
5.1.5.5	Maximum tube current at maximum voltage rating				
5.1.6	Are the following technique related items addressed in the written procedure?				
5.1.6.1	Total Image Unsharpness (UIM) limits for material thicknesses inspected <b>Recommendation: FWGIDR 002-12: 8.3.5.5</b>				
5.1.6.2	Minimum and maximum allowable pixel intensity values for inspection area(s) of interest <b>Recommendation: FWGIDR 002-12: 8.3.5.6</b>				
5.1.7	Has a system of measurement verification been established and documented? <b>Requirement: ASTM E2033-99: A1.5.8</b>				
5.1.7.1	If any physical standards are used to verify the accuracy of a measurement, are the standards certified annually using standards traceable to NIST? <b>Advisory Note: Traceability to NIST ensures accuracy of the measurement calibration.</b>				
5.1.8	Does the procedure specify the method for determining the exposure level to ensure contrast and noise levels are controlled to achieve quality inspection results? <b>Recommendation: FWGIDR 002-12: 8.3.5.7</b>				
5.1.9	Does the procedure specify how to identify and handle digital artifacts that might mask or be confused with defects in the material being examined? <b>Recommendation: FWGIDR 002-12: 8.3.5.8</b>				
5.1.10	Does the procedure specify how to update the artifact map for each imaging plate when a new artifact is located? <b>Recommendation: FWGIDR 002-12: 8.3.5.9</b>				
5.1.11	Does the procedure specify how to identify and handle residual images left over from a previous exposure? <b>Recommendation: FWGIDR 002-12: 8.3.5.10</b>				
5.1.12	Does the procedure specify how the system will be checked for performance before each day's production usage, using the method and devices that were initially used to qualify the written procedure? <b>Requirement: ASTM E2033-99: A1.5.5</b>				

	Question	Yes	No	N/A	Remarks
<b>5.2</b>	<b>Calibration Procedures</b>				
5.2.1	Is the frequency of calibration in accordance with manufacturer recommendation? Specify the frequency in the remarks. <b>Recommendation: FWGIDR 002-12: 8.3.5.11</b>				
<b>5.3</b>	<b>Image Display (Monitor) Performance</b>				
5.3.1	Is image display performance checked on a daily basis and documented in a procedure? (Specify procedure and interval in remarks) <b>Recommendation: FWGIDR 002-12: 8.3.5.1</b>				
5.3.2	Is an SMPTE RP133 test pattern used for image display testing? <b>Recommendation: FWGIDR 002-12: 8.3.5.1 &amp; 8.3.5.2</b>				
5.3.2.1	Has the test pattern been configured for the system display resolution and aspect ratio? <b>Recommendation: FWGIDR 002-12: 8.3.5.1 &amp; 8.3.5.2</b>				
5.3.3	Does the procedure specify that the minimum brightness at the maximum DDL shall be measured and specify a minimum of 250 cd/m <sup>2</sup> ? <b>Recommendation: FWGIDR 002-12: 8.3.5.2</b>				
5.3.4	Is a calibrated light meter used to check the display brightness? <b>Recommendation: FWGIDR 002-12: 8.3.5.2</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>Recommendation: FWGIDR 002-12: 8.3.5.2</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>Recommendation: FWGIDR 002-12: 8.3.5.1</b>				
5.3.7	Does the procedure specify that the display shall be free of discernable geometric distortion? <b>Recommendation: FWGIDR 002-12: 8.3.5.1</b>				

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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>Recommendation: FWGIDR 002-12: 8.3.5.1</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>Recommendation: FWGIDR 002-12: 8.3.5.1</b>				
5.3.10	Does the procedure specify checking for display of linear patterns of alternating pixels at low contrast in both the horizontal and vertical directions at the display center and each of the four corner locations without aliasing? <b>Recommendation: FWGIDR 002-12: 8.3.5.1</b>				
<b>5.4</b>	<b>Performance Monitoring</b>				
5.6.1	Does the operating procedure specify the periodicity and method for evaluating the performance of the computed radiography system for degradation? <b>Requirement: ASTM E2033-99: 7.2.1</b>				
<b>5.5</b>	<b>Imaging Plate Handling Procedures</b>				
5.5.1	Has a reference set of known/substantiated artifact image files been created for each uniquely identified image plate? <b>Requirement: ASTM E2445-05: 6.2.7.3</b>				
5.5.2	Are artifact image files updated regularly? <b>Requirement: ASTM E2445-05: 6.2.7.3</b>				
5.5.3	Does the operating procedure specify when and how to get these files updated when a new artifact is located? <b>Recommendation: FWGIDR 002-12: 8.3.5.9</b>				
5.5.4	Does the operating procedure state that all imaging plates be scanned within within a certain period of time of exposure? <b>Recommendation: FWGIDR 002-12: 8.3.5.12</b>				
<b>6</b>	<b>System Performance Tests</b>				
6.1	Has the Initial System Qualification Testing been conducted in accordance with ASTM E2445? <b>Requirement: ASTM E2445-05</b>				

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6.1.1	Was Initial System Qualification Testing done utilizing a CR phantom in accordance with ASTM E2445 or individual equivalent test targets? <i>Requirement: ASTM E2445-05: 4.2</i>				
<b>6.2</b>	<b>Geometric Distortions</b>				
6.2.1	Has spatial linearity of the CR system been evaluated with the horizontal and vertical scales of the ASTM E2445 phantom? <i>Requirement: ASTM E2445-05: 6.2.1.1</i>				
6.2.2	Was measured spatial non-linearity less than 5%? <i>Requirement: ASTM E2445-05: 6.2.1.1</i>				
<b>6.3</b>	<b>Laser Beam Function</b>				
6.3.1	Has laser beam scan line integrity, beam jitter, signal dropout and focus been evaluated with the "T" target on the ASTM E2445 phantom? <i>Requirement: ASTM E2445-05: 6.2.2</i>				
6.3.2	Are the edges of the T straight and continuous? <i>Requirement: ASTM E2445-05: 6.2.2</i>				
6.3.3	Is the image free from under or over-shoot of the scan lines in the light to dark transitions? <i>Requirement: ASTM E2445-05: 6.2.2</i>				
6.3.4	Are the image scan lines of uniform spacing when viewed with 4X magnification? <i>Requirement: ASTM E2445-05: 6.2.2</i>				
6.3.5	Is the image free from scan line dropout, detectable as a lucent straight line in the open field? <i>Requirement: ASTM E2445-05: 6.2.2</i>				
<b>6.4</b>	<b>Shading Evaluation</b>				
6.4.1	Has scanning laser intensity been checked using the three circle targets on the ASTM E2445 phantom? <i>Requirement: ASTM E2445-05: 6.2.5</i>				
6.4.2	Is the average linear pixel value for the two outer circles within +/- 15% of the center circle? <i>Requirement: ASTM E2445-05: 6.2.5</i>				
<b>6.5</b>	<b>Scanner Slipping</b>				
6.5.1	Has slipping of the imaging plates been checked using the slipping target on the ASTM E2445 phantom? <i>Requirement: ASTM E2445-05: 6.2.4</i>				

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	Question	Yes	No	N/A	Remarks
6.5.2	Is there any evidence of slipping or any distortion in the scanning and reading system, shown as deviations in the intensity of the scanned lines? <b>Requirement: ASTM E2445-05: 6.2.4</b>				
<b>6.6</b>	<b>Blooming (flare) and Aliasing</b>				
6.6.1	Has blooming or flaring been checked using the "T" target on the ASTM E2445 phantom? <b>Requirement: ASTM E2445-05: 6.2.3</b>				
6.6.2	Is there any visual evidence of intensity overshoot or streaking in areas with high density contrast? <b>Requirement: ASTM E2445-05: 6.2.3</b>				
<b>6.7</b>	<b>Contrast Sensitivity</b>				
6.7.1	Has contrast sensitivity been evaluated using the contrast sensitivity gauges on the ASTM E2445 phantom? <b>Requirement: ASTM E2445-05: 6.1.1</b>				
<b>6.8</b>	<b>Unsharpness</b>				
6.8.1	Has measured unsharpness been evaluated using the ASTM E2002 duplex wire gauge? <b>Requirement: ASTM E2445-05: 6.1.2</b>				
6.8.3	Has measured unsharpness been evaluated based on a dip between the wires of less than 20%? <b>Requirement: ASTM E2445-05: 6.1.2</b>				
<b>6.9</b>	<b>Signal-to-Noise Ratio</b>				
6.9.1	Has the signal-to-noise ratio been determined by the procedure specified in E2445? <b>Requirement: ASTM E2445-05: 6.2.8</b>				
<b>6.10</b>	<b>Residual Images</b>				
6.10.1	Was residual images checked by thoroughly erasing and subsequently re-exposing uniformly the imaging plate? <b>Requirement: ASTM E2445-05: 6.2.6</b>				
6.10.2	Was the image found to be free of any residual images with a measurable pixel value delta of 1.0% or greater? <b>Requirement: ASTM E2445-05: 6.2.6</b>				

	Question	Yes	No	N/A	Remarks
<b>6.11</b>	<b>Pixel Value Range Qualification</b>				
6.11.1	Have the minimum and maximum pixel value ranges for meeting the initial qualification contrast sensitivity requirements been established? <b>Requirement: ASTM E2033-99: A.1.5.9</b>				
6.11.1.1	Was minimum and maximum pixel value ranges established using EPS testing? <b>Recommendation: FWGIDR 002-12: 5.2.1.1</b>				
6.11.2	Has another methodology for ensuring adequate signal-to-noise been established, approved by the CEO and documented in the procedure? <b>Recommendation: FWGIDR 002-12: 5.2.1.1</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?				
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?				

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	Question	Yes	No	N/A	Remarks
<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)?				
<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 DICOM 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 DICOM format?				

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	Question	Yes	No	N/A	Remarks
<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>				
<b>8.1</b>	<b>Technique Documentation</b>				
8.1	Are the following technique specific items addressed in the written procedure or technique? <i>Requirement: ASTM E2033-99: A1.5.2</i>				
8.1.1	A drawing, sketch, or photograph of a component showing the location of the part and IQI with respect to the radiation source.				
8.1.2	A physical description of the part, including size, thickness, weight and composition				
8.1.3	Classification of the part into zones, if used				
8.1.4	Part masking, if used				
8.1.5	Part masking, if used, for each required view				
8.1.6	The nominal exposure of the x-ray machine, voltage, milliamps, filter, exposure time, frame averages, beam or detector collimation and effective focal spot size.				
8.1.7	Imaging processing methods/techniques employed (i.e. contrast, brightness, magnification, filter types)				
8.1.8	The geometric magnification factor, including source to object and object to detector distances.				
8.1.9	Imaging Plate type and size				
8.1.10	Filter screen types, thicknesses and relative locations, internal and external, of the exposure cassette				
8.1.11	The IQI size and type, required radiographic quality level and minimum quality level.				
8.1.12	Thickness and type of material for shims or blocks.				

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	Question	Yes	No	N/A	Remarks
8.1.13	The window width and level used to visualize the image as well as any digital image zoom.				
8.1.14	Any image processing parameters used to obtain the required image quality or improve fine detail detection.				
8.1.15	The acceptance limits and the zones or sections of the part to which they apply.				
<b>8.2</b>	<b>Total Image Unsharpness</b>				
8.2.1	Is total image unsharpness calculated for each technique and checked against the maximum values agreed upon by the CEO? <b>Recommendation: FWGIDR 002-12: 8.3.5.5</b>				
<b>9</b>	<b>Additional Requirements</b>				
	<i>Note: Additional Requirements listed below have been added at the discretion of the Customer and have not been studied or endorsed by the FWGIDR.</i>				