Certification Services Division
Newton Building, St George's Avenue
Northampton, NN2 6JB
United Kingdom

Tel: +44(0)1604-893-811.
Fax: +44(0)1604-893-868.
E-mail: pcn@bindt.org

PCN/GEN ISO 20807 Appendix A1.1

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SPECIFIC REQUIREMENTS FOR THE QUALIFICATION AND CERTIFICATION OF PERSONNEL ENGAGED IN ULTRASONIC TESTING OF WROUGHT PLATE – INCLUDING THICKNESS GAUGING

(In accordance with ISO 20807 (Qualification of personnel for limited application of non-destructive testing)

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1. SCOPE

This document, which is an Appendix to PCN/ISO 20807/GEN, prescribes procedures by which personnel may be examined and, if successful, certificated for the ultrasonic testing of wrought plate including thickness gauging in accordance with the procedures detailed in ISO 20807.

This certification provides limited certification of NDT personnel in this sector.

It shall be the responsibility of the employer of personnel certificated in accordance with these requirements to designate the responsibilities of such personnel in respect of interpretation and certification of inspection results and authorisation of NDT procedures and instructions.

2. ELIGIBILITY

The provisions of PCN General requirements for vision as detailed in PSL/44 shall apply.

To be eligible for examination, candidates should have successfully completed an approved training course as follows:

Level 2: 40 hours of formal training to the published syllabus. APPENDIX A1.1

To be eligible for certification, candidates will have acquired experience prior to or following the examination of ultrasonic testing of wrought plate as follows:

Level 2: not less than 480 hours practical work on site or in-works under qualified supervision.

3. EXAMINATION CONTENT

The examination format is as follows:.

3.1 Level 2

All candidates will be required to attempt an examination comprised of the following parts:

3.1.1 Theory of the Ultrasonic NDT method for normal beam applications. Thirty multiple choice questions and include questions on the relevant Standards and Product Technology. Pass mark: 70%. Time allowed: 60 minutes.

3.1.2 Sector Specific Practical examination comprising:

(i) preparation and calibration of testing equipment;

(ii) testing 4 wrought plates of variable thickness for the presence of defects (laminations, inclusions and clusters) against a provided specification;

(iii) testing a further 5 samples, selected to demonstrate a range of thickness measurements within a defined tolerance;

(iv) reporting the results in a prescribed manner on proforma report sheets provided.

3.1.3 The total time allowed for the sector specific practical examination is 6 hours. The minimum pass mark for each practical part (ii, iii) is 80%. ALL MANDATORY REPORTABLE DISCONTINUITIES MUST BE DETECTED AND REPORTED

3.2 Equipment

3.2.1 No reference documentation other than that provided by the test centre will be allowed. The use of a non-programmable pocket calculator is permissible. Digital UT sets will be cleared of memory before and after use where appropriate.

4. RENEWAL & RECERTIFICATION PROCEDURE

4.1 PCN policy for renewal and recertification of limited applicants is detailed in document reference PCN/ISO 20807/GEN

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PCN/GEN ISO 20807 Appendix A1.*2*

EXAMINATION SYLLABUS FOR THE QUALIFICATION AND CERTIFICATION OF PERSONNEL ENGAGED IN ULTRASONIC TESTING OF WROUGHT PLATE – INCLUDING THICKNESS GAUGING

(In accordance with ISO 20807 (Qualification of personnel for limited application of non-destructive testing)

ASSOCIATED DOCUMENTS: Appendix

A1.1

Examination Scope

Appendix A1.3

Specimen questions

1 Principles

1.1 Wave properties – types of wave, vibration, waves, sound waves, continuous wave, pulse, frequency, velocity, wavelength. Units, relationship between frequency velocity and wavelength.

1.2 Principles of reflection and transmission of sound waves at perpendicular incidence. Effect of coupling media on transmission. Acoustic impedance.

1.3 Effect of reflector on echo response.

1.4 Sound field – influence of frequency, sound velocity and size of transducer. Estimate of near field, far field and beam divergence.

1.5 Influence of properties of test object on sound propagation, sound velocity, attenuation, geometry and surface condition.

1.6 Generation of ultrasonic waves. Electromechanical transducer (piezo-electric). Properties of the transducer, (nominal and working frequency, band width). Effect of different transducer materials.

1.7 Sound field. Calculation and estimation of near field, far field and beam spread.

2 Equipment

2.1 Types of probe – normal beam, single and twin. Construction and mode of operation.

2.2 Signal presentation – A, B, C scans.

2.3 Amplifier characteristics, broad and narrow band, logarithmic, saturation, linearity, suppression, DAC correction.

2.4 Definition and use of decibel.

2.5 Test methods – manual.

3 Testing techniques

3.1 Pulse-echo technique – basic principle, measured values (transmit time, echo amplitude), advantages and limitations.

3.2 Application of compression waves.

3.3 Coupling:

i) Contact technique – couplant, protective layer

ii) Gap scanning

4 Calibration of Testing Systems

4.1 Timebase calibration- normal, single, twin crystal. Calibration blocks and reference blocks, calibration checks. Effect of different sound velocities in calibration block and test piece. Measurement of wall thickness and flaw position using normal beam probes.

4.2 Sensitivity and signal to noise ratio.

4.3 Beam width.

4.4 Sensitivity setting – simple methods, BWE, DAC. Effect of finish, geometry, attenuation in specimen.

4.5 Effects of protective coatings.

5 Detectability of Defects

Advantages and limitations of the test method with regard to defect detection.

6 Factors Affecting the Performance of the Ultrasonic Test

6.1 Mechanical properties of the material, attenuation.

6.2 Geometry of the specimen.

6.3 Surface condition.

6.4 Temperature

7 Codes of Practice and Standards

See recommended reading list. (Appendix A1.3)

8 Conducting and Recording the Test

8.1 Procedure to be adopted to carry out the test.

8.2 Information to be recorded on the report.

8.3 Flaw assessment and reporting.

9 Product Technology Theory

9.1 Basic production - crude and finished products

9.1.1 Ingot types narrow end up and wide end up, concast methods (continuing casting process). Definition used in the production of ingots and casting.

9.1.2 Difference between ingot and concast production processes, Ingot casting for further hot working, rolling, forging and extrusion.

9.2 Forming processes

9.2.1 Primary rolling – blooms and slabs.

9.2.2 Secondary rolling

ESSENTIAL READING – Standards and Specifications

☐	BS EN 1330-2	Non-destructive testing – Terminology – Part 2: Terms common to the non- destructive testing methods.
☐	BS EN 1330-4	Glossary of terms used in non-destructive testing: Ultrasonic flaw
☐	BS EN 12668-1	Non-destructive testing – Characterisation and verification of ultrasonic examination equipment – Part 3 combined equipment.
☐	BS EN 583-1	Non-destructive – Ultrasonic examination – Part 1: General principles
☐	BS EN 583-3	Non-destructive testing – Ultrasonic examination – Part 3: Transmission techniques
☐	BS EN 583-5	Non-destructive testing – Ultrasonic examination – Part 5: Characterisation and sizing of discontinuities
☐	BS EN 10160	Ultrasonic testing of steel flat products of thickness equal to or greater than

NOTE: National or international standards equivalent to the above may be used as alternatives.

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.

Recommended Reading

☐ Basic Metallurgy for NDT Edited by J L Taylor. British Institute of NDT, Newton Building, St Georges Ave, Northampton, NN26JB

☐ 'Ultrasonic Flaw Detection for Technicians' by J C Drury. Obtainable from The British Institute of NDT, Newton Building, St Georges Ave, Northampton, NN26JB.

☐ ASNT Classroom Training Handbook originally published by General Dynamics.

☐ ASNT Self Study Handbook originally published by General Dynamics.

☐ ASNT Question and Answer Book

☐ NDT Handbook, second edition, volume 3 (1985).

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PCN/GEN ISO 20807 Appendix A1.3

SPECIMEN QUESTIONS FOR THE QUALIFICATION AND CERTIFICATION OF PERSONNEL ENGAGED IN ULTRASONIC TESTING OF WROUGHT PLATE – INCLUDING THICKNESS GAUGING

(In accordance with ISO 20807 (Qualification of personnel for limited application of non-destructive testing)

ASSOCIATED DOCUMENTS:

Appendix A1.1
Examination Scope

Appendix A1.2
Examination Syllabus

Specimen Questions

1. The depth of a discontinuity cannot be determined when using the:

a) straight beam testing method

b) through transmission method

c) angle beam testing

d) paint brush testing

2. A term used to describe the ability of ultrasonic testing equipment to detect discontinuities close to the scanning surface of the material is:

a) sensitivity

b) penetration

c) segregation

d) resolution

3. The process of comparing an instrument with a standard is called:

a) angulation,

b) calibration,

c) attenuation,

d) correlation

4. The most appropriate wave mode for locating lamination in plate would be:

a) lamb

b) shear

c) surface

d) longitudinal

5. Which of the following is not a method of flaw sizing?

a) 20 dB drop

b) 6 dB drop

c) B-Scan

d) maximum amplitude

6. A couplant is required in ultrasonic testing to:

a) protect the test material

b) protect the probe shoe

c) protect the tester's hands

d) enable sound energy to pass into the test material

7. The fundamental frequency of a piezo-electric crystal used in ultrasonic probes is a function of:

a) its thickness,

b) the velocity of sound in the crystal material

c) both A and B above

d) its diameter

8. A linear time base is achieved when the electron beam in the CRT:

a) is deflected with constant velocity

b) is deflected with constant acceleration

c) is deflected with the same velocity as the probe movement

d) produces four echoes on the screen.

9. DGS diagrams compare flaw signal amplitudes to:

a) Reference blocks

b) flat bottomed holes

c) a theoretical maximum

d) DAC

10. Given that the velocity of a compression wave in steel is 6000m/s, how long does it take a wave to travel from one side to the other of a 30 mm steel plate?

a) 5 microseconds

b) 5 milliseconds

c) 2 microseconds

d) 2 milliseconds

11. The most appropriate method for sizing lamination in rolled plate would be:

a) DGS

b) DAC

c) 20dB

d) 6 dB