NZ Non Destructive Testing Association Inc.

C/- HERA, PO Box 76-134 Manukau City, Auckland 2241

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COURSE TITLE **Radiographic Testing - Level 2 (Welds)**

COURSE CODE **RT20W**

Revision **Rev 1 dated - 06 April 2022**

Purpose:

The body of technical knowledge required of non-destructive testing (NDT) personnel is essential for maintaining the quality level of all NDT inspections regardless of method or technique. The content and expected outcomes of this course are designed to cover the Radiographic inspection of welds for evaluation of thickness and internal discontinuities at qualification Level 2 (ISO 9712).

This course is designed to prepare the trainee for the **Theory** part of the CBIP Radiographic certification **RT2.** This course will also serve to reinforce the practical skills gained during their RT experience to assist with preparation for the practical exam.

This course is also designed for personnel preparing for Radiographic Level 1. Course duration for Level 1 trainees may be reduced in accordance with CBIP and ISO-9712 requirements.

Practical training and assessments have been included in this course for demonstration purposes and to confirm the adequacy of the training.

Introduction to specialized inspection techniques such as Digital Radiography and Computerized Tomography are included in the training, however additional formal training in these categories will be required before applying for certification in these techniques.

Competency Standards:

This course and associated training materials have been designed to comply with the following documents

ISO 9712-2012 -Non-Destructive Testing - Qualification and Certification Of NDT Personnel

ISO/TS 25107:2019 - Non-destructive testing — NDT training syllabuses

CBIP PRO-CER-18 - Guidelines for certification General

CBIP PRO-CER-16 - Guidelines for certification Radiographic testing

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Learning Outcome:

Trainees will be able to demonstrate knowledge of the Radiographic inspection process including practical applications and Interpretation and evaluation at Level 2

They should be able to perform the following;

- Select the RT technique best suited for the inspection, and work directly from RT standards and specifications such as AS 2177.
- Define the limitations of Radiographic method.
- Translate RT standards, specifications and procedures into written instructions.
- Set up and verify equipment settings.
- Perform RT tests including interpretation and evaluation of results according to applicable standards and procedures.
- Provide training and guidance for personnel at or below Level 2.
- Report the results of Radiographic Inspections.

For Whom

Personnel involved in the Radiographic inspection of Welds for defect detection. Personnel seeking RT certification to Level 2 iaw CBIP PRO-CER-16 and ISO 9712.

Course Duration

The course is normally required to be delivered over a period of 120 hours covering 15 days for trainees with little or no experience.

Total training hours for this course has been reduced to **80 hours (10 days)** in accordance with the ISO and CBIP Requirements. Reducing this training to 80 hours requires all trainees to meet the following conditions;

1 Have a current radiation safety licence and at least 40 hours theory training in radiation safety.
2 Have at least 3 months on job practical experience as a Radiographer Assistant.
3 Have at least one ISO 9712 L2 certification (or equivalent) in either; MT, PT, ET or UT. Refer ISO 9712 section 7.2.5 and CBIP PRO-CER-16 section 2.2.3
4 Have completed the NDTA RT20W pre-course training and assessment package (Approximately 10hrs duration)

A course plan detailing the expected timetable will be issued to the trainee at the start of the course. The course will consist of theory lecturers, practical exercises and assessments as detailed in the course programme and attached syllabi.

The practical content of this course can be delivered in the classroom or at the trainee's workplace.

Prerequisite

Trainees attending this course shall have a basic understanding of the Radiographic method and hold a current NZ Radiation Safety License.
Refer also to the **Course Duration** paragraph as noted above

Trainees shall also have an understanding of English (written and spoken) to a level of TOEFL 500

Instructor

Course instructors shall be accepted by NZNDTA and their adequacy documented.
Instructors should be qualified to L3 (or equivalent as determined by NZNDTA) in the Radiographic method. Subject Matter experts as determined by the Instructor may be used for specific training modules when required.

Assessments:

Informal assessments will be allocated to trainees at the end of each day. These will be used for determining training effectiveness. The end of course assessment shall consist of a minimum of 40 questions adapted from the ASNT Recommended Practice SNT-TC-1A question and answer book. To **successfully complete** this course a minimum pass mark of 70% is required
CBIP certification exams need to be applied for separately – Additional charges apply

Resources:

Trainees will be issued with training notes and handouts reflecting the training presentation as identified in the course program.
Course evaluation/feedback forms will also be supplied and upon successful completion of all modules, an NZNDTA endorsed completion certificate will be issued.
Trainees will also be provided with a list of training material required along with any Health and Safety requirements prior to commencement.

Course Program and Syllabi

The Course syllabus is designed to comply with CBIP PRO-CER-16 and ISO/TS-25107.
Course content has been derived from a variety of resources including equipment manufacturers and on line education packages.
Refer to appendix A for course content/syllabi and Instructors time table

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Course Delivery

The course may be delivered by one (or a combination) of the following

A. ***Computer based interactive webinar***.- This will be confined to specific theory modules that do not include any practical content or where trainees are required to have only minimal participation. Trainees will have the ability to communicate with the instructor and other participants. Learning outcomes and training effectiveness will be evaluated by written assessments delivered at the end of each module

C ***Classroom***.- Interactive classroom training where the trainee has access training material, equipment and test pieces.

B ***Home study***. Trainees will be given written assessments that require them to review and interpret the training material at the end of each day/module

D ***Workplace Practical Exercises*** – Trainees will be given written practical exercises that can be completed at their normal place of work. This will enable trainees to access additional equipment and resources to complement their training. These will be supervised by the instructor or delegated representative to confirm and supervise the effectiveness of the training. The delegated representative will be approved by the instructor and NZNDTA and will be at least RT Level 2 and IANZ signatory. This may be the trainees employer/supervisor. Training effectiveness will be evaluated by specific checks documented at each stage of the exercise.

Appendix A

The course syllabi and instructor guide (appendix A) will detail the acceptable delivery system(s) and timing for each module.

Practical exercises are documented at the end of appendix A along with itemised practical training samples required for each exercise.

Minimum requirements for the RT equipment to be available for the practical exercises are also included.

Documentation Control

Course documentation will be approved, controlled and owned by NZNDTA.

Course APPROVAL:

NZNDTA Rep _____

RT Level 3 _____

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Appendix A

Course RT20W
Radiographic Testing Level 2
Course Syllabi and Instructor Time Table

The following course timetable of 80 hours duration is based on the requirements as noted on page 2.

The following referenced material has been used to develop the structure and content of this course.

- CBIP PRO-CER-16 and 18 Training Guidelines
- ISO/TS 25107 Non-destructive testing — NDT training syllabus
- ANSI/ASNT CP-105 Qualification outlines
- ASNT Training handbook
- NDE/NDT Resource Center
- OEM supplied equipment training material

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RT20W pre-course training and assessment package (PCA)	
Content	**Timeframe and notes**
Radiation safety review	**Notes** **Zoom Meeting** **10 hours**
Basic atomic structure and radioactivity	
Basic radiographic setup	
Exposure calculations	
Film development	
Equipment control and calibration	
AS 2177 and ATM E 1742	
Confirmation of training effectiveness	• Basic Maths questions and formula exercises • Review questions

Module 1 ***Introduction to NDT Certification and History of Radiographic Testing (RT)***	
Content	**Timeframe and notes**
Role of NDT	**Notes** **4 hours**
NDT Certification	
Definitions	
Discontinuities	
History of Radiographic Testing	
Present state and Future State	
The Basic Radiographic Process	
Advantages and Limitations	
Confirmation of training effectiveness - Module 1	• Basic Maths questions and formula exercises • Review questions

Module 2 ***Radioactivity and Ionisation***	
Content	**Timeframe and notes**
Atoms	**Notes** **4 hours**
Isotopes	
Radioactivity	
Ionising Radiation and Decay	
X Rays	
Ionization	
Attenuation	
Confirmation of training effectiveness - Module 2	• Review questions

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Module 3 ***X-ray and GAMMA-Ray Sources***	
Content	**Timeframe and notes**
X-ray production	**Notes** **4 hours**
The x-ray tube	
Anode design and focal-spot	
Panoramic x-ray tubes	
Rod anode tubes	
The basic x-ray unit	
Milliamps - mA	
Kilovoltage	
Constant potential units	
Specialised equipment	
High-voltage equipment	
X-ray application	
Gamma radiation	
The curie	
The roentgen	
Gamma ray sources	
Half life	
Gamma ray quality characteristics.	
Gamma ray equipment	
Radiation Safety Review 3a	**4 hours**
Confirmation of training effectiveness - Module 3	• Maths questions and formula exercises • Review questions

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Module 4 ***Scattered Radiation and Screens***	
Content	**Timeframe and notes**
Scattered radiation	**Notes** **4 hours**
Control of scatter	
Backscatter	
Mottling	
High energy scatter	
Radiographic screens	
Lead foil screens	
Lead oxide screens	
Fluorescent screens	
Cassettes and film holders	
Confirmation of training effectiveness - Module 4	• Review questions

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Module 5 *Factors Governing Exposure*	
Content	**Timeframe and notes**
Geometric principles	**Notes** **8 hours**
Geometric unsharpness	
Factors governing exposure	
X ray quality	
Radiation emitted by gamma rays	
Inverse square law	
Radiation scatter	
Equivalency tables	
Determination of exposure factor	
Contrast	
Multiple film techniques	
Arithmetic of Exposure	
Exposure - Distance Relation	
Milliamps - Time Relation	
Logarithms	
Photographic Density	
Exposure Charts	
Confirmation of training effectiveness - Module 4	• Maths questions and formula exercises • Review questions

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Module 6 *The Characteristic Curve*	
Content	**Timeframe and notes**
Contrast	**Notes** **4 hours**
Speed	
Relative Exposure Calculations	
Overlay Methods	
Multi Thickness Specimens	
Multiple Films	
Confirmation of training effectiveness - Module 6	• Maths questions and formula exercises • Review questions

Module 7 *Radiographic Image Quality*	
Content	**Timeframe and notes**
Factors Affecting Image Quality	**Notes** **+ Practical exercises** **8 hours**
Radiographic sensitivity	
Radiographic Contrast	
Definition	
Film Graininess, Screen Mottle	
Penetrameters (IQI)	
Equivalent Penetrameter Sensitivity	
Penetrameters vs Visibility of Discontinuities	
Interpreting Radiographic Quality	
Confirmation of training effectiveness - Module 7	• Maths questions and formula exercises • Review questions

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Module 8 ***X-Ray Film and Processing***	
Content	**Timeframe and notes**
Industrial X-ray Films	**Notes** **+ Practical exercises** **8 hours**
Film Selection	
Film Handling and Storage	
Film Identification and classification	
Development vs Speed and Contrast	
Film Graininess and Signal-to-Noise Ratio	
Latent Image	
Film Processing	
Manual Processing	
Automated Film Processing	
Equipment Control	
The Processing Room	
Confirmation of training effectiveness - Module 8	• Review questions

Module 9 ***Special Radiographic Techniques***	
Content	**Timeframe and notes**
"In-Motion" Radiography	**Notes** **4 hours**
Depth Localization of Defects	
Thickness Measurement	
High Speed Radiography	
Geometric Enlargement	
Neutron Radiography	
Fluoroscopy	
Digital Radiography	
Confirmation of training effectiveness - Module 9	• Review questions

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Module 10 *Weld Inspection*	
Content	**Timeframe and notes**
Information Prior To Testing	**Notes** **+ Practical exercises** **16 hours**
AS 2177 • *RAY EQUIPMENT.* • *GAMMA-RAY SOURCES* • *INTENSIFYING SCREENS* • *CASSETTES* • *FILTERS* • *IMAGE QUALITY INDICATORS* • *FILMS* • *FILM PROCESSING FACILITIES* • *VIEWING FACILITIES* • *SURFACE PREPARATION* • *IMAGE QUALITY INDICATORS* • *GEOMETRIC UNSHARPNESS* • *RADIOGRAPHIC DENSITY* • *FILM COVERAGE* • *BACK-SCATTER PROTECTION* • *MASKING* • *RADIOGRAPHIC IDENTIFICATION* • *FILM LOCATION* • *PROCESSING OF RADIOGRAPHS* • *VIEWING OF RADIOGRAPHS* • *STORAGE OF RADIOGRAPHS* • *RECORD OF TEST* • *TEST REPORT* • *RADIOGRAPHIC EQUIVALENCE FACTORS* • *IMAGE QUALITY AND FILM SYSTEM CLASSES*	
Confirmation of training effectiveness - Module 10	• Maths questions and formula exercises • Review questions

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Module 11 (MF20A) Product Knowledge and Manufacturing		
Section	**Content**	**Timeframe and notes**
Basic Steel manufacturing and manufacturing defects	Production of steel and fabrication processes.	**Notes** **4 hours**
	Heat Treatment	
	Common defects associated with the processing methods	
	Casting Rolling and Forging (Wrought)	
	Welding and welding defects	
	Tubing, Pipe and Composite	
	Hydrogen Embrittlement	
In-service inspection	Corrosion and cracking	
	Fatigue	
Confirmation of training effectiveness - Module 11		Review questions

Module 12 *Written Instruction, Examination preparation and sample questions*	
Content	**Timeframe and notes**
Production of written Instruction (Level 2)	**BINDT CP25** **4 hours**
Theory and Specific exam review	**4 Hours**
Practical exam preparation	
RT Formula	
BINDT CP25 – Procedure and written Instruction preparation	
AS 2177	
ASTM E1742	
Confirmation of training effectiveness - Module 12	Review questions

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RT20W Practical Exercises - Weld		
Test Piece Description	**Identification**	**Practical Demonstration**
To Be Advised		

RT20W Practical Exercises - Equipment

The following equipment (or equivalent) is required for performance of the practical exercises. The equipment must comply with the requirements of AS 2177

- X ray unit capable of at least 160KV
- X ray booth compliant with MoH ORS C7
- Radiation survey meter
- Calibrated densitometer
- Film processing unit with certified Denstep
- Agfa D4 and D7 film, or equivalent, with screens
- Film identification markers and relevant IQI's
- Film viewer capable of at least 4D

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