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## **CERTIFICATION OF PERSONNEL ENGAGED IN COMPUTED RADIOGRAPHIC TESTING (CRT) AND/OR COMPUTED RADIOGRAPHIC INTERPRETATION (CRI)**

### **ASSOCIATED DOCUMENTS:**

PSL/68 - Eligibility in PCN qualification examinations for holders of other Certification

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The British Institute of Non-Destructive Testing is an accredited certification body offering personnel and quality management systems assessment and certification against criteria set out in international and European standards through the PCN Certification Scheme.

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# **SPECIFIC REQUIREMENTS FOR THE CERTIFICATION OF PERSONNEL ENGAGED IN COMPUTED RADIOGRAPHIC TESTING**

## **1. SCOPE**

1.1 This document prescribes the generic requirements and procedures by which personnel may be examined and, if successful, certified competent for Computed Radiographic Testing (CRT) and/or Computed Radiographic Interpretation (CRI)

1.2 This certification is generic and does not apply to any specific proprietary equipment. Employers must satisfy themselves that individuals are sufficiently competent at using specific equipment types and versions of software in the appropriate product sector.

1.3 Requirements contained in this document are supplementary to those contained in the current edition of the PCN General Requirements for Certification of Personnel engaged in Non-Destructive Testing. Information on the status of PCN documents is available from [www.bindt.org](http://www.bindt.org).

## **2. ELIGIBILITY**

### **2.1 For examination**

2.1.1 Candidates will hold current, valid PCN Level 1, 2 or Level 3 Radiographic Testing (RT) certification or Radiographic Interpretation (RI) certification, as appropriate. EN ISO 9712 RT or RI certification issued by bodies other than BINDT may be accepted on a case by case basis (see PSL/68). Candidates attempting the CRT L3 must hold CRT L2 or will be required to successfully complete the examination in clause 3.2 to be eligible for the examination.

### **2.2 For certification**

2.2.1 Candidates will be required to demonstrate satisfactory completion of a validated CRT or CRI course, as appropriate, at a BINDT Accredited Training Organisation, the duration of which is not less than shown in Table 1.

2.2.2 Candidates will be required to provide verifiable evidence of CRT and/or CRI experience (as appropriate) gained under supervision, the duration of which is not less than shown in Table 1.

Table 1	CRT Level 1	CRI (Interpretation)	CRT Level 2	CRT Level 3
Minimum training duration (hours) – see Note 1.	16	16	24	24
Minimum experience duration (months)	1	3	3	6

## **3. EXAMINATION CONTENT**

### **3.1 Level 1 CRT Data Acquisition**

Except where exemptions apply (refer to PCN General Requirements), all candidates will be required to attempt an examination comprised of the following parts:

3.1.1 Sector specific written examination covering the application of the CRT method in the sector(s) concerned including basic production processes and associated defects. (See PCN GEN)

3.1.2 Sector Specific Practical examination (see Note 2) comprising:

- (i) the radiographic testing of 3 specimens, selected by the examiner as appropriate to the certification sought (see Note 3), in accordance with NDT instructions provided.
- (ii) evaluation of the suitability for interpretation of the images produced during (i) above.

The total time allowed for the practical part is 5 hours. The minimum pass mark for the practical part is 70% in each sample tested

### **3.2 Level 2 CRT Data Acquisition and Interpretation**

Except where exemptions apply (refer to PCN General Requirements), all candidates will be required to attempt an examination comprised of the following parts:

3.2.1 Sector specific written examination covering the application of the CRT method in the

sector(s) concerned, (see PCN GEN).

3.2.2 Sector Specific Practical examination (see Note 2) comprising:

- (i) the evaluation of a phantom image (see Note 4) to verify the testing system
- (ii) the examination described at 3.1.2 above (unless a valid PCN Level 1 CRT certificate is held).
- (iii) preparation of a detailed NDT Instruction to a provided code, specification or standard for one specimen. Prove this instruction by creating appropriate image(s)
- (iv) viewing, interpreting and reporting on a total of 6 images representative of the categories of certification sought.

The total time allowed for the practical part is 8 hours. The minimum pass mark for the practical part is 70% in each sample tested and image interpreted

### 3.3 Computed Radiographic Interpreter (Level 2).

Except where exemptions apply (refer to PCN General Requirements), all candidates will be required to attempt an examination comprised of the following parts:

3.3.1 Sector specific written examination covering the application of the CRT method in the sector(s) concerned. The maximum time allowed is 2 minutes per question. The minimum pass mark is 70%

3.3.2 Sector Specific Practical examination requiring the candidate to read, mark up and report on a total of 6 images representative of the categories of certification sought. Maximum time allowed: 1½ hours. The pass mark is 70% for each radiographic image interpreted.

### 3.4 Level 3 CRT

3.4.1 All candidates will be required to attempt a Main Method examination comprising the following parts.

- i) 30 multiple choice questions covering the General Theory of the application of CRT. (60 minutes).
- ii) 20 multiple choice questions covering the Specific Theory of the application of CRT in the sector concerned, including the applicable codes, standards, and specifications. This may be an open book examination in relation to codes, standards, and specifications. (40 Minutes)
- iii) The candidate will be required to produce a comprehensive CRT test procedure embodying an NDT Instruction for a specific configuration to a provided specification, standard or code. (4 hours)

## 4. CERTIFICATION AVAILABLE (see Note 5)

4.1 Level 1 CRT of general engineering materials, components and fabrications in the pre and in-service inspection multi-sector

4.2 Level 2 CRT (includes Interpretation) of general engineering materials, components and fabrications in the pre and in-service inspection multi-sector.

Alternatively, Level 1 and Level 2 candidates may apply for single sector certification covering one (**only**) of the following groups:

4.2.1 Castings

4.2.2 Welds

4.2.3 Wrought Products

4.3 CRT Interpreter of data covering **one** of the following: Multi Sector or single sector for Castings, Welds **or** Wrought Products

4.4 Level 3 CRT of Castings, Welds and Wrought Products (all 3 sectors).

Candidates who achieve an overall score of 80% or more for Level 1, 2 and 3 examinations shall be awarded with the distinction level 'D' (refer to PCN GEN – Grading of Examinations).

## **5. RENEWAL AND RECERTIFICATION**

- 5.1 The general rules for Level 1 and 2 renewal and recertification are given in PCN document CP16.
- 5.2 The general rules for Level 3 renewal and recertification are given in PCN document CP17.

## **6. SUPPLEMENTARY EXAMINATIONS**

6.1 Candidates holding certification in one product sector who wish to add another single sector will be required to pass a further practical examination comprising the testing of 3 samples selected by the examiner as representative of the single sector sought.

Candidates should note that this will result in 2 separate certificates being held and will need to be maintained separately.

6.2 Candidates holding certification in one product sector who apply for certification in the multi-sector (all product sectors) will be required to pass a further practical examination comprising the testing of three samples selected by the examiner as representative of the additional sectors sought (see Clause 4.2 above). Level two candidates attempting supplementary examination will not be required to produce a written instruction (Clause 3.2.2 (iii)).

## **7. GRADING**

To be eligible for certification all candidates must achieve an overall score of no less than 80%, which is the average of the scores for the general, specific and practical examination parts. All examination scores shall be of equal weight in determining the average score.

## **8. NOTES**

**NOTE 1:** Up to 50% of the required minimum training hours previously obtained at non-accredited training establishments may be accepted with the provision of supporting documentary evidence in a form acceptable to PCN.

**NOTE 2:** At the discretion of the examiner oral questions may be used to support the practical examination to ensure the candidate's ability to fully understand the requirements.

**NOTE 3:** The examiner will select test pieces which will ensure a comprehensive test of the technician's abilities in the selected sector.

**NOTE 4:** Definition of the term 'Phantom' from BS EN 14784-1: 2005: 'a device containing an arrangement of test targets to evaluate the quality of a CR system as well as monitoring the quality of the chosen system'

**NOTE 5:** The candidate will need to hold Level 2 in the sector they wish to apply for Level 3 in. (i.e Level 2 CRT in Welds, can apply for CRT L3 Welds but will need to complete the Level 2 practical & Specific theory in the other sectors if applying for more than one sector).

## **TRAINING SYLLABUS FOR COMPUTED RADIOGRAPHIC TESTING**

### **SYLLABUS SPECIFIC TO LEVEL 1, 2 & 3 COMPUTED RADIOGRAPHIC TESTING (CRT).**

Minimum quality requirements to be in accordance with appropriate National and International Standards

#### **1.0     Sectors**

- 1.0.1   Welds
- 1.0.2   Castings
- 1.0.3   Wrought
- 1.0.4   Other specialised techniques may be added as appropriate

Note: Product knowledge specific to the sector sought is essential

#### **2.0     Equipment**

- 2.0.1   Suitable imaging plates
- 2.0.2   Cassettes
- 2.0.3   CR Scanner
- 2.0.4   Radiation sources
- 2.0.5   Appropriate workstation
- 2.0.6   Suitable quality and measurement indicators
- 2.0.7   Category representative samples must be available

#### **3.0     Calibration**

Requirement for functional check for data recording and suitability of system over time

#### **4.0     System parameters**

- 4.0.1   Scanner types
- 4.0.2   Scan resolution
- 4.0.3   Scanner speed
- 4.0.4   Gain setting
- 4.0.5   Imaging plate types
- 4.0.6   Bit range
- 4.0.7   Filtration
- 4.0.8   Software tools (including BSR and SNR)
- 4.0.9   Monitor resolution
- 4.0.10  Image formats

#### **5.0     Practical considerations**

- 5.0.1   Handling of phosphor screen
- 5.0.2   Ambient lighting levels and effects on imaging plates
- 5.0.3   Effect of temperature
- 5.0.4   Image plate fading/burn in
- 5.0.5   Effects of scatter and fluorescence
- 5.0.6   Imaging plate dose and saturation
- 5.0.7   Archiving

6 Measurement

- 6.0.1 Specific to each application and defined in the technique
- 6.0.2 Software specific parameters
- 6.0.3 Calibration of measuring tool
- 6.0.4 Effects of magnification
- 6.0.5 Constraints, limitations and capabilities of system accuracy/measurement

7 \*Interpretation

- 7.0.1 Manipulation/enhancement of image
- 7.0.2 Use of analysis software
- 7.0.3 Acceptance criteria
- 7.0.4 Viewing conditions

8 \*Reporting

Defined by user requirements or specification requirements

9 \*Procedure writing (See CP25 for guidance)

For level 3 candidates only

\*Note: The Level 1 syllabus is all the above excluding the interpretation, reporting and procedure writing.

## REFERENCE LITERATURE

### Recommended Reading

- ❑ BS EN ISO 19232-1: Non-Destructive Testing. Image quality of radiographs. Determination of the image quality value using wire-type image quality indicators.
- ❑ BS EN ISO 19232-5: Non-Destructive Testing. Image quality of radiographs. Determination of the image unsharpness value using duplex wire-type image quality indicators.
- ❑ BS EN 14784- Part 1: Non-Destructive Testing. Industrial computed radiography with storage phosphor imaging plates. Classification of systems
- ❑ BS EN 14784- Part 2: Non-Destructive Testing. Industrial computed radiography with storage phosphor imaging plates. General principles for testing of metallic materials using X-Rays and gamma rays
- ❑ EN 444, Non-destructive testing – General principles for radiographic examination of metallic materials using X-rays and gamma-rays
- ❑ ISO 11699-1, Non-destructive testing – Industrial radiographic films Part 1: Classification of film systems for industrial radiography
- ❑ ISO 5579, Non-destructive testing – Radiographic examination of metallic materials by X-and gamma rays – Basic rules

## SPECIMEN QUESTIONS FOR COMPUTED RADIOGRAPHIC TESTING EXAMINATIONS

### Level 1 Specimen Questions

- 1 Profile Radiography is also known as;
  - a) Computed Radiography
  - b) Tangential Radiography
  - c) Comparative Radiography
  - d) Stereo Radiography
- 2 Geometric unsharpness can be caused by which of the following factors
  - a) Too small a Source to film Distance (SFD)
  - b) Too large a physical source size
  - c) Too large an Object to Film Distance (OFD)
  - d) All of the above
- 3 In Profile Radiography, the Object to Film Distance (OFD) is measured as;
  - a) The pipe diameter
  - b) The distance between the front of the pipe and the film
  - c) The distance from the centreline of the pipe to the film
  - d) The pipe wall thickness
- 4 Comparators are used to provide;
  - a) A contrast comparison
  - b) A measure of the geometric unsharpness present
  - c) A density comparison between the inside and outside of the pipe
  - d) A reference of a known size that is projected on to the image plate
- 5 The image that is stored on the computer, but has not been enhanced or manipulated is known as;
  - a) The Latent image
  - b) The Primary image
  - c) The Unprocessed image
  - d) The Raw image

### Level 2 Specimen Questions

- 1 CO<sub>2</sub> corrosion is characterised by.
  - a) A very smooth surface
  - b) Heavy localised pitting
  - c) Heavy general pitting
  - d) Heavy pitting with a Sulphide film
- 2 Bimetallic / Galvanic corrosion is associated with which of the following.
  - a) Vibration and general movement between 2 load bearing surfaces
  - b) Two dissimilar metals in contact/close proximity



- c) A highly corrosive environment
  - d) Two similar metals in a dielectric solution where an electrical current passes between them
- 3 Fretting corrosion is characterised by
- a) Deep heavy pitting
  - b) Material loss caused by the rubbing action of solid particle
  - c) Smooth surface with material loss
  - d) A scab like appearance with heavy corrosive products beneath
- 4 Micro-biological corrosion will normally be found in areas of
- a) High velocity and high particulate content
  - b) Dead legs and stagnant areas
  - c) Under fibreglass insulation
  - d) High temperatures
- 5 When CO<sub>2</sub> mixes with water, an aggressive acid is formed that will gradually eat away at the parent material. This acid is called.
- a) Concentrated Hydrochloric acid
  - b) Sulfuric acid
  - c) Carbonated Hydrochloric acid
  - d) Carbonic acid
- 6 The most common form of corrosion found on unprotected pipe supports and clamps is
- a) Bi-metallic
  - b) Crevice
  - c) Galvanic
  - d) Micro-biological
- 7 Hydrogen Induced Cracking (HIC) and hydrogen blisters are associated with which process environments
- a) Hydrocarbon
  - b) Water processing
  - c) Acid
  - d) Caustic
- 8 Smoothing of the enhanced image is carried out by
- a) Using high pass filters
  - b) Using low pass filters
  - c) Reducing the edge contrast effect
  - d) Blurring of the pixel
- 9 Blow-up of the image is defined as
- a) The increase in the apparent size of an object when its shadow is projected onto a surface
  - b) The percentage distortion or geometric enlargement of an image when projected onto the screen

- c) When a three dimensional object is projected onto a two dimensional plane, blow-up is the amount of distortion present
  - d) None of the above
- 10 What is meant by the term "Burn-off"
- a) That part of the image that is too dark to see
  - b) The apparent thinning of the pipe OD due to overexposure
  - c) The blurring and distortion seen at the edges of the image
  - d) Damage to the screen caused by heat, resulting in an area of blackness in the image.

### **Level 3 Specimen Questions**