



**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 6: Visual and Optical 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'.

## **VISUAL AND OPTICAL INSPECTOR**

### **1 Level 1**

#### **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 (welds), time allowed 30 minutes
- 30 multiple choice questions (general engineering), time allowed 45 minutes
- Pass mark 70%

#### **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 1 hour
- Pass mark 70%

#### **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.

##### **1.4.1 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%

##### **1.4.2 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), according to written instructions provided.

- Time allowed 3 hours
- Pass mark 70%

## **2 Level 2**

### **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 (welds), time allowed 30 minutes
- 30 multiple choice questions (general engineering), time allowed 45 minutes
- Pass mark 70%

### **2.3 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 1 hour
- Pass mark 70%.

### **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%.

#### **2.4.2 Instruction writing**

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

- Time allowed 1 hour
- Pass mark 70%

#### **2.4.3 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%.

#### **2.4.4 Instruction writing**

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

- Time allowed 1 hour
- Pass mark 70%

### **3 Level 3**

#### **3.1 Basic Examination (Exempt if already holding Level 3 ISO 9712 certification)**

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

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

##### **Section A2 - Knowledge of the Certification System**

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

This section of the examination shall be open book.

##### **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 2 certificate holders in the main NDT methods.

#### **3.2 Main Method Examination**

##### **Section C1 – Level 3 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%

##### **Section C2 – 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 30 minutes
- Pass mark 70%

##### **Section C3 – Procedure Production**

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 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.

### **4.1 Level 1 Welds**

#### **4.1.1 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 1 hour
- Pass mark 70%

#### **4.1.2 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%

### **4.2 Level 1 General engineering**

#### **4.2.1 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 1 hour
- Pass mark 70%

#### **4.2.2 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), according to written instructions provided.

- Time allowed 3 hours
- Pass mark 70%

### **4.3 Level 2 Welds**

#### **4.3.1 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 1 hour
- Pass mark 70%

#### **4.3.2 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 different 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 1 hour
- Pass mark 70%

### **4.4 Level 2 General engineering**

#### **4.4.1 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 1 hour
- Pass mark 70%

#### **4.4.2 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%

#### **4.4.3 Instruction writing**

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

- Time allowed 1 hour
- Pass mark 70%

## **5 Examination Syllabus**

### **5.1 Level 1 - Visual and Optical Inspection**

#### **5.1.1 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.

**5.2 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.

**5.2.1 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 how it works. Types of defect in castings detectable by visual and optical inspection.

**b. Wrought Production Processes**

Definition of rolling and how it works. Types of defect in rolled material detectable by visual and optical inspection. Definition of forging and how it works. 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.

**5.3 Level 2 Visual and Optical Inspection**

**5.3.1 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.

**5.3.2 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.

**5.3.3 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, 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 how it works, 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.

### **5.4 Level 3 Visual and Optical Inspection**

#### **5.4.1 General theory**

##### **5.4.1.1 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 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**

#### **5.4.1.2 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.

#### **5.4.1.3 Standards and Documentation Relating to the Certification of NDT Operators**

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

## **5.4.2 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.

### **5.4.2.1 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.

## **6 Recommended Reading**

- PCN Classroom Training Handbook on the Visual Inspection of Metallic Materials in General Engineering Use. The British Institute of Non-Destructive Testing.
- Product Technology Classroom Training Handbook – The British Institute of Non-Destructive Testing.
- Visual Examination: Inspection of Metals. RC Anderson, American Society for Metals 1983.
- Non-Destructive Testing, Vol 8, Visual and Optical Testing, ASNT.
- ASNT Question and Answer Book.
- ASNT Level III Study Guide.
- Basic Metallurgy for Non-Destructive Testing, Edited by J L Taylor. The British Institute of Non-destructive Testing.