GE IT
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Historical successes with CR implementation & critical paths to process approval

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"If you went to bed last night as an industrial company, you're going to wake up this morning as a software and analytics company."
Jeff Immelt Chairmen and CEO, GE

Where are we now?

Military and DOD utilizing 500+ CR Systems.

Many are used to inspect for cracking on aircraft

OEM's utilize CR Radiography in their production operations

USAF along with other entities have approved CR for crack detection on their aircraft at a program level

ROI is difficult with singular inspection approvals

Other industries embracing film to digital conversion

2008 US Air Force Working Group Meeting

USAF Computed Radiography System
NSN (6635-01-553-4539RN)

Rhythm Workstation
- Computer
- SVGA Monitor
- High Resolution Monitor
- Rhythm Software

CR50P Phosphor Scanner

Shipping Cases

HP Printer

Phosphor Imaging Plates & Cassettes
13ea – Type: IPX, Size: 14” x 17”
13ea – Type: IPX, Size: 8” x 10”
13ea – Type: IPX, Size: 5” x 7”

Why X-Ray?

OEM’s still rely on RT method for future inspections

CR may Increase method utilization

Composites applications – increasing use of composite structure

Component Inspections

Airline Film to Digital transition Status

Limited Numbers of Inspection approved from CR

Most OEM's require case-by-case approval

Some airlines well on their way to understanding and utilizing CR technology

CR manufactures well versed and dedicated to technology, support requirements and future product innovation
Industry specifications now exist for conversion path

A general reluctance or lack of aircraft and engine OEM support for conversion.

CR System Key Metrics

spatial resolution, and signal-to-noise ratio (SNR). These metrics can be identified measured following existing specification procedures.

Selection of proper IPs (Imaging Plates) is critical. IP's are available in high resolution (HR) and ultra-high resolution (UHR). Lower resolution IP's are available for less critical inspections.

"Scanner features to be aware of include custom IP handling, IP wear and Erasure capabilities. CR systems may have one or multiple monitors. The monitor for viewing the CR image should be a high resolution monitor containing 3 or 5 million pixels". (USAF Report No. AFRL/RXS 14-064

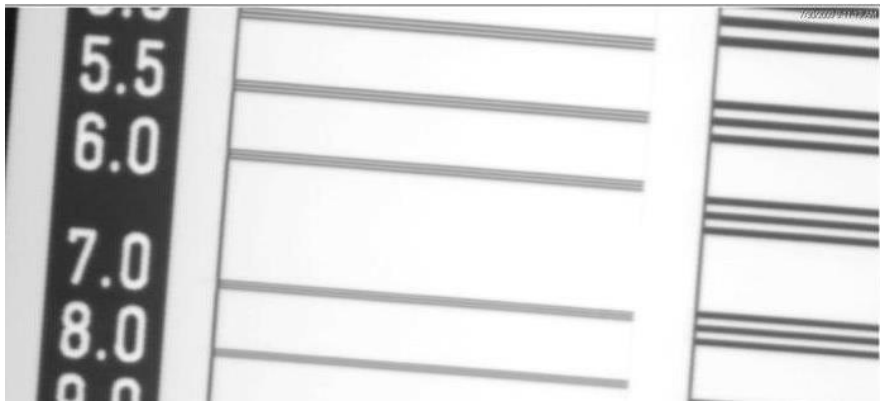
CR System Key Metrics

Pixel Pitch (Sampling Pitch): the geometrical spacing between adjacent samples of the phosphor brightness on an exposed imaging plate

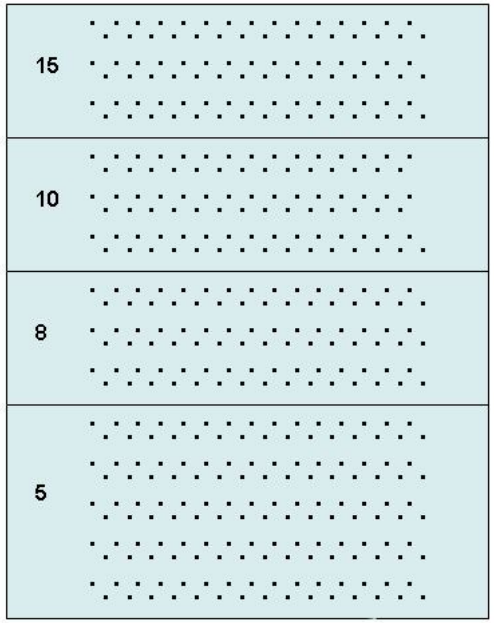
Pixel Value (PV): the numerical value assigned to a sample brightness on an exposed imaging plate

Evaluating Spatial Resolution and Spatial Noise Resolution

Foil Line Pair Gauges



Equivalent Penetrameter Sensitivity (EPS)



minimum of 20 holes (out of 30 holes in each duplex row) are clearly visible

Smaller May Be Better…….

Scanning size and laser spot sizes can be confusing

Example of scanning Pixel Pitch: “shall be capable of scanning at a pixel pitch resolution of 50 microns”

Laser spot size and scanning pixel pitch will typically be different so be aware of this difference.

Smaller scanning size has its advantages and drawbacks. Smaller scanning size is not always better

The bottom line should be Basic Spatial Resolution (BSR), Contrast-to-Noise Ratio (CNR) and Signal-to-Noise Ratio (SNR) for your required applications, which can be determined using the proper procedure and gauges.

Past Efforts

The Federal Working Group on Industrial Digital Radiography (FWGIDR)
formed in 2007, to address the problems and concerns faced by the industrial radiographic community in transitioning to digital radiography

The Metals Affordability Initiative
Funded by USAF was initiated to accelerate the introduction of digital radiography into the aerospace industry for castings. Team members included: US Air Force, GE-Aviation, Boeing, Lockheed-Martin, Honeywell, Pratt & Whitney, Rolls-Royce, Howmet, PCC, GE Inspection Technologies, Fuji, North Star Imaging, VJ Technologies, and Yxlon

Standards created by ASTM

ASTM E746 − 07 (Reapproved 2014)
Standard Practice for Determining Relative Image Quality Response of Industrial
Radiographic Imaging Systems
ASTM E2445/E2445M − 14
Performance Evaluation and Long-Term Stability of Computed Radiography Systems
This practice is intended to be used by the NDT using organization to measure baseline performance of the CR system and to monitor its performance throughout its service as an NDT imaging system.
ASTM E2033
Standard Practice for Computed Radiology. Covers application details and a fairly thorough tutorial of CR.
ASTM E2339
Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation (DICONDE).

Industry Papers

AFRL-RX-WP-TR-2011-4347 (public release version)
Computed Radiography Crack Detection Validation Study. A detailed summary of the USAF crack detection study.

Guide for Qualifications of Digital Radiography Systems and Processes
Developed by the Federal Working Group on Industrial Digital Radiography (FWG-IDR)

Example of CR System Training Courses

Intermediate Digital X-Ray Testing Level II – 40 Hours

Advanced Digital X-Ray Testing Level III – 40 Hours

Computed Radiography (ASTM E2445, ANSI/ASNT CP-105 & NAS 410) – 40 Hours

Digital Film Interpretation – 40 Hours

How do we achieve Conversion Approval?

Historical successes have come from industry teaming efforts like MAI.

We have seen small segmented successes from airlines on an inspection-by-inspection basis.

Many of these OEM's have existing and approved internal procedures they can leverage and most have implemented the technology for their internal use

Approval by specific inspection the ROI will not be acceptable for years to come

How do we achieve Conversion Approval?

The Team should research existing specifications, past transition efforts and papers covering subjects.

The Team will need to identify parameters that provide equivalency of CR Radiography to film radiography, create a PD CID.

Some POD Studies may be required

This approach will greatly reduce the time, cost and effort for an OEM to approve the transition process versus approval on inspection-by-inspection basis (for Airline and OEM NDII Groups)

CR System PD example - USAF

Scope:
"This Product Description (PD) provides the minimum requirements for a Computed Radiography imaging system suitable for NDI of a variety of metallic and non-metallic products used in military aircraft maintenance environments, which may be located at fixed military bases or deployed to austere forward locations"……..

Section 5 – lists Salient Characteristics

How do we achieve Conversion Approval?

Extract technology base that exists with equipment OEM's as they have worked initiatives like this with other industries and attend a CR Radiography or Digital Radiography course or courses to ensure group or working group is properly educated in CR Radiography.

Conclusion:

Gain Technical competence of CR

Study Past Conversion successes

Form Industry Team

Program Level Approval