Certification Services Division
Newton Building, St George's Avenue
Northampton, NN2 6JB
United Kingdom

Tel: +44(0)1604-893-811.
Fax: +44(0)1604-893-868.
E-mail: pcn@bindt.org

PCN ISI_GEN APPENDIX A1-ISI ISSUE 1 REV D DATED 22nd JULY 2015

IMPLEMENTATION DATE: 1st AUGUST 2015

CERTIFICATION OF PERSONNEL FOR IN-SERVICE INSPECTION – MANUAL ULTRASONIC TESTING - VIA THE MODULAR ROUTE

ASSOCIATED DOCUMENTS:

Appendix Z1 to PCN/GEN (examination syllabus compendium) - For General Theory of UT only

CONTENTS

1. IN-SERVICE INSPECTION - MANUAL ULTRASONIC TESTING

1. SCOPE

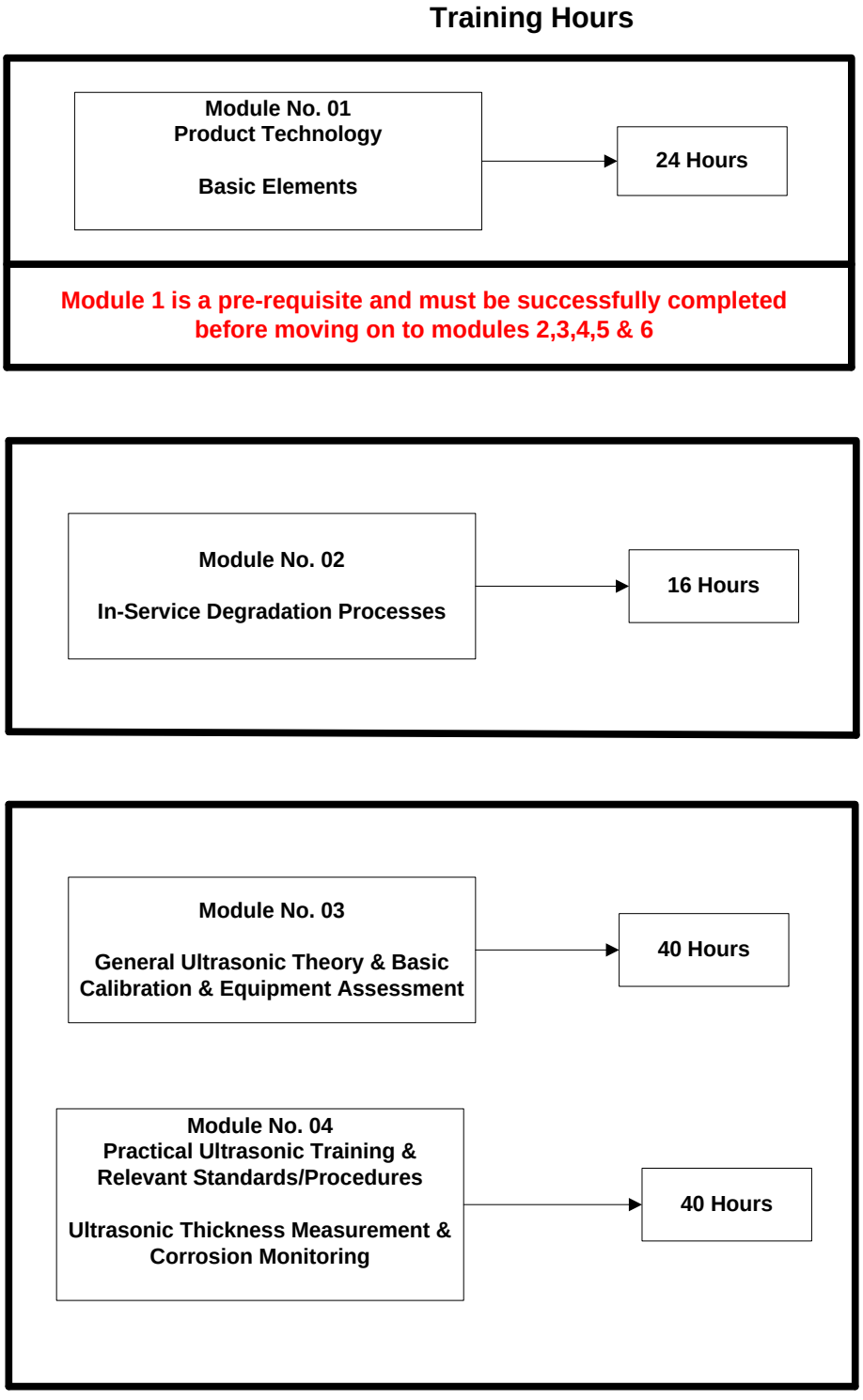
1.1 This document prescribes the specific requirements and procedures by which personnel may be examined and, if successful, certified competent for the ultrasonic testing of In-service Inspection – Manual Ultrasonic Testing. Requirements contained in this document are supplementary to those contained in the current edition of the PCN ISI General requirements for qualification and PCN certification of NDT personnel for in- service inspection.

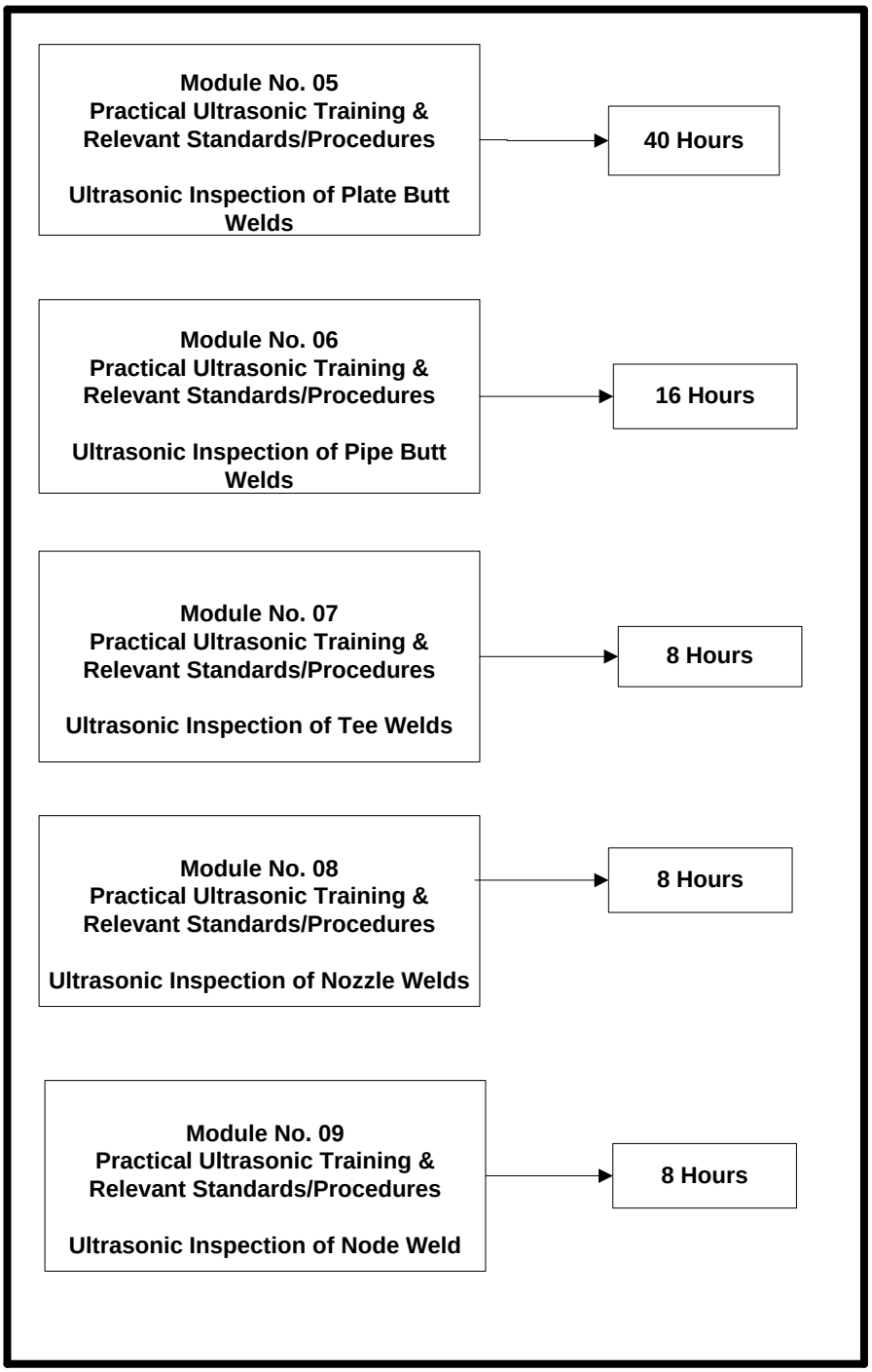
1.2 This document describes the modular approach to obtaining a UT qualification for In-service Inspection. Rules of this modular approach are listed below:

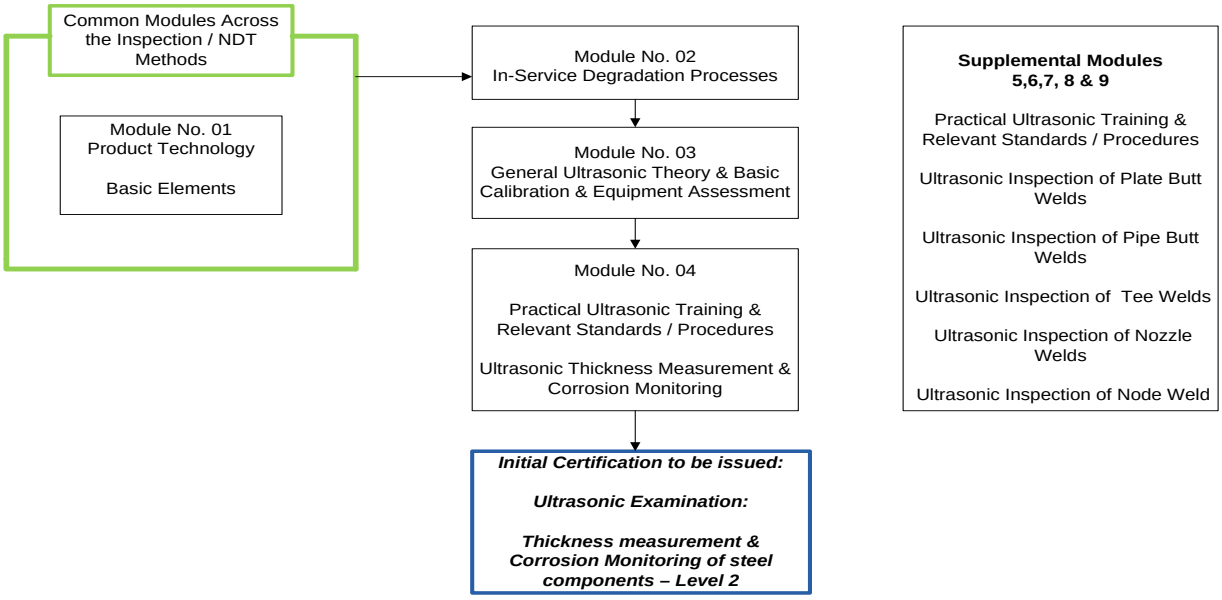
- **Module 1 is a pre-requisite and a certificate of successful completion will be required by the AQB/ATO before allowing candidates to take the remaining modules and examination. The success will be determined by an end of module assessment of 60 M/C questions time allowed (120 Minutes).**
- **Module 3 will be exempt for holders of Current PCN UT certification.**
- There is a 24 month period in order to complete the modules.
- Candidates will be given 24 months to gain experience after completion of all modular examinations.
- Candidates should be aware that if using the full 24 months to complete the modules the re-examination requirements could result in earlier modules going past the 24 month expiry date, and will therefore need to re-take the earlier examinations.
- The grading is a straight 70% mark on each examination part with no overall average grade applied.

1.3 Candidates are encouraged to bring their own equipment, including probes, but examination centre equipment may be hired or provided subject to availability. Additional time will be allowed in the practical examination for candidates using examination centre provided equipment, the additional time allowed is only to calibrate equipment, producing DAC curves, checking beam spread and main beam angles not for testing samples.

2. MODULAR APPROACH FOR TRAINING DURATION




Module No. 05
Practical Ultrasonic Training &
Relevant Standards/Procedures
Ultrasonic Inspection of Plate Butt Welds
40 Hours
Module No. 06
Practical Ultrasonic Training &
Relevant Standards/Procedures
Ultrasonic Inspection of Pipe Butt Welds
16 Hours
Module No. 07
Practical Ultrasonic Training &
Relevant Standards/Procedures
Ultrasonic Inspection of Tee Welds
8 Hours
Module No. 08
Practical Ultrasonic Training &
Relevant Standards/Procedures
Ultrasonic Inspection of Nozzle Welds
8 Hours
Module No. 09
Practical Ultrasonic Training &
Relevant Standards/Procedures
Ultrasonic Inspection of Node Weld
8 Hours



3. EXAMINATION CONTENT

General information on examination content and time allowed for each written part is described in PCN ISI General requirements for qualification and PCN certification of NDT personnel for in- service inspection. This Appendix amplifies the provisions of that document only where necessary.

The total time allowed for the practical examination is six hours. The minimum pass mark for the practical part is 70% in each sample tested

3.1 Level 2

Except where exemptions apply (refer to PCN ISI General requirements for qualification and PCN certification of NDT personnel for in- service inspection), all candidates will be required to attempt an examination comprised of the following parts:

3.1.1 General Theory of the Ultrasonic Method. (Module 03) 40 M/C questions time allowed (80 minutes)

3.1.2 Sector specific theory of the application of the ultrasonic method and including In-service degradation processes and associated defects. (Modules 02 & 04). 30 M/C questions time allowed (60 minutes)

3.1.3 Sector specific practical examination comprising:

(i) calibration of test equipment. (Module 03)

(ii) Ultrasonic Thickness measurement & Corrosion Monitoring (Module 04)

The practical examination shall consist of 5 samples in total:
1 x step wedge type, non-coated demonstrating 10 x accurate thickness measurements reported.
1 x Coated Plate with typical corrosion type defects.
2 x Coated Pipes with typical corrosion type defects
1 x Coated typical Industry configured component such as an elbow bend or flange or welded flange or bottom of a vessel.

The preparation of a detailed NDT instruction suitable for level 1 certificate holders to follow covering the testing of one plate or pipe specimen to a provided code, standard or specification, and to prove the instruction by testing.

Total time allowed 6 hours

3.3 Level 3

Except where exemptions apply (refer to PCN ISI General requirements for qualification and PCN certification of NDT personnel for in- service inspection), all candidates will be required to attempt an examination comprising a Basic examination and a Main Method examination.

Information on the content and grading of PCN Level 3 examinations is provided in PCN ISI General requirements for qualification and PCN certification of NDT personnel for in- service inspection.

Level 3 candidates who do not hold PCN level 2 certification for the ultrasonic testing of welds will be required to successfully complete the examination described in Clause 3.1.3 (excepting sub-clause (iv))

4. SUPPLEMENTARY EXAMINATION CONTENT

Existing PCN level 2 certificate holders, certificated in accordance with PCN ISI_GEN Appendix A1-ISI, who apply to be certificated for the ultrasonic testing of additional weld categories, will be required to pass a further specific and practical examination. The examination content will comprise of 30 M/C questions and the testing of samples from the category in which certification is sought (see Clause 4.1 above) (Modules 05, 06, 07, 08, 09 as relevant)

Note: for candidates attempting additional modules 5, 6, 7, 8 & 9 parts (iii) and (iv) needs to be completed.

(iii) for initial level 2 candidates who are additionally being examined in the ultrasonic testing of welds, the preparation of a detailed NDT instruction covering the testing of one butt weld in a plate specimen to a provided code, standard or specification, and to prove the instruction by testing.

(iv) reporting the results of tests on forms provided, indicating the location, type and size of flaws detected in the weld.

NOTE. *There is no maximum imposed on the number of samples that candidates may attempt on any one visit to the test centre*

The total maximum time allowed for the practical examination is calculated by adding 2½ hours per sample tested, 1 hour for calibration of the test equipment and 1 hour for drafting the NDT instruction. The minimum pass mark for the practical part is 70% in each sample tested.

5. CERTIFICATION AVAILABLE

5.1 Level 2

5.1.1 Thickness measurement & Corrosion monitoring of steel components - (after successful completion of Modules, 01, 02, 03, 04).

5.1.2 Butt welds in plate* (two samples selected from three categories) - (after successful completion of 4.1.1 & Module 05)

5.1.3 Butt welds in pipe (three samples selected from three categories) - (after successful completion of 4.1.1 & Module 06)

5.1.4 Constructional T joints (two samples selected from two categories) - (after successful completion of 4.1.1 & Module 07)

5.1.5 Nozzles and variable configuration welds (two samples selected from two categories) - (after successful completion of 4.1.1 & Module 08)

5.1.6 Nodes (one sample from one category) - (after successful completion of 4.1.1 & Module 09)

5.1.7 Thickness measurement & Corrosion monitoring of steel components

Six samples in total. Three selected from each of two categories. Category 1 - Planar defect type samples, Category 2 - samples which demonstrate corrosion and/or erosion commonly found in the Industry in which the method is to be applied. .

5.1.8 Butt welds in plate (two samples to be attempted). This group is sub-divided according to thickness and type of weld into the following categories:

Category	Thickness (mm)	Type of weld
3.1.2	6-15 (inclusive)	Deposited from one side of plate
3.1.3	Over 15	Deposited from both sides of plate
3.1.4	Over 15	Deposited from one side of plate

Butt welds in plate also covers pipe welds of 500 mm outside diameter and above.

To obtain a certificate for butt welds in plate, success must be achieved in two categories. The selection of specific categories in this group will be by test centre staff.

5.1.9 Circumferential butt welds in pipe and tube (three samples to be attempted). This group is sub-divided according to wall thickness and outside diameter into the following categories:

Category	Outside diameter (mm)	Wall thickness (mm)
3.2.1	50 - 105	6 - 15
3.2.5	Over 105	6 - 15
3.2.7	Over 105	Over 15

NOTES.

i) All welds are deposited from outside the pipe without backing strips. Certification on such welds covers welds deposited from both outside and inside of the pipe.

ii) Candidates for certification in pipe, will be required to complete examinations on three categories of sample, 3.2.1, 3.2.5 and 3.2.7. To obtain a certificate all three categories must be successfully examined.

iii) All welded samples shall contain at least one representative in-service defect.

5.1.10 Constructional T joints (two samples to be attempted). This group is sub-divided into two categories: 3.3.2 Full penetration T joints and 3.4.2 Partial penetration T joints. Candidates concerned with constructional steelwork will be examined on a full penetration T joint and a partial penetration T joint. *All welded samples shall contain at least one representative in-service defect.*

Success must be achieved in both samples and in butt welds in plate to obtain a certificate for this category. Candidates successful in Group Nozzles are exempt Constructional T Joints and this will be awarded automatically.

5.1.11 Nozzles and variable configuration welds (two samples to be attempted). This group comprises two categories: 3.3.1 Full penetration nozzles and 3.4.1 Partial penetration nozzles, and covers welds in branches and stubs as well as nozzles. *All welded samples shall contain at least one representative in-service defect.*

Successful completion of this group provides exemption from Group 3.7 Constructional T joints. Candidates seeking certification in this group will be examined on one full penetration 3.3.1 and one partial penetration joint 3.4.1 of this type, both of which will be of variable geometry. Success must be achieved in both samples and in plate and/or pipe butt welds to obtain a certificate.

5.1.12 Nodes (one sample to be attempted). This group covers full penetration node joints. *All welded samples shall contain at least one representative in-service defect.*

Success must be achieved in one sample and in plate and/or pipe butt welds to obtain a certificate.

5.2 Level 3

Candidates may obtain level 3 certificates by successful completion of the examination described in Clause 2.3, but they must hold appropriate level 2 certification for ultrasonic testing of welds issued under PCN requirements, or an equivalent approval recognised by PCN. Otherwise they must successfully complete a practical examination equivalent to PCN level 2 plate butt welds .

6. RENEWAL AND RECERTIFICATION

6.1 The general rules for level 1 and level 2 renewal and recertification are fully described in PCN document CP16, and the rules for level 3 renewal and recertification are detailed in PCN document CP17.

6.2 Level 2 certificate holders seeking recertification will be required to undertake a practical recertification examination involving the writing of a satisfactory NDT instruction on the testing of a butt welded plate sample suitable for level 1 personnel to follow, and the practical testing of one welded sample from each weld categories for which certification was issued, interpreting codes, standards or specifications as required, and reporting the results in a prescribed manner in accordance with instructions provided. The time allowed will be 2½ hours per sample tested, plus 1 hour for drafting the NDT instruction. The minimum pass mark for the practical part is 70% in each sample tested .

6.3 The minimum overall pass mark for recertification in any category, comprising of an average of the marks awarded for instruction writing and each practical sample tested within the category, is 70%, and the minimum mark for each individual element of the examination is 70%. Level 2 candidates must pass the NDT instruction writing part in order to recertify.

6.4 A level 2 candidate seeking to recertify in multiple categories who is not successful in all categories may be issued certification covering those categories in which success *was* achieved. However, level 2 candidates for recertification who fail all butt welded specimens (plate and pipe), but who are successful in the NDT instruction writing part and one or more variable weld configuration specimens (nozzle or node) will have the variable configuration group(s) held over pending the one allowable retest, success in which will result in the issue of a PCN certificate that includes the previously passed variable configuration group as well as the group successfully tested during the retest examination. Failure in the one allowed retest will result in the individual concerned being considered an initial candidate for certification in the sector, method and level concerned.

7. GRADING

General information on the grading of examinations will be as specified in the current edition of PCN General Requirements for Certification of Personnel engaged in Non-Destructive Testing, and information on the grading of practical examinations is provided in PCN document CP22.

8. REFERENCE LITERATURE

Essential Reading

- ❑ BS EN 1330-2 Non-destructive testing – Terminology – Part 2: Terms common to the non-destructive testing methods
- ❑ BS EN 1330-1 Non-destructive testing-Terminology – Part 1 List of general terms
- ❑ BS EN 1330-4 Glossary of terms used in non-destructive testing. Ultrasonic flaw detection
- ❑ BS EN 12668-1 Non-destructive testing – Characterisation and verification of ultrasonic examination equipment – Part 1: Instruments
- ❑ BS EN 12668-2 Non-destructive testing. Characterisation and verification of ultrasonic examination equipment. Probes
- ❑ BS EN 12668-3 Non-destructive testing – Characterisation and verification of ultrasonic examination equipment – Part 3 combined equipment
- ❑ BS EN 583-1 Non-destructive testing –Ultrasonic examination – Part 1: General principles
- ❑ BS EN 583-3 Non-destructive testing –Ultrasonic examination – Part 3: Transmission technique
- ❑ BS EN 583-5 Non-destructive testing –Ultrasonic examination – Part 5: Characterisation and sizing of discontinuities
- ❑ BS EN 12223 Calibration block No.1 for ultrasonic examination

- BS EN 27963 Calibration block No.2 for ultrasonic examination of welds
- BS EN 14127 Non-destructive testing – Ultrasonic thickness measurement (ISO 16809)
- BS EN ISO 11666 Non-destructive examination of welds - Ultrasonic examination of welded joints Acceptance levels
- BS EN ISO 23279 Non-destructive examination of welds - Ultrasonic examination – Characterisation of indications in welds
- BS EN ISO 17640 Non-destructive examination of welds - Ultrasonic testing – Techniques, testing levels and assessment
- BS EN 12062 Non-destructive examination of welds – General rules for metallic materials
- BS 499-1 Welding terms and symbols - Part 1 : Glossary for welding, brazing and thermal cutting.
- BS EN ISO 9000 Series, Quality Management Systems
- Product Technology Classroom Training Handbook – The British Institute of Non-Destructive Testing.
- Training Course Notes. PCN requires candidates to have attended an approved course of training. Accredited Training Establishments are required to provide trainees with an up-to-date set of training course notes. These are considered essential reading.
- Plant Ageing. Management of equipment containing hazardous fluids or pressure, 2006.
- Health & Safety Executive Research Report RR509
- Best Practice for the Procurement and Conduct of Non-Destructive Testing, Part 1: Manual Ultrasonic Inspection
- Health & Safety Executive, Gas and Process Safety, Technology Division. Available on the internet at http://www.hse.gov.uk/NDT
- Evaluation of the effectiveness of non-destructive testing screening methods for in-service inspection
- Health & Safety Executive, Research Report 659. Available on the internet at http://www.hse.gov.uk/NDT
- Extract from a Recommended Practice for the Inspection of Weld Corrosion HOIS (08) R7 Draft 2. Available as a download from the HOIS website, http://www. Hoispublications.com
- Nordtest method NT NDT 008 Available on the internet at http://www.nordtest.info/index.php/technical-reports/category/non-destructive-testing.html
- The mechanical integrity of plant containing hazardous substances. A guide to periodic examination and testing. EEMUA Publication 231-Ed1. SAFed Publication IMG 1. Available on the internet at http://safed.co.uk/technical-guides/pressure-equipment/
- RG0 Guidelines on the competence of personnel undertaking engineering inspections. Available on the internet at www.ukas.com/library/Technical-Information/Pubs-Technical-Articles/Pubs-List/RGO%20Edition%202%202007.pdf
- Energy Institute Document; Guidance for Corrosion Management in Oil and Gas Production and Processing. REF/ISBN 9780852934975.
- The Practical Reference Guide for Corrosion of Welds – Causes and Cures
- AWS Publication
- Corrosion for Science and Engineering, K Trethewey & J Chamberlain, ISBN 0-582-23869-2, A Pearson Education Print on Demand Edition.

Recommended Reading

- **Procedures and 'Recommendations for Ultrasonic Testing of Butt Welds' 2nd edition. The Welding Institute**
- 'Ultrasonic Flaw Detection for technicians' by J C Drury. Obtainable from the British Institute of Non-Destructive Testing
- Mathematics and formulae in NDT. Edited by Dr. R Halmshaw. Obtainable from the British Institute of Non-Destructive Testing
- ASNT Classroom Training Handbook originally published by General Dynamics
- NDT Handbook, second edition, volume 7.

NOTE. Some of the above are available only in reference libraries. For information on sources of the above recommended reading contact The British Institute of Non-Destructive Testing, Newton Building, St George's Avenue, Northampton, NN2 6JB, United Kingdom.

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ANNEX A - SYLLABUS

Section 1: General theory

Please see PCN Z1 Appendix for UT.

Section 2: Specific theory:

Steel production methods, manufacturing processes relative to steel wrought products. Casting and forging of steel components.

Impact of Corrosion, Why metals Corrode

Types of corrosion including:

- General/Uniform
- Pitting and Microbial
- Erosion
- Fatigue
- Galvanic
- Crevice
- Intergranular
- Selective leaching
- Environmentally assisted cracking
- Cavitation and Turbulence

Corrosion mechanisms including:

CO_2 (Sweet Corrosion), H_2S (Sour Corrosion), Oxygen Corrosion, Electrochemical Corrosion.

Where Corrosion Occurs, Corrosion Control System (Overview). Scanning procedures. Causes of spurious indications. Errors in measurement

Reporting systems including roles and responsibilities

Generic reporting formats

Drawings – different types, specifically isometric line drawings

Overview of structures to be inspected

Section 3: Practical Application – General

Parent material and weld heat affected zone examination:

Information required prior to examination. Parent material examination, attenuation measurements, methods of flaw sizing 20dB, 6dB, DGS, maximum amplitude, use of flaw location slide, reporting methods. Brief knowledge of component surface finish and its measurement.

Calibration of compression wave and 45 degree probes. Appropriate sensitivity settings.

Surface conditions and surface preparation

Practical techniques including:

General application, measurements during manufacturing of product and in-service measurement of residual wall thickness.

Probe selection: Limiting parameters

Material differing from the reference

Specific measuring conditions including measurements at elevated temperatures and temperatures below 0^0C, hazardous atmospheres.

Instrument settings:

General initial settings. Differing methods including those for digital thickness instruments and A-scan instruments. Instrument checks for settings.

Factors influencing accuracy including:

Operational conditions, surface conditions, surface temperature, metallic and non-metallic coatings, geometry.

Equipment resolution and range

Evaluation of accuracy:

General and specific influencing factors. Method of calculation.

Influence of materials:

General factors, inhomogeneity, anisotropy, attenuation, surface conditions including contact and reflecting surfaces, corrosion and erosion.

Test reports.

General information and inspection data.

Section 4 – Specific practical - corrosion in vessels and piping.

Measurement of general corrosion, corrosion with pitting.

Probe selection and limiting parameters

Appropriate instrument and sensitivity settings.

Notes:

(1) It is considered necessary to allocate a period of not less than 80 hours tuition for the above. All practical has to be conducted with both compression and 45 degree probe.

(2) It is extremely unlikely that the level of practical described above will be conducted as part of a standard 3.1/3.2 weld inspection course.

(3) It is therefore unlikely that a Technician holding a 3.1/3.2 will have the necessary skills required to conduct the corrosion monitoring techniques relative to Oil and Gas Industry.

(4) Supplemental training and assessment will be necessary for holders of 3.1/3.2. Suggest a minimum 2 day practical and specific theory followed by a practical assessment consisting of 2 corroded components.

Other sections:

1. Material Selection; Metallic materials/Metallurgical principles

2. Influence of Service Conditions on Materials

3. Interaction of Operating Conditions; Stress and specific corrosion environments, Combination of Temperature and Corrosion, (Common Corrosion Mechanisms, include SCC, CUI etc)

4. Design Considerations

5. NDT Corrosion Monitoring Methods

Certification Services Division
Newton Building, St George's Avenue
Northampton, NN2 6JB
United Kingdom

Tel: +44(0)1604-893-811.
Fax: +44(0)1604-893-868.
E-mail: pcn@bindt.org

ANNEX B - EXAMPLE QUESTIONS

1. Fatigue failure normally initiates at:

   a) Low stress areas
   b) Areas of high stress concentration
   c) At weld surfaces
   d) Only at corroded areas

2. A component may fail due to Fatigue when:

   a) The applied stress levels exceed the tensile strength of the material
   b) There are differences in weld metal and base metal
   c) The applied loading is cyclic and less than the tensile strength of the material.
   d) All of the above

3. In general corrosion of steel, the steel aided by moisture, combines with:

   a) Oxygen and Nitrogen to form oxides and nitrides
   b) Nitrogen and Hydrogen to form nitrides and hydrides
   c) Oxygen and Hydrogen to form oxides and hydroxides
   d) Carbon and Oxygen to form oxides and carbides

4. A serious type of corrosion which occurs when the material is in tensile stress and in contact with a corrosive medium is called:

   a) Tensile corrosion.
   b) Tensile cracking
   c) Stress Corrosion Cracking
   d) Tensile Creep corrosion.

5. Tensile stresses may be:

   a) Directly applied
   b) Residual
   c) Both a) and b)
   d) Only applied cyclically.

6. Hydrogen cracking:

   a) Occurs only in welds and at or adjacent to, grain boundaries
   b) Can occur In-Service from chemicals or a high Hydrogen Sulphide environment.
   c) Will be evident at or close to the weld centre line
   d) Is a weld root defect.

7. Hydrogen Cracking is usually evident as:

   a) Fine network of multidirectional cracks
   b) Linear or non-linear in direction
   c) A blister on the surface of the component
   d) All of the above.

8 Corrosion attacks metals by:

a) Direct chemical reaction.
b) Electrolysis
c) A combination of direct chemical reaction and electrolysis.
d) All of the above

9. Which of the following statements is true?

a) All metals react to corrosion at similar rates
b) Some metals will be more reactive than others
c) Only some metals will react to corrosive environments
d) Metals will not corrode

10. Stainless Steel is:

a) Less reactive than Aluminium but more reactive than carbon steel.
b) Less reactive than Aluminium and less reactive than carbon steel
c) Not corrosive
d) Same reaction as stainless steel and carbon steel

11. Pitting corrosion may be described as:

a) General corrosion
b) Multi-faceted corrosion
c) Localised corrosion.
d) Less serious type of corrosion relative to general corrosion.

12. Corrosion as a result of two similar or dissimilar materials being joined with a non-uniform electrolyte is called:

a) Tensile corrosion.
b) Salt corrosion
c) Stress Corrosion Cracking
d) Crevice corrosion

13. A type of galvanic cell in crevice corrosion is called:

a) Concentration cell
b) Positive cell
c) Crevice cell
d) Anode

14. On Ferrous based materials Fretting corrosion will show as:

a) Red coloured deposits
b) Yellow coloured deposits.
c) No visible evidence of corrosion
d) Deep blue coloured deposits.

15. What materials are particularly susceptible to MIC?

a) Carbon steels
b) 300 stainless steels
c) Copper Alloys
d) Aluminium Alloys

16. Avoiding MIC pitting is difficult. Effective methods may include:

a) Heating the material above the Curie Point
b) Substitute high Nickel Alloys
c) Change the water source
d) Use biocides and other water treatments

17. Inter-crystalline Corrosion is sometimes known as?

    a) Inter-Granular Corrosion
    b) Inter material Corrosion
    c) Grain structure distortion
    d) Metallic grain structure will not corrode

18. *Wear* describes mechanisms that:

    a) The action of a hard material cutting the surface of a softer material
    b) One material sliding over another with surface interaction
    c) Materials vibrating or impacting against one another
    d) Particles or fluids impinge upon a surface.

19. When particles or fluids impinge on a surface this mechanism is known as:

    a) Fretting
    b) Adhesive wear
    c) Abrasive wear
    d) Erosive wear

20. A term to describe the continuous deformation of a material under constant load is:

    a) Fatigue
    b) Creep
    c) Tensile Loading
    d) Plastic flow

21. Which of the following statements is true?

    a) The anode is the positive electrode and the cathode the negative electrode
    b) The cathode is the positive electrode and the anode the negative electrode
    c) Both the cathode and anode are positive
    d) Both the cathode and anode are negative.

22. Within metallic systems exposed to aqueous corrosive environments the areas of differing potentials or voltages may be formed by:

    a) Combination of dissimilar alloys
    b) Differences in weld metal and base metal
    c) Metal surfaces that have a mix of mill scale and clean surface
    d) All of the above

23. Zinc is often applied to steel to improve resistance to corrosion. This is called?

    a) Zincing
    b) Galvanising
    c) Vulcanising
    d) Zincalising

24. One effective method of reducing Stress, Corrosion Cracking in a weld is to:

    a) Work harden the weld
    b) Stress relieve the weld
    c) Reduce the temperature of the weld
    d) Use flux coated welding rods

25. The ultrasonic technique to be applied to the component is:

    a) An area scan
    b) A spot check
    c) Evaluation scan
    d) As defined in the work-pack / Procedure issued.

26. The surface temperature of the component to be tested with conventional ultrasonic probes should not exceed?

    a) 60^0 Celsius
    b) 120^0 Celsius
    c) 300^0 Celsius
    d) Does not affect the scan

27. Typical defects to be detected, located and reported include:

    a) Erosion/Corrosion
    b) Laminations and Inclusions
    c) Pitting
    d) All of the above

28. A visual inspection of the surface condition of the component to be tested:

    a) Is not necessary
    b) Is critical and anomalies should be reported
    c) This is a job for the Supervisor
    d) Surface condition is not a limiting parameter.

29. Transfer correction for coating and surface conditions should:

    a) Not exceed 6dB
    b) Not be less than 6dB
    c) Does not affect the test
    d) Be recorded on the ultrasonic report

30. A loss of multiple back wall echoes is indicative of:

    a) Loss of couplant
    b) Using the wrong probe angle
    c) Erosion/corrosion
    d) a) and c)

31. The use of standard pulse echo techniques when testing for weld root erosion is:

    a) An accurate method of sizing root defects
    b) Poor reliability in detection and sizing weld corrosion
    c) Is likely to provide no inspection capability for near surface breaking weld corrosion
    d) b) and c)

32. Under standard testing conditions when using manual pulse echo techniques the minimum thickness for shear wave examination of welds is:

    a) 4 to 6mm
    b) 8 to 12 mm
    c) 6 to 8mm
    d) Thickness will not affect the examination

33. When testing a 150mm diameter painted carbon steel pipe butt weld in a Petrochemical environment the in-service failure mechanisms are likely to be:

    a) Lack of side wall fusion
    b) Slag inclusions
    c) Fatigue cracks
    d) Cluster porosity.

34. When testing a coated 200mm diameter pipe butt weld in a Petrochemical environment for weld corrosion, the shear wave probe angles should be:

    a) Sufficiently high to achieve coverage of the weld root area.
    b) Depends on the nominal thickness of the pipe.
    c) A 60^0 probe covers most of the areas to be inspected
    d) A 45^0 probe should not be used.

35. When testing small diameter pipes (less than 75mm) for corrosion / weld root corrosion it is recommended that:

    a) The shear wave is not less than 10mm diameter
    b) The frequency should be as low as possible
    c) The Perspex wedge be contoured to accommodate the surface of the pipe
    d) It is not possible to test such a small diameter pipe

36. When testing a coated 150mm diameter pipe in a Petrochemical environment and pitting is detected with complete loss of back wall echoes the area should be testing using a:

    a) 45^0 probe
    b) Grind the surface and test using a twin crystal compression probe
    c) Verify that the loss is not due to lack of couplant
    d) a) and c)

37. When testing a 150mm diameter thin wall pipe of nominal thickness 6.00mm for weld root corrosion it is necessary to ensure:

    a) The shear wave is as low an angle as possible to ensure shortest beam path
    b) The full weld thickness is tested
    c) Both compression and shear wave probes are employed
    d) The Perspex wedges are contoured to match the surface of the pipe.

38. When testing a 150mm diameter coated pipe butt weld in a Petrochemical environment it is essential to ensure adequate sensitivity. This should be:

    a) As per the verified procedure
    b) 3.0mm diameter side drilled hole at the same range to Full Screen height
    c) 1.5mm diameter side drilled hole at the same range to Full screen height.
    d) DAC plus 14dB

39. When inspecting vessel circumferential seams in a Petrochemical environment the in-service defects are likely to occur at:

    a) The external toe of the weld
    b) The root area when a single V joint
    c) At the cladding/metal interface.
    d) All of the above.

40. When testing a vessel shell plate in a Petrochemical environment a contour on the surface of the shell is noted and inclusions are detected in the middle of the shell plate. The defect mechanism is likely to be:

    a) Segregation
    b) Loss of the cladding on the internal of the vessel
    c) Build up of Nitrogen in the shell plate
    d) Hydrogen blistering.