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 ISO 9712

APPENDIX 1

Examination Content and Syllabus details for CSWIP-ISO-NDT-11/93-R scheme

PART 10: Leak Detection Inspector, Level 1, 2 and 3

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Issued under the authority of the Governing Board for Certification
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1.1.0 CSWIP Leak Detection Inspector Level 1: Pressure Testing

1.1.1 General theory examination

- 40 multiple-choice questions
- Time allowed: 80 minutes
- Pass mark: 70%

1.1.2 Specific theory examination

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

1.1.3 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%

1.1.4 Specific practical examination

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

- Time allowed: 5 hours
- Pass mark: 70%

1.2.0 CSWIP Leak Detection Inspector Level 1: Tracer Gas Testing

1.2.1 General theory examination

- 40 multiple-choice questions
- Time allowed: 80 minutes
- Pass mark: 70%

1.2.2 Specific theory examination

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

1.2.3 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%

1.2.4 Specific practical examination

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

- Time allowed: 2 hours

- Pass mark: 70%

1.3.0 CSWIP Leak Detection Inspector Level 2: Pressure Testing

1.3.1 General theory examination

- 40 multiple-choice questions
- Time allowed: 80 minutes
- Pass mark: 70%

1.3.2 Specific theory examination

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

1.3.3 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%

1.3.4 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: 2.5 hours
- Pass mark: 70%

1.3.5 Instruction writing examination

The candidate shall write an NDT instruction on a plate butt or pipe butt weld suitable for Level 1 personnel as selected by the examiner.

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

1.4.0 CSWIP Leak Detection Inspector Level 2: Tracer Gas Testing

1.4.1 General theory examination

- 40 multiple-choice questions
- Time allowed: 80 minutes
- Pass mark: 70%

1.4.2 Specific theory examination

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

1.4.3 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%

1.4.4 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%

1.5.0 CSWIP Ultrasonic Inspection Level 3

1.5.1 Basic examination

Candidates successful in Sections A, B and C will be not required to re-sit this section when attempting additional Level 3 examinations in other methods.

Section A: Materials Science and Process Technology

- 25 multiple-choice questions
- Time allowed: 50 minutes
- Pass mark: 70%

Section B: Knowledge of the Certification Scheme

This part of the examination may be open book.

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

Section C: 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: 120 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.

1.5.2 Main method examination

Section D: Level 3 Knowledge of the Test Method

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

Section E: Application of the NDT Method

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

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

Section F: Procedure Writing

The drafting of an NDT procedure for a component selected by the Examiner. The use of applicable codes, standards and specifications by the candidate shall be allowed.

- Time allowed: 5 hours
- Pass mark: 70%

2 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.

2.1.0 Level 1 Pressure Testing

2.1.1 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%

2.1.2 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%

2.2.0 Level 1 Tracer Gas Testing

2.2.1 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%

2.2.2 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%

2.3.0 Level 2 Pressure Testing

2.3.1 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%

2.3.2 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%

2.4.0 Level 2 Tracer Gas Testing

2.4.1 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%

2.4.2 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%

3 Examination Syllabus

3.1.0 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

3.2.0 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. 7

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

3.3.0 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 - 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.

3.4.0 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.

3.5.0 Level 3 Leak Detection

3.5.1 Basic Examination

3.5.1.1 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, original 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 and 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 knowledge of process overview, 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

3.5.1.2 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.

3.5.1.3 Standards and documentation relating to the certification of NDT operators
BS EN ISO 9712, SNT-TC-1A.

3.5.1.4 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.

3.5.1.5 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.

3.5.1.6 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:

3.5.1.7 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.

3.5.1.8 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.