

PCN/GEN Appendix C2 ISSUE 7 REV A

CERTIFICATION OF PERSONNEL FOR RADIOGRAPHIC TESTING OF WELDS

ASSOCIATED DOCUMENTS:

Annex Z1 to PCN/GEN (examination syllabus compendium)

Annex Z2 to PCN/GEN (example examination questions)

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CERTIFICATION OF PERSONNEL FOR RADIOGRAPHIC TESTING OF WELDS

1. SCOPE

This document prescribes the specific requirements and procedures by which personnel may be examined and, if successful, certified competent for the radiographic testing of welds. Requirements contained in this document are supplementary to those contained in PCN General Requirements for Certification of Personnel engaged in Non-Destructive Testing.

2. EXAMINATION CONTENT

General information on examination content and time allowed for each written part is described in PCN General Requirements for Certification of Personnel engaged in Non-Destructive Testing. This Appendix amplifies the provisions of that document only where necessary.

2.1 Level 1

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

2.1.1 General Theory of the Radiographic NDT method.

2.1.2 Sector Specific Theory of the application of the Radiographic NDT method to welds.

2.1.3 Sector Specific Practical examination comprising:

- (i) testing five specimens selected by the examiner from plate butt welds and pipe butt welds using single wall single image, double wall single image and double wall double image techniques in accordance with the NDT instructions provided.
- (ii) examine and evaluate the suitability for interpretation of the radiographs produced during (i) above.
- (iii) reporting significant areas for further investigation detected in (ii) above in a prescribed manner in accordance with the NDT instructions provided.

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 radiograph interpreted

NOTE: *PCN radiography certificates are valid only so long as the holder holds any other level of PCN radiation protection certification, or valid radiation safety certification recognised by the British Institute of NDT. For initial radiography candidates, the basic radiation safety examination may be taken at the same time as the radiography examination.*

2.2 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:

2.2.1 General Theory of the Radiographic Method.

2.2.2 Sector Specific Theory of the application of the Radiographic method in the testing of welds in all metal groups (regardless of the category of certification sought) including basic weld production processes and associated defects.

2.2.3 Sector Specific Practical examination comprising:

- (i) testing five specimens from plate butt welds and pipe butt welds in metals selected by the examiner appropriate to the certification sought (refer to Clause 3) using single wall single image, double wall single image and double wall double image techniques. Basic instructions on the techniques to be used, and the sensitivities required will be provided.
- (ii) processing the resulting radiographs and reporting significant areas for further investigation detected in (i) above in a prescribed manner in accordance with the NDT instructions provided. Time allowed: 2 hours per sample.
- (iii) NDT Instruction Writing. Candidates will be required to prepare a detailed NDT Instruction to provided codes, specifications or standards for one of the specimens

described in (i) above. The instruction shall include any calculations necessary to determine inspection sensitivity and film density. Time allowed: 1 hour per sample.

- (iv) Radiographic Interpretation. The candidate will be required to read, mark up and report on a total of 12 radiographs representative of the categories of certification sought (the candidate will read and report on 12 radiographs regardless of the categories attempted). Time allowed: 3 hours.

The total time allowed for the practical part is 18 hours. The minimum pass mark for the practical part is 70% in each sample tested and radiograph interpreted.

<i>Category</i>	<i>Light</i>	<i>Dense</i>	<i>Combined</i>
<i>No of samples</i>	12	12	12 (6 Light + 6 Dense)

NOTE: PCN radiography certificates are valid only so long as the holder holds any other level of PCN radiation protection certification, or valid radiation safety certification recognised by the British Institute of NDT. For initial radiography candidates, the basic radiation safety examination may be taken at the same time as the radiography examination.

2.3 Level 3

Except where exemptions apply (refer to PCN General Requirements), all candidates will be required to attempt an examination comprising a Basic examination and a Main Method examination. Information on the content and grading of PCN level 3 examinations is provided in PCN General Requirements for Certification of Personnel engaged in Non-Destructive Testing.

Level 3 candidates who do not hold PCN level 2 certification for radiography of welds, or whose certification category does not include gamma radiography, are required to successfully complete the examination described in Clause 2.2.3 for x and gamma radiography (certification category 3.2.4).

NOTE: PCN radiography certificates are valid only so long as the holder holds any other level of PCN radiation protection certification, or valid radiation safety certification recognised by the British Institute of NDT. For initial radiography candidates, the basic radiation safety examination may be taken at the same time as the radiography examination.

2.4 Radiographic Interpreter (Welds)

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

2.4.1 General Theory of the Radiographic Method.

2.4.2 Sector Specific Theory of the application of the Radiographic method in the testing of welds in all metal groups (regardless of the category of certification sought), and ten further questions covering all basic weld production processes and associated defects.

2.4.3 Sector Specific Practical examination requiring the candidate to read, mark up and report on a total of 12 radiographs representative of the categories of certification sought (the candidate will read and report on 12 radiographs regardless of the categories attempted). Maximum time allowed: 3 hours. The pass mark is 70% for each radiograph interpreted.

<i>Category</i>	<i>Light</i>	<i>Dense</i>	<i>Combined</i>
<i>No of samples</i>	12	12	12 (6 Light + 6 Dense)

3. CERTIFICATION AVAILABLE

3.1 Level 1

3.1.1 X-Radiography of Light Metal Welds.

3.1.2 X-Radiography of Dense Metal Welds.

3.1.3 Gamma Radiography of Dense Metal Welds.

3.1.4 X-Radiography and Gamma Radiography of Dense Metal Welds.

3.1.5 X-Radiography of Light and Dense Metal Welds and Gamma Radiography of Dense Metal Welds.

3.2 Level 2

3.2.1 X-Radiography of Light Metal Welds.

3.2.2 X-Radiography of Dense Metal Welds.

3.2.3 Gamma Radiography of Dense Metal Welds.

3.2.4 X-Radiography and Gamma Radiography of Dense Metal Welds.

3.2.5 X-Radiography of Light and Dense Metal Welds and Gamma Radiography of Dense Metal Welds.

3.3 Level 3 Radiographer (Welds)

3.4 Radiographic Interpreter (Welds).

This qualification will cover weld radiographs from either or both of the following groups:

3.4.1 'Dense metal welds' comprising ferritic steels including clad steels, Austenitic steels and high nickel alloys, Copper, Copper alloys, Monel and Titanium alloys: manufactured by the MMA, MAG, MIG, TIG, mechanised fusion welding, and oxy-acetylene welding processes.

3.4.2 'Light metal welds' comprising aluminium, Magnesium and their alloys: manufactured by the MIG and TIG welding processes.

4. RENEWAL AND RECERTIFICATION

4.1 The general rules for level 1 and level 2 renewal and recertification are fully described in PCN document CP16, and the rules for level 3 recertification are detailed in PCN document CP17.

4.2 Level 1 certificate holders seeking recertification will be required to undertake the practical examination detailed at Clause 2.1.3 above, except that they will test only three welded samples.

4.3 Level 2 certificate holders seeking recertification will be required to undertake the practical examination detailed in Clause 2.2.3 above, except that they will test only three welded samples and read, interpret and report on two radiographs from each metal group they hold certification for (groups are detailed in Clause 3.4).

4.4 Radiographic Interpreters seeking recertification will be required to read, interpret and report upon two radiographs from each metal group they hold certification for (groups are detailed in Clause 3.4).

4.5 The minimum pass mark for recertification is 80% and only one retest of failed recertification examinations is permitted. Failure in the one allowable retest results in the applicant being considered an initial candidate for certification in that sector, and NDT method.

NOTE: *PCN radiography certificates are valid only so long as the holder holds any other level of PCN radiation protection certification, or valid radiation safety certification recognised by the British Institute of NDT. The radiation safety examination may be taken at the same time as the recertification examination.*

5. SUPPLEMENTARY EXAMINATION CONTENT

5.1 PCN Level 1 Radiography of Welds certificate holders wishing to upgrade to level 2 are required to be successful in all level 2 examination parts detailed in Clause 2.2 above, except that the specimens tested will number only three in appropriate metals.

5.2 Existing PCN level 1 certificate holders who apply to be certificated for additional groups will be required to pass a further practical examination comprising the testing of three appropriate samples and reading/reporting on radiographs from the group in which certification is sought (see Clause 3.1 above).

5.3 Existing PCN level 2 certificate holders who apply to be certificated for additional groups will be required to pass a further practical examination comprising the testing of three appropriate samples and reading/interpreting/reporting on radiographs from the group in which certification is sought (see Clause 3.2 above).

5.4 Existing PCN radiographic interpreters who apply to be certificated for additional groups will be required to pass a further practical examination comprising reading/interpreting/reporting on a total of 12 radiographs for each group in which supplementary certification is sought (see Clause 3.4 above).

6. GRADING

General information on the composite grading of examinations will be as specified in the current edition of PCN General Requirements, and information on the grading of practical examinations is provided in PCN document CP22.

REFERENCE LITERATURE

Essential Reading - radiographic theory and practical

- BS 499 Part 1 : Glossary for welding, brazing and thermal cutting.
- BS 2633 : Class 1 arc welding of ferritic steel pipework for carrying fluids.
- BS 3455 : Glossary of terms used in nuclear science and technology.
- BS 5650: Specification for apparatus for Gamma radiography.
- BS EN 444: Industrial Radiography-General principles for radiographic examination of metallic materials using X and Gamma rays
- BS EN 462-1: NDT Image Quality of Radiographs - Image quality indicators (wire type) determination of image quality value
- BS EN 462-2: NDT Image Quality of Radiographs –Image quality indicators (step/hole type) – Determination of image quality value
- BS EN 462-3: NDT Image Quality of Radiographs - Image quality classes for ferrous metals
- BS EN 462-5: NDT Image Quality of Radiographs - Image quality indicators (Duplex wire type) determination of total image unsharpness value.
- BS EN 584-1: Industrial Radiographic Film - Part 1: Classification of films systems for industrial radiography
- BS EN 584-2: Non-destructive testing. Industrial radiographic film. Control of film processing by means of reference values
- BS EN 895: Destructive tests on welds in metallic materials. Transverse tensile test
- BS EN 910: Destructive tests on welds in metallic materials. Bend tests
- BS EN 1320: Destructive tests on welds in metallic materials. Fracture tests
- BS EN 1321: Destructive test on welds in metallic materials. Macroscopic and microscopic examination of welds
- BS EN 1330-1: Non-destructive testing-Terminology – Part 1 List of general terms
- BS EN 1330-2: Non-destructive testing-Terminology – Part 2 Terms common to the non-destructive testing methods
- BS EN 1330-3 : Non-destructive testing - Terminology. Terms used in industrial radiographic testing.
- BS EN 1435 : Non-destructive examination of welds. Radiographic examination of welded joints.
- BS EN 12543-1: Non-destructive testing. Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing. Scanning method.
- BS EN 12543-2: Non-destructive testing. Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing. Pinhole camera radiographic method
- BS EN 12543-3: Non-destructive testing. Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing. Slit camera radiographic method

- ❑ BS EN 12543-4: Non-destructive testing. Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing. Edge method
- ❑ BS EN 12543-5: Non-destructive testing. Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing. Measurement of the effective focal spot size of mini and micro focus X-ray tubes
- ❑ BS EN 25580: Minimum requirements for industrial radiographic illuminators for non-destructive testing
- ❑ BS EN ISO 9000 series (for level 3 candidates only).

Product Technology Classroom Training Handbook – The British Institute of Non-Destructive Testing.

Training Course Notes. PCN requires candidates to have attended an approved course of training. Accredited Training Establishments are required to provide trainees with an up to date set of training course notes. These are considered essential reading.

Essential Reading - Safety aspects

A full reading list is published in PCN/GEN Appendix E3.2.

Recommended Reading

- ❑ Handbook of Radiographic Apparatus and Techniques, a concise guide to the radiography of welds. The Welding Institute.
- ❑ An Introduction to Industrial Radiology Techniques by R Halmshaw. Wykeham Publications.
- ❑ Non-Destructive Testing (second edition, 1991) by R Halmshaw. Edward Arnold.
- ❑ The Physics of Industrial Radiography by R Halmshaw. Heywood.
- ❑ Industrial Radiography. Kodak Limited, London.
- ❑ Data Sheets for Industrial Radiography. Kodak Limited, London.
- ❑ Industrial Radiography. Agfa-Gevaert Limited. Brentford, Middlesex.
- ❑ Recent Developments in Non-Destructive Testing. The Welding Institute.
- ❑ Radiation Safety for Site Radiography. Kluwer Publishing Limited.
- ❑ ASNT Classroom Training Handbook (originally published by General Dynamics).
- ❑ ASNT Self Study Handbook (originally published by General Dynamics).
- ❑ ASNT Question and Answer Book.
- ❑ ASNT Level III Study Guide.
- ❑ NDT Handbook, second edition, volume 7 (1991).
- ❑ ASNT Student Package.
- ❑ ASNT Instructor Package (overheads for training).

NOTE: Some of the above are available only in reference libraries. For information on sources of the above recommended reading contact The British Institute of Non-Destructive Testing, Newton Building, St George's Avenue, Northampton NN2 6JB.