



**CERTIFICATION SCHEME FOR PERSONNEL**

**DOCUMENT No. CSWIP-ISO-NDT-11/93-R  
Requirements for the Certification of Personnel Engaged in Non-Destructive Testing in accordance with the requirements of EN 473 and ISO 9712**

**APPENDIX 1**

**Examination Format and Syllabus for the Certification of Personnel engaged in Non-Destructive Testing of Welded Joints and General Engineering Components**

**PART 11: Long Range Ultrasonic Inspector, Level 1, 2 and 3**

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These syllabi are applicable to candidates seeking certification in accordance with Document CSWIP-ISO-NDT-11/93-R 'Requirements for the Certification of Personnel Engaged in Non-Destructive Testing.

## **LONG RANGE INSPECTOR**

### **1 Level 1**

#### **1.1 General theory examination**

- 40 multiple choice questions
- Time allowed 60 minutes
- Pass mark 70%

#### **1.2 Specific theory examination**

- 30 multiple choice questions
- Time allowed 45 minutes
- Pass mark 70%.

#### **1.3 General practical examination**

The candidate is required to verify required settings and operate the test equipment properly in order to obtain satisfactory results and correctly interpret these results. The candidate is required therefore to demonstrate to the satisfaction of the invigilator this ability, with comments, using the means available for each test method.

- Time allowed 60 minutes
- Pass mark 70%

#### **1.4 Specific practical examination**

Candidates for Level 1 certification are required to test and report on samples relevant to the certification sought containing real or simulated defects. Written instructions are provided for Level 1 candidates.

##### **1.4.1 Pipes and pipelines**

The candidate is required to test and report on two specimens selected by the examiner from pipes or a pipeline according to written instructions provided.

- Time allowed 120 minutes
- Pass mark 70%

### **2 Level 2**

#### **2.1 General theory examination**

The theory part consists of:

- 40 multiple choice questions
- Time allowed 60 minutes
- Pass mark 70%

#### **2.2 Specific theory examination**

The theory part consists of:

- 30 multiple choice questions

- Time allowed 45 minutes
- Pass mark 70%

### **2.3 General practical examination**

The candidate is required to verify required settings and operate the test equipment properly in order to obtain satisfactory results and correctly interpret these results. The candidate is required therefore to demonstrate to the satisfaction of the invigilator this ability, with comments, using the means available for each test method.

- Time allowed 60 minutes
- Pass mark 70%

### **2.4 Specific practical examination**

Candidates for Level 2 certification are required to test and report on samples relevant to the certification sought containing real or simulated defects.

#### **2.4.1 Pipes and pipelines**

The candidate is required to test and report on two specimens selected by the examiner from pipes or a pipeline according to written instructions provided.

The candidate is also required to interpret and report on data from 3 sections of pipe or pipeline.

The candidate is in addition required to produce an NDT instruction for one of the items to be tested.

- Time allowed 4 hours plus 1 hour for instruction writing
- Pass mark 70%

## **3 Level 3**

### **3.1 Basic Examination (Exempt if already holding Level 3)**

#### **Section A1**

- 30 multiple choice questions
- Time allowed 45 minutes.
- Pass mark 70%

#### **Section A2 (Open book examination)**

- 10 multiple choice questions
- Time allowed 15 minutes.
- Pass mark 70%

#### **Section B**

- 60 multiple choice questions
- Time allowed 90 minutes.
- Pass mark 70%

N.B. Exemptions may apply, for Level 2 certificate holders in the main NDT methods, for this examination section.

### **3.2 Main Method Examination**

#### **Section C1**

- 30 multiple choice questions
- Time allowed 45 minutes
- Pass mark 70%

#### **Section C2**

This section of the examination may be open book in relation to codes standards and specifications

- 20 multiple choice questions
- Time allowed 30 minutes
- Pass mark 70%

#### **Section C3**

The candidate is required to draft an NDT procedure for a component selected by the examiner.

- Time allowed 4 hours
- Pass mark 70%

## **4 Ten Year Examination**

Level 1 and Level 2 candidates whose certificates expire at the end of the maximum ten year period of validity will be required to undertake a renewal examination comprising practical tests only as detailed below.

Level 3 candidates should refer to CSWIP-ISO-NDT-11/93R, Section 7.5.3.

### **4.1 Level 1 Long Range Ultrasonic Inspector**

#### **4.1.1 Pipes and pipelines**

The candidate is required to test and report on two specimens selected by the examiner from pipes or a pipeline according to written instructions provided.

### **4.2 Level 2 Long Range Ultrasonic Inspector**

#### **4.2.1 Pipes and pipelines**

The candidate is required to test and report on two specimens selected by the examiner from pipes or a pipeline according to written instructions provided.

The candidate is also required to interpret and report on data from 3 sections of pipe or pipeline.

The candidate is in addition required to produce an NDT instruction for one of the items to be tested.

## **5 Level 1 Long Range Ultrasonic Syllabus**

### **5.1 General theory**

- a. Brief history of development of ultrasonic testing theory.**
- b. Ultrasonic capabilities in relation to other NDT methods.**

**c. Physical principles of sound**

Nature of sound, relationship between wavelength, frequency and velocity. Wave motions, particle vibrations, velocities in common materials.

**d. Behaviour of ultrasonic waves**

Reflection, refraction, diffraction. Snell's laws, attenuation, acoustic impedance, mode conversion, resonance, scattering from defects.

**e. Production of ultrasonic waves**

Piezo-electric effect. Types and properties of transducers, pulse width, near and far fields, effect of frequency and sound velocity on near field, far field and beam divergence. Dead zone, production of compression, shear and surface waves, critical angles, construction of single and twin crystal probes. Couplants.

**f. Ultrasonic equipment**

Block diagrams of flaw detector, controls, amplifier and equipment performance characteristics. A-scan, B-scan and C-scan displays.

**g. Calibration and equipment checks**

Calibration and reference blocks, check for dead zone, penetrative power, resolution, sensitivity, probe index, angle of refraction, linearity of time base and amplifier. Plotting beam spread diagrams. Calibration of time base ranges. Comparison of probe sensitivities. Setting sensitivity levels for scanning.

**h. Practical applications - parent material and weld examination**

Information required prior to examination. Parent material examination, attenuation measurements, methods of flaw sizing 20dB, 6dB, DGS, maximum amplitude, use of flaw location slide, reporting methods. Brief knowledge of component surface finish and its measurement

**5.2 Specific theory**

**a. NDT and Corrosion**

Corrosion in pipes, Direct corrosion, Wet corrosion, Localised pipe corrosion  
NDT methods for monitoring pipe corrosion (Visual, Radiographic, Ultrasonic, Electromagnetic.)

**b. Principles of Long Range Ultrasonics**

Wave modes, the ultrasound beam, Critical angles, Plate or Lamb waves, Guided waves in pipes. Dispersion curves, Sound attenuation, Reflection of guided waves. Comparison of guided wave with conventional ultrasonics

**c. Principles of Operation of the Teletest<sup>®</sup> System**

Structure of the Teletest<sup>®</sup> guided wave test system. Tool, Pulser-receiver unit, Instrument, Power

**d. A-Scan Screen and Test Data**

Types of A-scan, Distance Amplitude Correction (DAC) Curves, A-scans from multiple wave modes

**e. Selection of Optimum Test Frequency for Guided Waves**

Longitudinal Waves, Torsional Waves, lower and upper frequency limits, Effect of the transducer tool

**f. Gathering and Analysing test data.**

**g. Multi-Mode Operation**

Equipment Required, Operation, Software

**h. Excitation Conditions**

**i. Teletest<sup>®</sup> Using Focusing**

Purpose and Benefits

**j. Principles of Hardware Operation**

Means of Access to Focus Functions, Segment Normalisation  
Data Collection Options

**k. Presentation and Reporting of Results**

**6 Level 2 Long Range Ultrasonic Syllabus**

**6.1 General theory**

The syllabus is the same as that for Level 1 but the questions will be more complex.

**6.2 Specific theory**

As for level 1 but in addition:

**a. Principles of Interpretation**

Five step method, Spurious signals and Anomalies.

**b. Management of Teletest<sup>®</sup> Operations.**

**7 Level 3 Long Range Ultrasonic Syllabus**

**7.1 Basic examination**

**7.1.1 Materials, Processes and Product Technology**

**Material Technology**

Properties of materials, origin of discontinuities and failure modes, statistical process control and probability of detection.

## **Basic Production – Crude and Finished Products**

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

Difference between ingot and concast production processes.

Ingot casting further hot working, rolling, forging and extrusion.

## **Basic Casting Production Methods – Finished Products**

Methods of casting: sand casting, die casting, investment casting  
Basic defects associated with cast products, their appearance and how they are formed:  
shrinkage, inks, cold shuts, porosity, laps, hot tears, cracks

## **Wrought Production Processes**

Rolling process: primary rolling – blooms and slabs, secondary rolling, billets, sections and plates, cold rolling, sheets and strips, basic rolling defects, appearance and how they are formed

Forging: open die forging and press forging, closed die forging

Basic forging defects, their appearance and how they are formed: forging bursts, laps, seams, cracks

Extrusion: definition of and how it works, why extrusion is used instead of rolling or forging

## **Heat Treatment Processes**

Annealing. How annealing is carried out and the results obtained, full anneal and definitions, sub critical anneal and definition

Normalising: how it is carried out and the results obtained.

Stress relieving. Why stress relieving is and why it is carried out.

## **Machining and material removal**

Turning, boring, milling, grinding and electrochemical.

## **Surface finishing and corrosion protection.**

Shot peening, grit blasting, painting, plating, chemical conversion coatings.

## **Non-metals and composite materials processing**

### **Dimensional Metrology**

#### **7.1.2 Other NDT methods**

##### **Acoustic Emission**

Principles, sources of acoustic emissions, equipment and materials, proper selection of technique.

### **Electromagnetic Testing**

Principles, properties of eddy currents, effect of varying frequency, equipment, application and test results interpretation.

### **Thermography**

Principles, temperature measurement, technique selection, equipment, application and test results interpretation.

### **Magnetic Particle Inspection**

Principles, technique selection, equipment, application and test results interpretation.

### **Liquid Penetrant Inspection**

Principles, technique selection, equipment, application and test results interpretation.

### **Radiographic Inspection**

Principles, technique selection, equipment, application and test results interpretation.

### **Ultrasonic Inspection**

Principles, technique selection, equipment, application and test results interpretation.

### **Visual and Optical Inspection**

Principles, technique selection, equipment, application and test results interpretation.

#### **7.1.3 Standards and documentation relating to the certification of NDT operators**

ISO 9712, EN 473, SNT\_TC-1A

#### **7.2 Main Method Examination**

Candidates for Level 3 examinations will be questioned on the contents of the syllabus for Levels 1 and 2, the questions will however be of a more complex nature.

### **8 Reference Literature**

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

Electrical, Magnetic and Visual Methods of Testing Materials. J Blitz, W G King and D G Rogers, Butterworth 1969.

Non-Destructive Testing Handbook, edited by Robert G McMaster, The Ronald Press, New York.

Basic Metallurgy for Non-Destructive Testing, Edited by J L Taylor. The British Institute of Non-destructive Testing, 1 Spencer Parade, Northampton NN1 5AA.

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).