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

PART 4b Radiographic Interpreter Level 2

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Issued under the authority of the Governing Board for Certification
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1 EXAMINATION CONTENT

1.1.0 CSWIP Radiographic Interpreter Level 2: Welds

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 Practical examination

Certification is awarded in X-ray and Gamma ray radiography in either welds or casting sectors.
The candidate is required to be able to read, mark up, interpret and report radiographic image.
This ability shall be demonstrated by interpreting of set of 12 radiographs. In case certification is sought in both sectors together (welds and castings) 12 + 12 radiographs shall be interpreted.
For each radiograph the candidate is required to define location, size and characterisation of defects and to comment upon radiographic technique and quality of the radiographs.

Candidates will be asked to complete seven multiple choice questions targeting key areas concerning each of the radiographs issued. Candidates will report on a set of 12 radiographs as defined above (84 questions in total).

Composition of set (castings)
A set of radiographs shall cover variety of castings. The radiographs may cover various materials (e.g. copper, aluminium carbon steel or stainless steel). The requirement for number of radiographs from a given material is not specified.

Composition of set (welds)
A set of radiographs shall cover both Single Wall and Double Wall geometrical configuration. In set shall be at least 4 radiographs representing each geometrical configuration.
The set of radiographs must cover various materials (copper, aluminium, carbon steel and stainless steel must be represented by at least one radiograph in a set). Radiographs shall cover also X- ray and

Gamma ray techniques. The requirement for the number of radiographs of any specific technique is not specified.
Example of set composition - welds:

Image no	Configuration	Material	Source
1	SWSI	carbon steel	X-ray
2	SWSI	carbon steel	X-ray
3	DWSI	carbon steel	X-ray
4	SWSI	aluminium	X-ray
5	DWSI	stainless steel	Gamma ray
6	SWSI	copper	X-ray
7	DWDI	carbon steel	X-ray
8	SWSI	carbon steel	Gamma ray
9	DWDI	carbon steel	X-ray
10	DWDI	stainless steel	X-ray

11	SWSI	aluminium	X-ray
12	SWSI	carbon steel	X-ray

- Time allowed: 3 hours Set of 12 radiographs – 84 multiple choice questions
- Pass mark: 70% per set of 12 radiographs

1.2.0 CSWIP Radiographic Interpreter Level 2: Castings

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 Practical examination

Certification is awarded in X-ray and Gamma ray radiography in either welds or casting sectors.
The candidate is required to be able to read, mark up, interpret and report radiographic image.
This ability shall be demonstrated by interpreting of set of 12 radiographs. In case certification is sought in both sectors together (welds and castings) 12 + 12 radiographs shall be interpreted.
For each radiograph the candidate is required to define location, size and characterisation of defects and to comment upon radiographic technique and quality of the radiographs.

Candidates will be asked to complete seven multiple choice questions targeting key areas concerning each of the radiographs issued. Candidates will report on a set of 12 radiographs as defined above (84 questions in total).

Composition of set (castings)
A set of radiographs shall cover variety of castings. The radiographs may cover various materials (e.g. copper, aluminium carbon steel or stainless steel). The requirement for number of radiographs from a given material is not specified.

Composition of set (welds)
A set of radiographs shall cover both Single Wall and Double Wall geometrical configuration. In set shall be at least 4 radiographs representing each geometrical configuration.
The set of radiographs must cover various materials (copper, aluminium, carbon steel and stainless steel must be represented by at least one radiograph in a set). Radiographs shall cover also X- ray and

Gamma ray techniques. The requirement for the number of radiographs of any specific technique is not specified.
Example of set composition - welds:

Image no	Configuration	Material	Source
1	SWSI	carbon steel	X-ray
2	SWSI	carbon steel	X-ray
3	DWSI	carbon steel	X-ray
4	SWSI	aluminium	X-ray
5	DWSI	stainless steel	Gamma ray
6	SWSI	copper	X-ray

7	DWDI	carbon steel	X-ray
8	SWSI	carbon steel	Gamma ray
9	DWDI	carbon steel	X-ray
10	DWDI	stainless steel	X-ray
11	SWSI	aluminium	X-ray
12	SWSI	carbon steel	X-ray

- Time allowed: 3 hours Set of 12 radiographs – 84 multiple choice questions
- Pass mark: 70% per set of 12 radiographs

2 Ten Year Recertification

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 for initial exam.

The candidate is required to interpret and evaluate a set of 12 radiographs per sector. If certification in casting and welding sectors shall be renewed, then 12+12 radiographs shall be interpreted.

Same rules for sample selection as in case of initial exam shall be applied.
Time allowed: Set of 12 radiographs – 84 multiple choice questions (3 hours)

- Set of 12 radiographs – 84 multiple choice questions (3 hours).
- Pass mark: 70%

3 Examination Syllabus

3.1.0 Radiographic Interpreter (Welds) Level 2 Syllabus

3.1.1 General theory

a. Nature and Properties of X and/or Gamma Radiation
Penetration, absorption, scatter, diffraction, transmission. Rectilinear propagation. Photographic properties.

b. Photographic aspects
Dark room procedures: layout, light traps and entrance, wet and dry benches, film-pass hatches, processing units, safe-lights and ancillary equipment. Handling and processing of films, temperature control.
Sensitometry: types of film used in industrial radiography. Characteristic curves, speed, contrast, definition, density. Fog. Graininess. Inherent unsharpness. Latitude. Commercial films and their properties. The use of screens.

c. Fundamental aspects of Radiographic quality
Quality of radiation. Optimum working densities. Radiographic contrast. Objective and subjective contrast. Methods of controlling radiographic contrast. Effects of scattered radiation. Use of filters, screens, masking and blocking media. Influence of processing conditions and viewing conditions on contrast.
Radiographic definition: objective and subjective, unsharpness, geometric unsharpness, inter-relationship of dimensions of focal spot or source, focus (source) - object and focus (source) - film distances. Inherent unsharpness. Movement. Film screen contact. The summation of factors controlling definition.
Control of radiographic sensitivity and its assessment by the use of image quality indicators.

d. X-ray and Gamma ray equipment
A knowledge of the effects on radiographic quality in the event of equipment change.

e. Geometry of Image Formation
Control of focus (source) - object distance, object - film distance, focus (source) - film distance. Selection of beam angle.

3.1.2 Specific Theory - Welds

a. Exposure Calculations
Effect of distance on exposure. Use of exposure charts and calculators for X and gamma radiography.

b. Application to Welds
Interpretation of Radiographs in steel plate, and circumferential butt joints in steel pipe. Welds in aluminium. Welds in copper and its alloys. Welds in small bore tubes. The determination of the depth of a flaw from one surface in a specimen by the practical use of the tube or source shift method.

c. Viewing of Radiographs
Optimum viewing conditions. Checking for acceptable density, contrast and freedom from spurious indications. Analyse the loss of sensitivity in order to rectify faulty techniques. Spurious indications: light (and safe-light) fogging, chemical fog, strains, air bubbles, reticulation, pressure marks, static marks, drying marks, finger marks, defective screens, incomplete fixing, film manufacturing faults.

d. 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 radiography. Defect parameters which influence detectability, e.g. size, geometry, distance from surface, orientation, reflectivity and opacity.

3.1.3 Specific theory – Castings

a. Casting Methods
Sand castings, pressure and gravity die casting, investment casting

b. Casting Defects
Voids; porosity, gas and blowholes, airlocks and sponge Surface defects; sinks, scabs, chisel and other fettling marks fins and flash. Linear indications; hot tears, cold or stress cracks and cold shuts other defects; un-fused chill and chaplets, core shifts and mould damage.

c. Heat treatment
Common heat treatments and their reason for use.

3.1.4 Instruction writing examination

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

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