PCN CERTIFICATION AND EXAMINATION ELIGIBILITY REQUIREMENTS FOR PERSONNEL ENGAGED IN NON-DESTRUCTIVE TESTING USING THE ELECTROMAGNETIC TESTING (ET) METHOD AT LEVEL 1, 2, and 3.

BINDT Certification Services Department | Midsummer House | Riverside Way | Bedford Road | Northampton | NN1 5NX | UK
Tel: +44 (0) 1604-438-300 | Email: pcn@bindt.org | www.bindt.org

CONTENTS:

1. SCOPE:

The Electromagnetic Testing method and associated eddy current testing techniques when applied correctly can provide the NDT technician with effective real time detailed data for interpretation with the added benefit that inspection data can be stored in a suitable digital file format for future interpretation remote from site by other suitably qualified persons.

ET eddy current techniques are regularly used for a wide variety of NDT inspections across several industrial and product sectors, some examples of ET eddy current testing applications have been included below providing information on the scope of some typical ET eddy current testing applications:

a) High frequency eddy current testing (HFEC) when testing for discontinuities/defects such as surface breaking cracks in materials, components, and structures.

b) Testing the area in and around fastener hole bores such as those typically found within aircraft structures or other critical engineering structures for surface breaking defects.

c) Establishing material conductivity to sort ferrous and nonferrous alloys and for the verification of heat treatment processes applied and to confirm material property changes where materials have been exposed to extreme heat such as fire.

d) To detect the presence of corrosion and or material loss within metallic structures.

e) Use of low frequency eddy current (LFEC) techniques to locate corrosion and cracking within second- and third-layer structures/skins which might not otherwise be suitable to be tested ultrasonically, or where the use of radiography could be considered to be inappropriate.

f) Testing heat exchanger tubes for cracking, corrosion, structural damage, corrosion/material thickness variations.

g) For the testing of welds and the associated heat affected zone.

h) Use of Eddy Current Array (ECA) probes for coverage of larger or focused areas during a single scan.

This document prescribes specific requirements and procedures by which candidates may be examined and, where successful, certified to use the Electromagnetic Testing (ET) method and appropriate eddy current testing technique(s) when testing defined products within those industrial sectors listed within BS EN ISO 9712: Annex A, for the certification sought.

Requirements contained within this document are in addition to those contained in the current edition of PCN24/GEN: General requirements for PCN qualification and certification of NDT personnel which meets the requirements of BS EN ISO 9712:2022.

BINDT's full PCN examination format is described in PCN24/GEN. This appendix document provides the reader with the PCN examination requirements for PCN ET certification to meet the employer's requirement at PCN certification levels 1,2, and3 . Except where exemptions apply, all candidates will be required to attempt an examination comprised of the appropriate examination elements listed herein, appropriate to the certification sought.

2. ASSOCIATED DOCUMENTS:

2.1 PCN24/GEN: General Requirements for the Certification of Personnel Engaged in NDT.
2.2 BS EN ISO 9712: Non-destructive testing — Qualification and certification of NDT personnel.
2.3 PCN/GEN/SYLLABUS DOCUMENT.
2.4 PCN/GEN/SPECIMEN QUESTIONS COMPENDIUM.

3. EMPLOYER RESPONSIBILITIES:

3.1 **IMPORTANT:** PCN24/GEN details specific requirements which are ascribed to the employer.

3.2 Both candidates and employers shall ensure that they are conversant with responsibilities ascribed to both the candidate and the employer, and that it is the employer's responsibility to issue PCN certified employees with 'written authority to operate' before the PCN Certificate holder carries out NDT tasks on behalf of the employer or the employer's customers.

3.3 See PCN24/GEN – Section 5.5.

4. CERTIFICATION AVAILABLE:

4.1 After demonstrating success on an approved ET training course appropriate for certification sought, The AQB shall administer the appropriate certification examination for one of the following certification options listed within Table 1.

4.2 *Note: Where level 3 certificate holders are required to carry out testing and/or supervise tasks at all levels it is a PCN requirement that Level 3 certificate holders shall have demonstrated their practical competence at Level 2 or hold PCN or other suitable Level 2 certification.*

Table 1A:	PCN Electromagnetic Testing (ET) certification options.				
NDT Method:	Certification Options within the ET method:	PCN Certification Abbreviation:	PCN Certification Level		
			1	2	3
Electromagnetic Testing (ET)	Eddy Current Testing	ET-EC	✓	✓	✓
	Eddy Current Testing Non-ferrous Tubular wrought products	ET-EC-NFT		✓	✓
	Eddy Current Array Testing Non-ferrous Tubular wrought products	ET-ECA-NFT		✓	
	Remote Field Eddy Current Testing – Ferrous Tubular products	ET-RFT-FT		✓	
	Alternating Current Field Measurement - ACFM	ET-ACFM	✓	✓	✓
	Eddy Current Testing - Welds	ET-EC-W	✓	✓	✓

4.3 **ET CERTIFICATION OPTION 1:** PCN Eddy Current certification (ET-EC) is available at the following levels.

a) PCN Level 1

b) PCN Level 2

c) PCN Level 3

4.4 For persons required to test general engineering materials, products, components, assemblies and or sub-assemblies using the ET testing method and an appropriate eddy current testing technique(s) within the following industry, and product sectors:

4.4.1 **INDUSTRY SECTORS:**

a) Manufacturing (m)

b) Pre-and in-service testing which includes manufacturing (s)

4.5 **PRODUCT SECTORS:** Certification is available for any combination of product(s) from groups a), b), and c) at 4.7.1 for use within industry sectors listed at 4.4.1.

4.6 For multisector certification at least 1 specimen shall be tested from each product sector for which certification is sought. i.e., where certification is required for ET-ECT of castings and forgings, 1 casting and 1 forging specimen shall be tested, 1 specimen from each of the different product sectors for certification.

4.7 Where single product sector certification is required the minimum number of product specimens to be tested shall be 2 specimens from within the single product sector for certification. Each specimen shall be different in character, material specification, shape, size, and/or discontinuity type.

4.7.1 Product sectors for certification are:

a) Castings (c)

b) Forgings (f)

c) Wrought products (wp)

i. For forgings all types of forgings: ferrous and non-ferrous materials.

ii. For wrought products, products such as plates, bar, and rod).

4.8 **Typical ET Techniques deployed may include.**

a) High frequency eddy current testing.

b) Low frequency eddy current testing.

c) Dynamic - rotary open hole eddy current testing.

d) Mixed frequency eddy current testing.

e) Multi element array probe testing techniques.

f) Pulsed eddy Current testing techniques.

g) Material Conductivity measurement.

h) Coating thickness measurement.

i) Screw thread testing techniques.

4.9 **ET CERTIFICATION OPTION 2:** ET of tubular wrought products using eddy currents:

4.10 Certification for the testing of manufactured / in-service non-ferrous heat exchanger/condenser tubing using appropriate eddy current equipment and techniques when testing materials such as stainless steel, copper, titanium, and where required, for condenser tubing manufactured from low ferromagnetic or ferromagnetic tubing using remote field eddy current testing techniques.

a) Note: PCN Level 1 certification is currently not available.

b) **PCN Level 2 ET-EC-NFT:** Testing non-ferrous heat exchanger/condenser tubing using single and multi-frequency eddy current testing techniques.

c) **PCN LEVEL 2 ET-ECA-NFT:** Testing heat exchanger/condenser tubing using eddy current array probes.

d) **PCN LEVEL 2 ET-RFT-FT:** Testing of heat exchanger/condenser tubing using Remote Field Testing (RFT) techniques.

e) Any combination of Electromagnetic Testing certification for the testing of heat exchanger tubing from groups b), c), and d) where at least 1 specimen has been tested from within each group for certification during the PCN practical examination administered by the AQB where multi-sector certification is sought.

f) **PCN Level 3:** ET-EC-TP.

4.11 **Industry sectors:** Certification is available for use within the following industry sectors:

4.12 Manufacturing.

4.13 Pre-and in-service testing which includes manufacturing.

4.14 **ET CERTIFICATION OPTION 3:** Alternating Field Current Measurement (ACFM)

4.15 ACFM certification is available for the testing of ferritic welds and other industrial products listed at 4.16 herein within the following industrial sectors:

a) Manufacturing (m)

b) Pre-and in-service testing which includes manufacturing (s)

c) Railway maintenance (r)

4.16 A sub-division of the Electromagnetic Testing (ET) method ACFM utilises both standard ACFM weld testing probes and other multi element array probes for the testing of various weld configurations and other industrial products some of which are listed below:

a) ACFM may be used to confirm and size surface breaking defects such as cracks within the weld and or parent material. Probes will be selected according to the required application.

b) The Inspection of railway components.

c) The Inspection of gear box gear teeth, crank shafts, cylinder heads, turbines etc. within industry sectors such as the automotive industry sector.

d) The detection of cracks and corrosion in vessels, storage tanks, and oil and gas pipework.

e) Use in the underwater environment when testing marine vessels, oil and gas platforms or other subsurface engineering installations. Testing within these extreme environments requires an understanding between diver/probe manipulator (subsurface) and the certified ACFM technician (topside) to accomplish the ACFM inspection task.

f) Minimum certification requirement for ACFM data analysis topside - PCN ACFM L2 or equivalent.

4.17 ACFM certification is available at the following levels:

a) PCN Level 1 ET – ACFM.

b) PCN Level 2 ET – ACFM.

c) PCN Level 3 ET – ACFM.

4.18 **ET CERTIFICATION OPTION 4:** ET of welds using eddy current testing techniques:

4.19 Certification is available for the ET of welds using eddy current testing techniques for those persons required to test welds and the associated weld heat affected zone made to materials, products, components, assemblies and or sub-assemblies within the following industry sectors:

a) Manufacturing (m)

b) Pre-and in-service testing which includes manufacturing (s)

c) Railway maintenance (r)

4.20 Typical industrial testing applications include the ability to test welds made to plate, pipe, and other variable geometry welds such as "T", "Y", cruciform, and gusset plate using single frequency eddy current testing techniques when testing for typical defects which may include but not be limited to:

a) Surface breaking defects such as cracks occurring on both flat and curved surface welds both within the weld, the weld heat affected zone, and in parent material directly adjacent to the heat affected zone.

b) Defects originating within the parent material and or weld may be attributed to and as a direct consequence of any welding process applied or, may manifest themselves over time and be known as in-service defects. Typical in-service defects including corrosion, stress corrosion cracking and fatigue cracking of the weld and parent material directly adjacent to the weld and the welds heat affected zone are not uncommon in manifesting as in-service defects.

4.21 ET eddy current certification for the testing of welds is available at the following levels.

a) PCN Level 1 - ET-EC-W

b) PCN Level 2 - ET-EC-W

c) PCN Level 3 - ET-EC-W

5. PCN EXAMINATION ELIGIBILITY:

5.1 Candidates shall provide documentary evidence of acceptable near vision acuity and colour vision perception in accordance with PCN24/GEN requirements.

5.2 Candidates shall provide documentary evidence of having achieved the required amount of practical industrial experience in accordance with PCN24/GEN requirements.

5.3 Candidates shall provide documentary evidence of having satisfactorily completed an approved course of NDT training within the general ET method, and for the specific certification option required from within Table 1 herein to meet the full PCN training requirements contained within PCN24/GEN.

6. EXAMINATION CONTENT OVERVIEW:

6.1 The full PCN examination format linked to the candidate's personal certification requirements shall be as described in PCN24/GEN. This PCN examination requirements Appendix document serves to highlight to candidates the potential examination elements which might be attempted during a PCN

examination, dependent upon whether the examination attempted is for initial, recertification, retest or for supplementary certification.

6.2 Examination time shall be confirmed to the candidate on the front of the PCN examination paper. Additional time may be allowed at the discretion of the AQB for those circumstances detailed below at 6.3.1 and 6.3.2.

6.3 Extensions shall be recorded by the AQB prior to examination commencement.

6.3.1 Where the candidate's primary language is not English, who may require additional reading time (25%).

6.3.2 Where the candidate suffers with disabilities such as dyslexia, and who may require additional reading time (25%). It will be a requirement for candidates to supply to the AQB a medical declaration/attestation from a suitably qualified medical professional confirming matters. A copy of the declaration/attestation shall be retained within the candidate's examination records file.

7. PCN LEVEL 1 INITIAL CERTIFICATION:

7.1 GENERAL THEORY WRITTEN EXAMINATION ELEMENT FOR ET.

7.1.1 Written examination element specific to the general theory of the Electromagnetic Testing method.

7.1.2 40 multiple choice questions.

7.1.3 Time allowed per question: 2 minutes.

7.1.4 Pass mark 70%.

7.2 SECTOR SPECIFIC WRITTEN THEORY EXAMINATION ELEMENT FOR ET:

7.2.1 Specific theory written examination element on the application and use of those ET eddy current testing technique(s) required for certification from the available certification options listed at Table 1 herein.

7.2.2 25 multiple choice answer type questions for single sector certification, 35 for multisector:

7.2.3 Where the specific theory examination element covers two or more sectors, the specific theory written examination shall take into account the industrial or product sectors concerned, and questions shall be spread evenly across the product sectors for examination.

7.2.4 Time allowed per question: 3 minutes.

7.2.5 Pass mark 70%.

7.3 SECTOR SPECIFIC PRACTICAL EXAMINATION ELEMENT:

7.3.1 The practical examination element requires candidates to test practical specimens, record the resulting information to the degree required, reporting the results in the AQB's desired format. Specimens shall be sector (one or more) specific, representing field geometries and shall contain discontinuities representative of those likely to occur during manufacturing or in-service life, defects may be natural or manufactured, the examination shall be as follows:

7.4 **PRACTICAL EXAMINATION CONTROL CHECKS:**

7.4.1 Candidates shall demonstrate knowledge and correct use of NDT equipment and/or NDT media to include system and/or media control and validity of verifications and/or media, as per Annex D Table D.1 Item 1 within BS EN ISO 9712. (Control checks).

7.4.2 Time allowed 30 minutes.

7.5 **PRACTICAL TESTING LEVEL 1:**

7.5.1 Level 1 candidates shall follow written NDT instructions provided to them by the examiner to test product sector (one or more) specific practical specimens.

7.5.2 Where the certification examination covers two or more product sectors, practical specimens tested shall include a **MINIMUM** of one specimen from each product sector for certification. This shall result in candidates demonstrating their practical ability to deploy a number of different NDT techniques within the NDT method.

7.5.3 The number of specimens tested shall be as advised by the AQB at the time of examination to meet the requirements of BS EN ISO 9712 Annex B. Each specimen shall be different in character, i.e., in product form, material specification, shape, size, or discontinuity type.

7.5.4 Single product sector practical examination candidates shall be required to test a minimum of three specimens and, for multiple product sectors, a minimum of one specimen from each product sector for certification with a minimum of three specimens to be tested in total.

7.5.5 Candidates shall report results obtained during testing in the AQB's required format.

7.5.6 Recommended time allowed per specimen tested is 1 Hour. However, the certification body (BINDT) allows the AQB to extend this time period where required based upon the complexity of the component tested and the NDT test technique(s) applied to complete the test.

7.5.7 Pass mark: ≥ 70% for each specimen tested.

8. PCN LEVEL 2 INITIAL CERTIFICATION:

8.1 Candidates shall follow the examination process requirements as described for Level 1 certification but at the required theoretical (general and specific) knowledge level for Level 2 certification, and in addition they shall demonstrate the following enhanced practical testing requirements:

8.2 Level 2 candidates shall **SELECT** the appropriate NDT technique and determine the operating conditions required related to a given code, standard or specification.

8.3 Candidates shall test prescribed specimens, recording, and **INTERPRETING** the resulting information to the degree required, reporting the results obtained in the AQB's desired format.

8.4 Recommended testing time allowed per specimen tested is 1 Hour. However, the BINDT allows the AQB to extend this time period if required based upon component complexity, and test techniques deployed.

8.5 Pass mark: ≥ 70% for each practical specimen tested.

8.6 **WRITTEN NDT INSTRUCTION WRITING ELEMENT - LEVEL 2:**

8.6.1 Candidates shall draft a detailed written NDT Instruction for one of the specimens to be tested during the practical examination, the specimen shall be selected by the AQB.

8.6.2 Time allowed per written instruction: 1 hour.

8.6.3 Pass mark: 70%.

9. PCN LEVEL 3 CANDIDATES – BASIC EXAMINATION:

9.1 Initial PCN Level 3 candidates will be required to pass a Basic examination before attempting PCN Level 3 main method examinations.

9.2 The basic examination shall assess the candidate's knowledge of basic examination subjects using multichoice questions, selected in an unpredictable way from PCN's current collection of Level 3 Basic questions valid on the day of the examination. See PCN24/GEN for further information.

9.3 Basic examination Items/Parts are as follows:

Table 2A	PCN Level 3 Basic examination requirements	
Item/Part	Subject	Number of questions
A	Technical knowledge in materials science and process technology. Time allowed: 2 minutes per question – Total examination Time 60 minutes.	30
B	Knowledge of the certification body's qualification and certification system based on PCN24/GEN. This may be an open-book examination. Time allowed: 3 minutes per question – Total examination Time 30 minutes.	10
C	General knowledge of at least four methods as required for Level 2 and chosen by the candidate from the methods given in BE EN ISO:9712 Table 1. These four methods for each test method shall include at least one volumetric method (UT or RT). Time allowed: 2 minutes per question – Examination Time 120 minutes.	15 for each test method (Total 60)
For item C: The BINDT and PCN may adjust the number of questions per method for methods impacted by evolving technology, increasing methods and techniques being added.		

9.4 Successful PCN Level 3 Basic examination candidates may progress to PCN Level 3 main method training; however, candidates who do not hold appropriate Level 2 certification will be required to complete with a grade of ≥ 70% the practical examination requirements for Level 2 certification except they will not be required to draft a written NDT instruction.

9.5 A candidate who holds current valid Level 2 certification shall be exempt the need to pass the PCN Level 2 practical examination.

10. PCN LEVEL 3 MAIN METHOD EXAMINATION:

10.1 Written examination to assess the candidate's knowledge of the main method subjects using multiple-choice questions selected in an unpredictable way from the current collection of questions approved by BINDT at the time of the examination.

Table 3A	Minimum required number of main method examination element questions	
Item/Part	Subject	Questions
D	Level 3 knowledge relating to the test method applied. Closed book written examination covering the general theory of the method for certification sought. Time allowed: 2 minutes per question – Examination time 80 minutes.	40
E	Application of the NDT method in the sector concerned, including the applicable codes, standards, specifications, and procedures. This may be an open-book examination in relation to codes, standards, specifications provided by the AQB's examiner. Time allowed: 3 minutes per question – Examination time 90 minutes.	30
F	Drafting of one or more NDT procedures in the relevant sector. The applicable codes, standards, specifications, and other procedures shall be available to the candidate. For a candidate who has already drafted an NDT procedure in a successfully passed Level 3 examination, BINDT may replace the drafting of a procedure with the critical analysis of an existing NDT procedure covering the relevant method and sector and containing errors and/or omissions. Time allowed: 4 hours arbitrary per procedure; pass mark: 70%	N/A

11. SUPPLEMENTARY EXAMINATIONS:

11.1 After completing additional specific training for the required supplementary certification, already certified Level 1 or Level 2 individuals who would like to change sectors, or adding another sector for the same NDT method, shall be required to attempt additional sector specific and practical examination elements for the new sector/certification sought.

11.2 PCN Level 2 candidates shall be required to draft an NDT instruction for the new sector.

11.3 A certified Level 3 individual changing sectors or adding another sector for the same NDT method shall be required to take the sector specific examination Parts E and F of the main method examination element only.

11.4 All candidates will be required to meet the additional industrial experience requirements as per PCN24/GEN.

12. CERTIFICATION RENEWAL AND RECERTIFICATION:

12.1 Comprehensive general rules for certification renewal, recertification, and retests at all levels are described in PCN24/GEN Sections 10 and 11.

12.2 Applications for renewal of existing Level 1, or Level 2 certification can be made using PCN document PCN document CP16.

12.3 Applications for renewal of Level 3 certification can be made using PCN document CP17.

13. REFERENCE LITERATURE ESSENTIAL READING:

13.1 All associated PT reference literature can be found within PCN document PCN24/XXX.

PCN24/GEN/APP/ET Document issue and review status.		
Document issue for review:	Changes/amendments:	Current document Status:
Not applicable.	New Document Issue 01.	PCN24/GEN/APP/ET. Issue 01 1st January 2024 Implementation - 01 July 2024