1.4.7. IMAGE QUALITY ASSESSMENT OF CR SYSTEMS

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Computed and Digital Detector Arrays (CR and DDA) are replacing the traditional film as the technologies of Digital Industrial Radiography (DIR) became more reliable and attractive for inspection companies. Digital Detector Arrays, also named as flat panel detectors, demonstrated the feasibility of the production of radiographic images (High Contrast Sensitivity Radiography) beyond the quality of radiographic films due to special calibration procedures, while high definition CR systems are offered today, which are appropriated for weld inspections.

Exposure condition and image unsharpness are essentially influencing the image quality. The flexibility and the robustness of CR systems with regard to over or under exposure increases the possibility of inappropriate exposed computed radiographs. Imaging plate – Scanner systems exhibit an inherent unsharpness which can restrict their proper application.

Several European – (EN 14784-1, -2) and North American Standards ASTM E 2445, E2446, E 2033 have been set up to ensure a reliable handling of CR systems in the field of non-destructive testing. Image Quality Indicator (IQI) such as wires (EN 462-1, ISO 19232-1 and ASTM E 747), step hole indicators (EN 462-2 and ISO 19232-2) or plate hole indicators (e.g. ASTM E 1025 and E 1742) are world wide proven and accepted to describe the achieved image quality. The required minimum IQI visibility on the computed radiograph shall be similar to that on a “classic” radiographic film and assures the image quality of the image. Contrast detail analysis is commonly used to assess image quality (IQ). Usually, the operator visually detects the contrast detail combinations in the image at a monitor or on the film viewer. The subjective nature of human perception and the variations in the decision of the threshold visibility pose limits to the objective estimation of the minimum value of the IQI detectability. The visibility levels of holes and wires in the image are different. The well known conversion rules for wires to step holes and plate holes are not necessary valid for digital detectors as well as for film radiography. In contradiction to the radiographic film, post-processing tools on the computer can further improve the CR image quality and must be considered in case if computed processing is permitted for the proof of image quality.

Basically, the perception of details on the radiographic image is related to the contrast to noise ratio (CNR) in the region of interest. The CNR is not only influenced by the effective absorption coefficient of the material and its thickness but also by the Signal to Noise Ratio (SNR) in the region of interest. The minimum SNR was introduced for CR systems to ensure a sufficient image quality by a minimal exposure dose. As in the case of IQI’s perception requirements, the minimum SNR values for CR systems were deduced from the required optical density and film system class for Class A and Class B inspections respectively.

The values derived from film system classification seem to be not the optimum values for CR systems. Previous studies at our laboratory have shown that high doses are not necessarily coupled with a higher image quality. The observed spectral sensitivity of the Storage Phosphor Imaging Plates is different from a radiographic film lead combination and does not allow the direct transformation of the maximum X-Ray voltage as given in EN 444 of X-Ray tubes as function of penetrated wall thickness for radiographic films. CR systems do have a distinctive structural noise originated from the IP design.

The ASTM Standard E746-07 defines a procedure for the determination of the Relative Image Quality Response (EPS) of industrial radiographic imaging systems.

In contradiction to a single type IQI tests the experimental set up uses different hole type image quality indicators which are formed together to a penetrameter array.

The concept of large number of holes, regularly arranged in an array, makes not only a statistical evaluation of the relative contrast resolution possible but is also sensitive to inhomogenities of the photosimulable storage phosphor sheet at the Imaging Plate.

The paper will present the influence of X-Ray doses and – source qualities on the relative image response qualities for different CR systems based on the IQI array concept. The results will be compared with image qualities of radiographic films (reference) and related to the measured minimum perception of single wires and holes.

New procedures for a better quality assessment of CR systems and optimized X-Ray voltage selections as function of the penetrated wall thickness and maximum achievable detector SNR will be suggested.