

Digital Radiography - CR and DDA

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The difference between film and digital radiography is the type of detector. Film uses a photo sensitive emulsion, while digital detectors can either be phosphor imaging plates called computed radiography (CR) or scintillation type detectors called digital detector arrays (DDA). Film produces an image that is viewed under a viewer. Digital produces a digital image that is viewed directly on the monitor

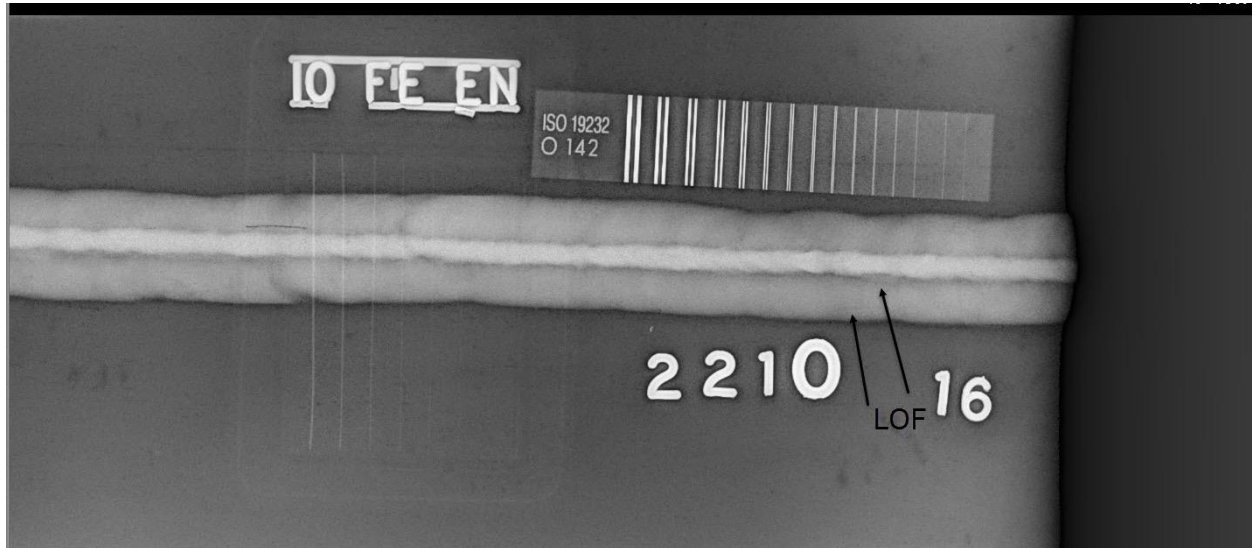


Figure 1. Digital RT image using DDA and X-Rays. Figure shows single wire IQI placed across the weld and 15 pair duplex wire for spatial image resolution placed on the side of the weld

COMPUTED RADIOGRAPHY

Computed radiography uses photostimulable (PSP) plate. PSP plates were first commercialized by Fuji film in the 1980s and is still widely used. The CR systems are available thru many companies to include Durr, Waygate technologies and Carestream. CR consists of a PSP plate and a CR reader or scanner. In the first step, latent image is formed by absorption of X-rays in the PSP plate. X-Ray energy deposited in the PSP plate causes local electrons to be trapped at lattice defects in the PSP crystal lattice. In step two, the exposed PSP plate undergoes a readout process in a CR scanner that produces a X-Ray images.

CR IP plates are generally available in three resolutions. The IP plate resolution class is assigned by BAM certification in Germany. These classes are generally IP 1/120, IP 1/80 and IP 1/50, however they can vary among manufacturers. A IP plate with a lower number will produce a higher resolution image.

DIGITAL DETECTOR ARRAY

There are two types of Digital detector arrays. The first one is based on scintillator converting the incoming X-Rays to light that charges the photodiodes. The second type is direct conversion

with amorphous silicon thin-film transistor for readout. The companies that produce DDA are Vieworks, DRTech and Fuji. DDA are available in a range of resolutions, however for most weld inspections for weld inspections is 99 microns.

ISO Standard 17636-2

ISO 17636-2 specifies techniques for digital radiography to achieve satisfactory and repeatable results. The radiographic techniques are divided into two classes. These are

Class A – Basic techniques

Class B – Improved techniques.

Film and digital radiography requirements to achieve acceptable image are different. Film image has to meet sensitivity, geometrical unsharpness and density. The requirements for digital radiography are

- Sensitivity
- SR_B^{image} - Spatial image resolution
- SNR_n - Normalized signal to noise ratio

Sensitivity: Sensitivity is validated using single wire type IQI or hole type penetrameter. This is same as film radiography.

Spatial image resolution: SR_B^{image} or spatial image resolution is measured using duplex IQI as shown in above figure. Duplex pair IQI can have either 13 or 15 pairs of wires and the ISO standard provides the wire pair to be resolved to meet SR_B^{image} . The required wire pair depends on radiographic class and thickness of the part. See Table B.14 of the ISO 17636-2

Normalized signal to noise ratio. SNR_n or normalized signal to noise ratio is the SNR measured on the image and calculated as $SNR_n = SNR \times 88.6 / SR_B^{image}$. The required SNR_n depends on radiographic class and location of measurement on the part - base metal or weld. See Table 3 of the ISO 17636-2

For a good radiographic inspection, all three parameters sensitivity, SR_B^{image} , and SNR_n must be met.