



**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 BS EN 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 10: Leak Detection Inspector, Level 1, 2 and 3**

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These syllabi are applicable to candidates seeking certification in accordance with the current version of Document CSWIP-ISO-NDT-11/93-R 'Requirements for the Certification of Personnel engaged in Non-Destructive Testing in accordance with the requirements of BS EN ISO 9712'.

## **LEAK DETECTION INSPECTOR**

### **1 Level 1 – Pressure Testing**

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

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

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

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

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

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

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

The candidate is required to test and report on two samples in accordance with the instructions provided.

- Time allowed 120 minutes
- Pass mark 70%

### **2 Level 1 – Tracer Gas Testing**

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

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

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

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

#### **2.3 General practical examination**

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

#### **2.4 Specific practical examination**

The candidate is required to test and report on two samples in accordance with the instructions provided.

- Time allowed 120 minutes
- Pass mark 70%

### **3 Level 2 – Pressure Testing**

#### **3.1 General theory examination**

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

#### **3.2 Specific theory examination**

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

#### **3.3 General practical examination**

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

#### **3.4 Specific practical examination**

The candidate is required to inspect two samples to a set procedure and draft a written instruction suitable for use by a Level 1 practitioner.

Time allowed: 90 minutes per sample plus 60 minutes for written instruction  
Pass mark 70%

### **4 Level 2 –Tracer Gas Testing**

#### **4.1 General theory examination**

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

#### **4.2 Specific theory examination**

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

### **4.3 General practical examination**

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

### **4.4 Specific practical examination**

The candidate is required to inspect two samples to a set procedure and draft a written instruction suitable for use by a Level 1 practitioner.

- Time allowed 180 minutes plus 60 minutes for written instruction
- Pass mark 70%

## **5 Level 3**

### **5.1 Basic Examination**

#### **5.1.1 Section A1 Material Science and Process Technology**

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

#### **Section A2 Knowledge of the Certification Scheme**

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

#### **5.1.2 Section B Level 2 Knowledge of other NDT Methods**

This section tests the knowledge of the candidate in at least four methods of NDT at a Level 2 standard. The methods shall be chosen by the candidate and shall include at least one volumetric method.

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

N.B. Exemptions may apply, for this examination section to valid ISO 9712 Level certificates holder in the main NDT methods.

### **5.2 Main Method Examination**

#### **5.3 Section C1 Knowledge of the Method General Theory**

The candidate will be tested on Level 3 knowledge relating to the test method for which certification is sought.

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

#### **5.4 Section C2 Application of the NDT Method**

This section of the examination may be open book in relations to codes, standards and specifications.

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

#### **5.5 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%

### **6 Ten Year Recertification 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 recertification examination comprising practical tests only as detailed below.

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

#### **6.1 Level 1 Pressure Testing**

##### **6.1.1 General practical examination**

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

##### **6.1.2 Specific practical examination**

The candidate is required to test and report on two samples in accordance with the instructions provided.

- Time allowed 60 minutes per sample
- Pass mark 70%

#### **6.2 Level 1 Tracer Gas Testing**

##### **6.2.1 General practical examination**

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

## **6.2.2 Specific practical examination**

The candidate is required to test and report on two samples in accordance with the instructions provided.

- Time allowed 60 minutes per sample
- Pass mark 70%

## **6.3 Level 2 Pressure Testing**

### **6.3.1 General practical examination**

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

### **6.3.2 Specific practical examination**

The candidate is required to inspect two samples to a set procedure and draft a written instruction suitable for use by a Level 1 practitioner.

Time allowed: 90 minutes per sample plus 60 minutes for written instruction  
Pass mark 70%

## **6.4 Level 2 Tracer Gas Testing**

### **6.4.1 General practical examination**

In the general practical part, 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 to demonstrate this ability, with comments, using the means available for the test method.

- Time allowed 60 minutes
- Pass mark 70%

### **6.4.2 Specific practical examination**

The candidate is required to inspect two samples to a set procedure and draft a written instruction suitable for use by a Level 1 practitioner.

- Time allowed 90 minutes per sample plus 60 minutes for written instruction
- Pass mark 70%

## **7 Examination Syllabus**

### **7.1 Level 1 Pressure Testing**

#### **a. Introduction to Pressure Testing**

History of leak testing, reasons for leak testing, fundamental terminology, fundamentals of leak and leak detection.

**b. Physical Principles**

Physical behaviour of gases, pressure, pressure range in vacuum, flow in vacuum, leakage measurement units, degassing, virtual and real leak.

**c. Product Knowledge**

Types of leak testing, object preparation, specification and method capabilities, bubble emission method, pressure change methods, tracer gas method, fundamentals of test method choice.

**d. Equipment**

Vacuum gauges, mechanical gauges, U-tube manometers and McLeod, Pirani and thermocouple gauges, cold and hot ion gauges, vacuum pumps, rotary and piston pumps, roots pumps, diffusion pump, turbo-molecular pump, valve, fittings.

**e. Information Prior to Testing**

Written procedures – interpretations, data report module filling.

**f. Testing**

Bubble testing practice and techniques, immersion technique, Liquid application technique, pressure change techniques and practice, pressure decay technique, pressure rise technique, bell pressure change technique, flow measurements technique, tracer gas practice and techniques, Mass spectrometers, halogen ion diode, thermal conductivity gauges, tracer gas flows, vacuum technique – total and partial, vacuum technique – local (spraying), tracer gas flows out of the objects, chemical detection with ammonia, vacuum box using internal tracer gas, vacuum box applying the tracer gas in the opposite side, pressure technique by accumulation, sniffing test, fundamental on pressurisation – evacuation testing (bombing), vacuum chamber technique.

**g. Evaluation and Reporting**

Test data report filling.

**h. Quality**

**7.2 Level 1 Tracer Gas Testing**

**a. Introduction to Pressure Testing**

History of leak testing, reasons for leak testing, fundamental terminology, fundamentals of leak and leak detection.

**b. Physical Principles**

Physical behaviour of gases, pressure, pressure range in vacuum, flow in vacuum, leakage measurement units, degassing, virtual and real leak.

**c. Product Knowledge**

Types of leak testing, object preparation, specification and method capabilities, bubble emission method, pressure change methods, tracer gas method, fundamentals of test method choice.

**d. Equipment**

Vacuum gauges, mechanical gauges, U-tube manometers and McLeod, Pirani and thermocouple gauges, cold and hot ion gauges, vacuum pumps, rotary and piston pumps, roots pumps, diffusion pump, turbo-molecular pump, valve, fittings.

**e. Information Prior to Testing**

Written procedures – interpretations, data report module filling.

**f. Testing**

Bubble testing practice and techniques, immersion technique, Liquid application technique, pressure change techniques and practice, pressure decay technique, pressure rise technique, bell pressure change technique, flow measurements technique, tracer gas practice and techniques, Mass spectrometers, halogen ion diode, thermal conductivity gauges, tracer gas flows, vacuum technique – total and partial, vacuum technique – local (spraying), tracer gas flows out of the objects, chemical detection with ammonia, vacuum box using internal tracer gas, vacuum box applying the tracer gas in the opposite side, pressure technique by accumulation, sniffing test, fundamental on pressurisation – evacuation testing (bombing), vacuum chamber technique.

**g. Evaluation and Reporting**

Test data report filling.

**h. Quality**

**7.3 Level 2 Pressure Testing**

**a. Introduction to Pressure Testing**

History of leak testing, reasons for leak testing, terminology, fundamentals of leak and leak detection.

**b. Physical Principles**

Physical behaviour of matter, pressure, pressure range in vacuum, flow in vacuum, leakage measurement, degassing, pumping speed, virtual and real leak.

**c. Product Knowledge**

Types of leak testing, object preparation, specification and method capabilities, bubble emission method, pressure change methods, tracer gas method, chemical or physical properties of detectors, principles of detection for the tracer gas flow into the object 0 Group A techniques, Principles of detection for tracer gas flow out of the object – Group B techniques, test method choice of criteria.

**d. Equipment**

Vacuum gauges, mechanical gauges, U-tube manometers and McLeod, Pirani and thermocouple gauges, cold and hot ion gauges, vacuum pumps, rotary and piston pumps, roots pumps, diffusion pump, turbo-molecular pump, valve, fittings, materials.

**e. Information Prior to Testing**

Analysis of written procedures, data report modules, tracer gas detector/instruments performance factor.



**f. Testing**

Bubble testing practice and techniques, immersion technique, Liquid application technique, pressure change techniques and practice, pressure decay technique, pressure rise technique, bell pressure change technique, flow measurements technique, tracer gas practice and techniques, Mass spectrometers (helium), halogen ion diode, thermal conductivity gauges, reactive tracers, gas analysis apparatus (gas chromatography etc), tracer gas flows, vacuum technique – total and partial, vacuum technique – local (spraying), tracer gas flows out of the objects, chemical detection with ammonia, vacuum box using internal tracer gas, vacuum box applying the tracer gas in the opposite side, pressure technique by accumulation, sniffing test, pressurisation – evacuation testing (bombing), vacuum chamber technique. Analysis through alternative techniques

**g. Evaluation and Reporting**

Test data report filling.

**h. Quality**

**i. Developments**

Special industrial installation.

**7.4 Level 2 Tracer Gas Testing**

**a. Introduction to Pressure Testing**

History of leak testing, reasons for leak testing, terminology, fundamentals of leak and leak detection.

**b. Physical Principles**

Physical behaviour of matter, pressure, pressure range in vacuum, flow in vacuum, leakage measurement, degassing, pumping speed, virtual and real leak.

**c. Product Knowledge**

Types of leak testing, object preparation, specification and method capabilities, bubble emission method, pressure change methods, tracer gas method, chemical or physical properties of detectors, principles of detection for the tracer gas flow into the object 0 Group A techniques, Principles of detection for tracer gas flow out of the object – Group B techniques, test method choice of criteria.

**d. Equipment**

Vacuum gauges, mechanical gauges, U-tube manometers and McLeod, Pirani and thermocouple gauges, cold and hot ion gauges, vacuum pumps, rotary and piston pumps, roots pumps, diffusion pump, turbo-molecular pump, valve, fittings, materials.

**e. Information Prior to Testing**

Analysis of written procedures, data report modules, tracer gas detector/instruments performance factor.

**f. Testing**

Bubble testing practice and techniques, immersion technique, Liquid application technique, pressure change techniques and practice, pressure decay technique, pressure rise technique, bell pressure change technique, flow measurements technique, tracer gas

practice and techniques, Mass spectrometers (helium), halogen ion diode, thermal conductivity gauges, reactive tracers, gas analysis apparatus (gas chromatography etc), tracer gas flows, vacuum technique – total and partial, vacuum technique – local (spraying), tracer gas flows out of the objects, chemical detection with ammonia, vacuum box using internal tracer gas, vacuum box applying the tracer gas in the opposite side, pressure technique by accumulation, sniffing test, pressurisation – evacuation testing (bombing), vacuum chamber technique. Analysis through alternative techniques.

**g. Evaluation and Reporting**

Test data report filling.

**h. Quality**

**i. Developments**

Special industrial installation.

**7.5 Level 3 Leak Detection**

**7.5.1 Basic Examination**

**7.5.1.1 Section A1**

**Materials, Processes and Product Technology**

**Same as Level 2 but more complex, including acceptability criteria assessment and ergonomic analysis.**

**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, inclusions, 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**

#### **7.5.1.2 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.

##### **Infrared Thermographic Testing**

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.

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

BS EN ISO 9712, SNT-TC-1A.

### **7.5.1.4 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.

### **7.5.1.5 Section C1 – General Theory**

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

### **7.5.1.6 Section C2 – Specific Theory**

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. In addition they will be questioned on:

#### **Pressure Testing Technology**

The influence of leak detection methods and techniques on the size and types of leaks that may be detected.

Defect parameters that influence detectability.

### **7.5.1.7 Section C3 – Procedure Writing**

Candidates are required to produce a fully detailed NDT procedure for a sample selected by the examiner from the sector in which the candidate is undergoing evaluation.

The leak detection procedure must include the scope of examination, test operator approvals, equipment and calibration, reference documents, acceptance and recording levels, reporting requirements, timings in relation to complementary NDT methods and stages of production/manufacture and actions in the case of procedure non-compliance.

## **8 Reference Literature**

- ASNT NDT Handbook - Leak Detection
- ASNT Level III Study Guide - Leak Testing
- ASTM Standards Section 3 .03.03 Non Destructive Testing
- ASM Handbook - NDE and Quality Control
- Current EN Standards for Leak detection and Method Selection