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 6: Visual and Optical Inspector Level 1, 2 and 3

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Issued under the authority of the Governing Board for Certification
All correspondence should be addressed to:

TWI Certification Ltd
Granta Park, Great Abington, Cambridge CB21 6AL, UK
Telephone: +44 (0) 1223 899000
Email: personnel@twicertification.com
Website: www.cswip.com

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1.1.0 CSWIP VISUAL AND OPTICAL INSPECTOR Level 1:

1.1.1 General theory examination

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

1.1.2.1 Specific theory examination single sector

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

1.1.2.2 Specific theory examination multi sector

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

1.1.3 General practical examination

The candidate is required to conduct and report on a control or function test for the practical applications of visual and optical testing as selected by the examiner

- Time allowed: 60 minutes
- Pass mark: 70%

1.1.4 Specific practical examination

Candidates for certification in visual and optical inspection can seek qualification in either the welding or general engineering sectors. The latter of these encompasses welds, castings and wrought products (including forgings). The specific practical examinations in these two sectors are as shown.

Welds

The candidate is required to inspect and report on three specimens selected from butt welds in plate, pipe or T-joint, according to written instructions provided.

- Time allowed: 2 hours
- Pass mark: 70%

Specific practical examination

The candidate is required to test and report on three specimens selected by the examiner from welds (in plate, pipe or T- joint), castings and wrought products (including forgings), according to written instructions provided.

- Time allowed: 3 hours
- Pass mark: 70%

1.2.0 CSWIP Visual and Optical Inspector Level 2: Thickness measurement and corrosion monitoring

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

The candidate is expected to calibrate equipment in a range of different materials commonly found in process and treatment plant.

- Time allowed: 60 minutes
- Pass mark: 70%

1.2.4 Specific practical examination

Candidates for certification in visual and optical inspection can seek qualification in either the welding or general engineering sectors. The latter of these encompasses welds, castings and wrought products. The specific practical examinations in these two sectors are as shown. 2.4.1

Welds

The candidate is required to test and report on three specimens: butt weld in plate, butt weld in pipe and a T-joint, using three different techniques selected by the examiner.

- Time allowed: 3 hours
- Pass mark: 70%

1.2.5 Instruction writing

The candidate shall draft an NDT instruction suitable for Level 1 personnel as selected by the examiner.

- Time allowed: 1 hours
- Pass mark: 70%

1.2.6 General engineering

The candidate is required to test and report on three specimens selected by the examiner from welds (in plate, pipe or T-joint), castings and wrought products (including forgings).

- Time allowed: 3 hours
- Pass mark: 70%

1.2.7 Instruction writing

The candidate shall draft an NDT instruction suitable for Level 1 personnel as selected by the examiner.

- Time allowed: 1 hours
- Pass mark: 70%

1.3.0 CSWIP Visual and Optical Inspector Level 3

1.3.1 Basic examination

Candidates successful in Section 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 test method.

- 60 multiple-choice questions
- Time allowed: 120 minutes
- Pass mark: 70%

1.3.2 Main method examination

Section D: Level 3 Level 3 General Theory

- 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 Protection

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 Level 1 Welds

2.1.1 General practical examination

The candidate is required to conduct and report on a control or function test for the practical applications of visual and optical testing as selected by the examiner.

- Time allowed: 60 minutes
- Pass mark: 70%

2.1.2 Specific practical

The candidate is required to inspect and report on three specimen selected from butt welds in plate, pipe or T-joint, according to written instructions provided.

- Time allowed: 3 hours
- Pass mark: 70%

2.2 Level 1 General engineering

2.2.1 General practical examination

The candidate is required to conduct and report on a control or function test for the practical applications of visual and optical testing as selected by the examiner.

- Time allowed: 60 minutes
- Pass mark: 70%

2.2.2 Specific practical

The candidate is required to test and report on three specimens selected by the examiner form welds (in plate, pipe or T-joint), castings and wrought products (including forgings), according to written instructions provided.

- Time allowed: 3 hours
- Pass mark: 70%

2.3 Level 2 Welds

2.3.1 General practical examination

The candidate is required to conduct and report on a control or function test for the practical applications of visual and optical testing as selected by the examiner.

- Time allowed: 60 minutes
- Pass mark: 70%

2.3.2 Specific practical

The candidate is required to test and report on three specimens: butt weld in plate, butt weld in pipe, and a T-joint, using two difference techniques selected by the examiner.

- Time allowed: 3 hours
- Pass mark: 70% 4.3.3 Instruction writing

The candidate shall draft an NDT instruction suitable for Level 1 personnel as selected by the examiner.

- Time allowed: 60 minutes
- Pass mark: 70%

2.4 Level 2 General engineering

2.4.1 General practical examination

The candidate is required to conduct and report on a control or function test for the practical applications of visual and optical testing as selected by the examiner.

- Time allowed: 60 minutes
- Pass mark: 70%

2.4.2 Specific practical

The candidate is required to test and report on three specimens selected by the examiner from welds (in plate, pipe or T-joint), castings and wrought products (including forgings). The candidate is in addition required to produce an NDT instruction for one of the items to be tested.

- Time allowed: 3 hours
- Pass mark: 70%

2.4.3 Instruction writing

The candidate shall draft an NDT instruction suitable for Level 1 personnel as selected by the examiner.

- Time allowed: 60 minutes
- Pass mark: 70%

3 Examination Syllabus

3.1.0 Level 1 - Visual and Optical Inspection

3.1.1 General theory

a. Introduction
Definition and history of visual testing.

b. Factors Influencing visual Inspection
Vision, lighting, material properties, environmental, visual perception, surface preparation, direct and indirect inspection.

c. Equipment
Mirrors, magnifiers, borescopes, fibrescopes, CC TV, gauges, templates, scales, automated systems, computer enhanced.

3.2.0 Specific theory - Welds

a. Inspection and Testing
Selection of parameters, inspection objectives and test points.

b. Reporting
Test standards/calibration, classification of indications.

c. Welding technology
Terminology for welds, welded joints, welding procedures. Types of defect in welds and parent metals detectable by visual and optical inspection.

3.2.1 Specific theory – General Engineering

As for Level 1 welds but in addition candidates for General Engineering certification will be required to have a knowledge of:

a. Basic Casting Production Methods – Finished Products
Definition of casting and knowledge of process overview. Types of defect in castings detectable by visual and optical inspection.

b. Wrought Production Processes
Definition of rolling and knowledge of process overview. Types of defect in rolled material detectable by visual and optical inspection. Definition of forging and knowledge of process overview. Types of defect in forged products detectable by visual and optical inspection.

c. Standards and Specifications
The standards and specifications to be used will be relevant to the region in which the examination is to be conducted and to the employment of the candidate.

3.3.0 Level 2 Visual and Optical Inspection

3.3.1 General theory

As for Level 1 plus:

a. Vision
The eye, limitations, disorders, vision requirements.

b. Light
Fundamental theories, light measurements, required levels, lighting techniques.

c. Material Attributes
Cleanliness, colour, condition, shape, size, temperature, texture, type, surface finish.

d. Environmental and Physical Factors
Atmosphere, comfort, distance, elevation, fatigue, health, humidity, mental attitude, position, safety, temperature, cleanliness.

e. Visual Perception

f. Equipment
Imaging systems, optical systems.

3.3.2 Specific theory - Welds

As for Level 1 Welds plus

a. Welding technology
Terminology for welds, welded joints, welding procedures, weld defects, parent metal defects.
Influence on techniques of geometry, size, surface condition, parent metal composition, weld metal structure. Influence of surface cladding, heat treatments and weld repairs.
Basic principles of fusion welding processes.
Types of defect associated with particular parent metal/welding process combinations. Types of defect in welds and parent metals detectable by visual and optical inspection.

3.3.3 Specific theory – General Engineering

As for Level 1 General Engineering plus

a. Welding technology
Terminology for welds, welded joints, welding procedures, weld defects, parent metal defects.
Influence on techniques of geometry, size, surface condition, parent metal composition, weld metal structure. Influence of surface cladding, heat treatments and weld repairs.
Basic principles of fusion welding processes.
Types of defect associated with particular parent metal/welding process combinations. Types of defect in welds and parent metals detectable by visual and optical inspection.

b. 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 for further hot working, rolling, forging and extrusion.

c. 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.

d. 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.

e. 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.

3.4.0 Level 3 Visual and Optical Inspection

3.4.1 General theory

3.4.1.1 Section A

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 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

3.4.1.2 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.

3.4.1.3 Standards and Documentation Relating to the Certification of NDT Operators
BS EN ISO 9712, SNT-TC-1A.

3.4.2 Section B
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.

3.4.2.1 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.