Training program for x-ray inspection film (RT)

In the NDT training course the following knowledge will be educated.

Subject	Level 1	Level 2	Level 3
Preface	+	+	+
Introduction	+	+	+
Properties of X rays and gamma rays	+	+	+
- X rays	+	+	+
- Properties of X rays and gamma rays	+	+	+
- Gamma rays	+	+	+
- Wave length or energy of electromagnetic radiation	+	+	+
- Intensity, dose and dose output of X rays	+	+	+
Basic physical principles	+	+	+
- X rays	+	+	+
- Generation of X rays	+	+	+
- Electron source	+	+	+
- Target	+	+	+
- Electron acceleration	+	+	+
- Intensity	+	+	+
- X-ray spectrum	+	+	+
- Continuous X-ray spectra	+	+	+
- Continuous spectra and characteristic radiation	---	+	+
- Interaction with matter	+	+	+
- Structure of the atoms	+	+	+
- Ionization	+	+	+
- Photoelectric effect	+	+	+
- Compton effect	+	+	+
- Pair formation effect	+	+	+
The human eye	+	+	+
- Anatomy	+	+	+
- How does seeing work?	+	+	+
- Light and dark adaptation	+	+	+
- Ametropia	+	+	+
- Eye tests	+	+	+
- Harmful effects of optical radiation on the eye	---	---	+
- Exposure limits and specifications	---	---	+
- Protective measures	---	---	+
- First aid measures	---	---	+
Radiographic inspection	+	+	+
- General information	+	+	+
- Absorption behavior of different materials	+	+	+
- Examples of different material thicknesses	+	+	+
- Examples of different materials	+	+	+
- Examples of varying beam quality with the intensity unchanged	+	+	+
- X-ray inspection of solids	+	+	+
- Stray radiation	+	+	+
- Internal stray radiation	+	+	+
- Lateral stray radiation	+	+	+
- Backscatter	+	+	+

continued

Subject	Level 1	Level 2	Level 3
Geometric fundamentals of image generation	+	+	+
- Geometric unsharpness U_g	+	+	+
- Image distortion	+	+	+
- The inverse square law	+	+	+
- New exposure rate	+	+	+
X-ray units	+	+	+
- X-ray tubes	+	+	+
- Cathode	+	+	+
- Heating filament	+	+	+
- Anode	+	+	+
- Focus	+	+	+
- Focusing	+	+	+
- Ray exit window	+	+	+
- Determination of focus size	---	+	+
- Electric power supply	+	+	+
- Cooling	+	+	+
- Control unit	+	+	+
- Operation of X-ray units	+	+	+
- Current-voltage characteristic	---	+	+
X-ray films	+	+	+
- General information	+	+	+
- Structure of X-ray films	+	+	+
- Film density	+	+	+
- Film sensitivity (speed)	+	+	+
- Film graininess	+	+	+
- Image quality	+	+	+
- Contrast	+	+	+
- Sharpness	+	+	+
- Film density	+	+	+
- Film viewer	+	+	+
- Sensitometric curve	+	+	+
Film development	+	+	+
- Manual development	+	+	+
- Developer bath	+	+	+
- Stop bath	+	+	+
- Fixing bath	+	+	+
- Watering	+	+	+
- Wetting agent bath	+	+	+
- Drying	+	+	+
- Automatic film processing	+	+	+
- Shelf life of X-ray films	+	+	+
Darkroom equipment	+	+	+
- Protection against external light	+	+	+
- Darkroom illumination	+	+	+
- Installation of automatic developing equipment	+	+	+
- Manual developing equipment	+	+	+
- Drying cabinet	+	+	+
- Cleanliness	+	+	+
- Film defects and their causes	+	+	+

continued

Subject	Level 1	Level 2	Level 3
Film-based imaging technique	+	+	+
- Auxiliary equipment	+	+	+
- Image quality indicators	+	+	+
- Apertures	+	+	+
- Filters	+	+	+
- Intensifier foils	+	+	+
- Lead screens and shot	+	+	+
- Determination of image quality	+	+	+
- Cassettes, film bags, etc.	+	+	+
- Scales, tape measures, protractors	+	+	+
- Positioning aids	+	+	+
- Lead letters, numerals, screens	+	+	+
- Screening	+	+	+
- Densitometer	+	+	+
- X-ray exposure diagrams	+	+	+
- Sensitometric curve	+	+	+
- Correction factor for X-ray equivalents	+	+	+
- Image sharpness	+	+	+
- Internal unsharpness U_i	+	+	+
- Film-focus distance	+	+	+
- High-definition radiography	---	+	+
Image quality indicators	+	+	+
- Hole penetrameters	+	+	+
- Hole penetrameter as per ASTM E 1025	+	+	+
- Hole penetrameter as per ASTM E 1742	+	+	+
- Pratt & Whitney TAMs (Tool Aerospace Manuals)	+	+	+
- Adjusting washers, blocks, step wedges	+	+	+
- Wire penetrameters	+	+	+
- Wire penetrameter as per DIN EN 462	+	+	+
- Wire penetrameter as per ASTM E 747	+	+	+
Definition of X-ray inspection procedure	+	+	+
- Basic conditions	+	+	+
- X-ray beam angle	+	+	+
- Arrangement of focus	+	+	+
- Central beam	+	+	+
- Location of discontinuities	+	+	+
- Film identification marking	+	+	+
- Image quality indicator	+	+	+
- Density requirements	+	+	+
- Applications	+	+	+
- Welds between sheets	+	+	+
- Heat-affected zones	+	+	+
- Welds between tubes	+	+	+
- Panoramic exposures	---	+	+
- Determination of indication depth (parallax method)	---	+	+
Establishment of exposure data	+	+	+
- Example 1 (limiting energy and exposure rate)	+	+	+
- Example 2 (different film sensitivity)	+	+	+
- Example 3 (different distance)	+	+	+
- Overview of calculation steps	+	+	+
- Example 4 (different wall thicknesses)	---	+	+
- Example 5 (double-exposure method)	---	+	+
Other imaging systems	+	+	+
- Radioscopy	+	+	+
- Image intensifier	+	+	+
- Quantum noise	---	+	+
- Computer tomography	---	+	+

continued

Subject	Level 1	Level 2	Level 3
- Neutron radiography	---	+	+
- Neutrons	---	+	+
- Neutron-matter interaction	---	+	+
- Principles of neutron radiography	---	+	+
- Functioning of the neutron source	---	+	+
- Detector systems	---	+	+
- Applications	---	+	+
Inspection system requirements	+	+	+
- Daily checks	+	+	+
- X-ray facility	+	+	+
- Densitometer	+	+	+
- Film viewer	+	+	+
- Checks to be performed at longer intervals	+	+	+
- Film	+	+	+
- Development processes	+	+	+
- Step wedges	+	+	+
- Lux meter	+	+	+
- IQIs, step wedges, blocks and adjusting washers	+	+	+
Evaluation	+	+	+
- Causes of defects	+	+	+
- Defects caused during the manufacture of blanks	---	+	+
- Defects caused by processing and machining	---	+	+
- Defects occurring in operation	---	+	+
- Manifestation of defects	+	+	+
- Types and causes of indications	+	+	+
- Assessment of indications	---	+	+
- Definition of inspection characteristics	---	+	+
- Acceptance limits	---	+	+
- Assessment of indications (component-specific specifications)	---	+	+
- Applicable documents	+	+	+
- Acceptance limits	---	+	+
- Assessment aids	---	+	+
- Identification marking	---	+	+
- Assessment of castings	---	+	+
Documentation	+	+	+
- Data sheet / inspection instructions	+	+	+
- Inspection report	+	+	+
Radioactive sources	+	+	+
- Radioactivity	---	+	+
- Natural radioactive elements	---	+	+
- Artificial radioactivity	---	+	+
- Advantages of sources of artificial radioactivity	---	+	+
- Disadvantages when used for radioscopy	---	+	+
- Units	---	+	+
- Activity	---	+	+
- Ion dose	---	+	+
- Energy dose	---	+	+
- Equivalent dose (personal dose)	+	+	+
- Half life of a radioactive element	+	+	+
- Half value layer	+	+	+
Protection against radiation during X-ray inspection	+	+	+
- X-ray unit	+	+	+
- X-ray quality	+	+	+
- X-ray ordinance	+	+	+
- Basic requirements	+	+	+
- Maximum permissible X-ray dose	+	+	+
- Basic principles of protection against radiation	+	+	+

continued

Subject	**Level 1**	**Level 2**	**Level 3**
- Measurement of radiation	+	+	+
- Pocket dosemeter	+	+	+
- Film dosemeter	+	+	+
- Ionization chamber	---	+	+
- Radiation-counter tube	---	+	+
- Screening	+	+	+
Other NDT methods	+	+	+
- Penetrant inspection	---	+	+
- Ultrasonic inspection	---	+	+
- Eddy-current inspection	---	+	+
- Thermography	---	+	+
- Magnetic particle inspection	---	+	+
- Visual inspection	+	+	+
Requirements on inspection personnel	+	+	+
Environmental protection	+	+	+
Standards and guidelines	+	+	+

\+ subitem of the level
--- no item of the level

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