



Magnetic Particle Testing (MT)

Course Curriculum





AFRICAN NDT CENTRE
COURSE CURRICULUM
MAGNETIC PARTICLE TESTING LEVEL 1, 2 and 3

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Who we are?

African NDT Centre (Pty) Ltd is an NDT training and service provider organization located in Roodepoort, South Africa, providing complete solutions for NDT training and inspection.

We conduct training for PCN certification for level 1,2 and 3 in the following methods:

- PCN - Eddy Current Testing (ET)
- PCN - Ultrasonic Testing (UT)
- PCN - Magnetic Particle Testing (MT)
- PCN - Liquid Penetrant Testing (PT)
- PCN - Radiographic Testing (RT)
- PCN – Radiographic Interpretation (RI)
- PCN – Basic Radiation Safety (BRS)
- PCN – Visual Testing (VT)
- PCN – UT Phased Array (PAUT)
- PCN – UT Time of Flight Diffraction (TOFD)

How to Book Your Training Course

To book a training course, simply contact us via phone or email and we will be happy to discuss your requirements. If necessary, we can provide advice on which type of training and certification is appropriate for you or your company.

Courses can be booked and paid online on the following links:

ANDTC Constantia Kloof Campus: <https://andtc.com/courses-constantia-kloof/>

ANDTC Vaal Training Centre: <https://andtc.com/courses-vaal/>

Training courses are conducted on a regular basis at both our branches, and PCN examinations are run ongoing at our Roodepoort Examination Centre.

Contact Us

ANDTC Constantia Kloof

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What is Magnetic Particle Inspection?

Magnetic Particle Testing (MT), also known as Magnetic Particle Inspection (MPI), is a non-destructive testing (NDT) method used to detect surface and near-surface discontinuities (such as cracks, seams, laps, or voids) in ferromagnetic materials (e.g., iron, steel, nickel, cobalt).

How it works:

- Preclean
- Magnetise the part
- Apply iron particles (dry or wet, often fluorescent)
- Defects cause magnetic leakage → particles cluster → visible indication
- Inspect under visible or UV light
- Demagnetise & clean

Detects: Cracks, seams, voids

Does NOT detect: Deep internal flaws, non-magnetic materials

Pros: Fast, sensitive, portable, cost-effective

Cons: Only for magnetic materials, needs proper field direction

Used in: Welds, castings, aerospace, automotive, rails.

About the Course

PCN Level 1&2

This course equips participants with a solid understanding of MPI theory and its practical application on welds, castings & forgings (multi-sector) preparing and qualifying them as PCN Level I or II in Magnetic Particle Testing.

PCN Level 3

This guidance course targets the PCN Level 3 requirements for Magnetic Particle Testing practitioners. Its primary goal is to familiarise candidates with the examination scope and required knowledge level. It helps identify weaker subject areas and provides advice on any additional training needed.



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Qualification Requirements

Prerequisites

- Matric (Grade 12) with Mathematics and/or Science
- Basic understanding of physics principles (recommended)
- For Level 3: Previous PCN certification as required by PCN standards

Training Hours

Level 1& Level 2 combined	Level 3
7 Days	4 Days

Note: Direct access to Level 2 or 3 requires the total days shown in the table for Levels 1 and 2, or Levels 1, 2 and 3 respectively.

Product Sector

Multi Sector - This course prepares candidates for certification across multiple product sectors as defined by PCN standards.

Experience Requirements

Level 1& Level 2 combined	Level 3
60 Days	240 Days

Note: Experience may be acquired either prior to (for Level 1 and 2 entry only) or following success in the qualification examination. However, the chances of success in a PCN examination may be significantly reduced if candidates have little or no current experience in the application of the NDT method in the sector concerned.

Documents to be Submitted for Examination

- PSL 57-A Initial Examination Application
- PSL 30 - Log of Experience
- PSL 44 - Vision Requirements
- CP-27 Code of Ethics
- Proof of either holding PCN certification or successful completion of BINDT PCN Online Product Technology- cert with QR code
- One government-approved identity document (Passport/ID Card/Driver's License)



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Learning Outcomes

PCN Level 1

Upon completion, candidates will be able to:

1. Explain the basic principles of magnetism and magnetic fields.
2. Describe how MPI detects surface and near-surface discontinuities in ferromagnetic materials.
3. Understand appropriate magnetisation techniques (circular, longitudinal, multidirectional).
4. Apply magnetic particles (wet/dry, visible/fluorescent) correctly.
5. Operate MPI equipment (yokes, prods, bench units) safely and effectively.
6. Interpret indications in accordance with instructions provided.
7. Perform MPI on welds, castings and forgings under direct supervision.
8. Carry out system performance checks and record results.
9. Follow written instructions and report results accurately.

Certification allows: Routine testing under Level 2 supervision.

PCN Level 2

(Level 1 outcomes + advanced responsibilities)

1. Develop MPI techniques for specific components.
2. Select test parameters (current type, field strength, particle medium, UV intensity).
3. Calibrate and verify MPI equipment performance.
4. Interpret and evaluate indications against acceptance criteria.
5. Supervise Level 1 personnel and verify their work.
6. Write clear, compliant inspection reports.
7. Understand limitations of MPI and when to use complementary NDT methods.
8. Perform demagnetisation and post-cleaning effectively.
9. Apply MPI to complex geometries (e.g., fillets, threads, multi-pass welds).

Certification allows: Independent testing, instruction writing and supervision.

PCN Level 3

Successful candidates will be able to:

1. Master the full scope of EN ISO 9712 Level 3 responsibilities.
2. Draft NDT procedures and instructions compliant with international codes.
3. Conduct technical justification for non-standard techniques.
4. Audit Level 1 & 2 activities and training programs.
5. Solve complex interpretation and equipment problems.
6. Understand quality management (ISO 17025, NADCAP) in NDT.
7. Prepare for PCN Level 3 Basic, Main and Method exams (theory + practical drafting).

What to Bring?

- Own PPE (coveralls or lab coat, safety boots)
- PCN wallet card or other form of photographic identification



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Special Notes

- African NDT Centre reserves the right to disqualify participants from the certification program when personnel are found not to meet PCN requirements
- Participants are not allowed to use their own equipment during training and examination. African NDT Centre provides all necessary ET equipment and accessories
- Professional dress code must be followed during the entire training and examination period
- Once enrolled, joining instructions will be sent via email with all necessary information communicated telephonically

Training and Examination Information

The training program comprises daily assessments after completion of each chapter, and participants are required to achieve above 70% marks. Based on daily assessment performance, candidates are awarded successful completion of training.

Participants are then required to undergo PCN examination which consists of:

- Theory examination
- Practical examination
- NDT instruction writing (Level 2 only)

Candidates must obtain a minimum of 70% in each examination element to achieve PCN certification as Level 1, 2, or 3.

PCN certification is valid for 5 years from the date of certification. The certificate must be renewed according to PCN requirements.

Syllabus Reference

This curriculum is aligned with the PCN examination syllabus as published in **PCN24/GEN/Appendix Z1 - NDT Examination Syllabi, Issue 1, February 2024**.

The detailed syllabus breakdown covering all topics for Level 1, 2, and 3 is available in our comprehensive course documentation (Document No: CC-MT, Issue 2, dated 01/07/2024 noted as Annexure A)

African NDT Centre regularly reviews and updates the curriculum in line with scientific, industrial, and technological developments in eddy current testing, as well as any changes to PCN certification requirements.



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ANNEXURE A

Contents	Level 1	Level 2	Level 3
1.0 Introduction, Terminology, purpose and history of NDT	1.0 Introduction Presentation of the magnetic particle testing Applicability and limits History Terminology	1.0 Introduction Presentation of the magnetic particle testing Applicability and limits History Terminology	1.0 Introduction Presentation of the magnetic particle testing Applicability and limits History Terminology
2.0 Physical principles and associated knowledge	2.0 Basic physical phenomena in terms of general description Electric circuits, typical values, units Magnetic circuits, typical values, units Magnetic field created by electric circuits Passage of the flux from a magnetic medium to a non magnetic media Magnetic flux of a magnetic discontinuity Influence of depth and orientation of a magnetic discontinuity on its detection Magnetic properties of materials Nonmagnetic materials Magnetic materials. Curie point	2.0 Basic physical phenomena Electric circuits, typical value, units Magnetic circuits, typical value, units Magnetic field created by electric circuits Indefinite rectilinear conductor Long magnetic coil Short or flat magnetizing coil Passage of the flow of a magnetic in a non magnetic media Continuity of HT Continuity of BN Magnetic flux of a magnetic discontinuity	2.0 Basics Diamagnetism – Paramagnetism Ferromagnetism – Ferrimagnetism Magnetic fields characterization and Measurements Magnetic field H - magnetic Induction B Hysteresis cycle and remarkable points Influence of the temperature on the magnetic properties Principle of magnetic particle testing Influence of the interface between a magnetic medium and a nonmagnetic medium Continuity of HT Continuity of BN



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		Influence of the geometry (depth, thickness) and of the orientation of a magnetic discontinuity on its detection Magnetic properties Designation of alloys Non magnetic materials Magnetic materials Field of application Curie Point Curve of the first magnetization Hysteresis cycle and remarkable points Magnetic properties of steels	Influence of the orientation of the discontinuity on magnetic flux Behaviour of a magnetic particle in the vicinity of a magnetic flux Influence of geometry (depth, thickness and orientation) on detectability Magnetic properties of principal ferromagnetic alloys Magnetic field H, magnetic induction B, relative magnetic permeability μR, coercitive force Hc, electrical resistance Influence of composition, heat treatments and work hardening of the steel. Influence of work hardening. Influence of heat treatment Particular alloys: e.g. Permalloys, Invar, Inconel
3.0 Product knowledge and capabilities of method and its derivate techniques	3.0 Typical discontinuities according to the production process (welds, forgings, castings and roller products	3.0 Typical discontinuities in welds, forgings, castings and roller products and there indications	3.0 Typical discontinuities in welds, forgings, castings and roller products and there indications
	3.1 Testing parameters: Magnetization, detection media and test of detection media indication.	3.1 Testing parameters: Magnetization, detection media and test of detection media indication.	3.1 Testing parameters: Magnetization, detection media and test of detection media indication.



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4.0 Equipment	4.0 Equipment Magnetizing equipment Viewing condition Measurement and calibration Demagnetization	4.0 Equipment Various types Portable electromagnet Mobile Magnetic benches Automatic and robotized with automatic detection (magnetic leakage field) Sources of light and conditions of illumination Accessories Flux indicators and products indicators Field strength measuring devices Photometers and radiometers Considerations on the choice of the equipment Elements to be taken into account materials and components to be controlled zones to be controlled, goal of the test place and environment Choice of the technique type of current Magnetic flow technique (open and closed circuit) Current flow technique – Induced current flow combined system Multidirectional magnetization and rotating field	4.0 Equipment Mobile or fixed equipment using magnetic flow technique or current flow technique Automatic and robotized with automatic detection (magnetic leakage field)
	4.1 Relevant standards: EN ISO 9934-2 and EN ISO 9934-3	4.1 Relevant standards: EN ISO 9934-2 and EN ISO 9934-3	4.1 Relevant standards: EN ISO 9934-2 and EN ISO 9934-3



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5.0 Information prior to testing	5.0 Application of a written instruction	5.0 Identification or designation material. -Kind of manufacture. -Catalogue of defects -Test condition and application of standard: -Accessibility -Infrastructure -Particular test condition -Application standard. Overview -Standard and codes assigned to the test objects -Acceptance criteria Preparation of written instructions Documents Presentation of the standards, codes and procedures	5.0 Identification or designation materials. -Kind of manufacture. -Catalogue of defects -Test condition and application of standard: -Accessibility -Infrastructure -Particular test condition -Application standard. Overview -Standard and codes assigned to the test objects -Acceptance criteria Preparation of written instructions Documents Presentation of the standards, codes and procedures
6.0 Testing	6.0 Testing according to the written Instructions Surface preparation Cleaning, machining Use of contrast paint Magnetization, types and time of application Application of the detection media Recording of discontinuities Continuous technique Remanence technique Grid and covering Control of conditions of magnetization	6.0 Testing Surface preparation Cleaning, machining Use of contrast paint Magnetization, types and time of application Application of the detection media Continuous technique Remanence technique Grid and covering Control of conditions of magnetization	6.0 Testing Preparation of the parts and influence of the surface quality Means of magnetization. Values of the parameters. Continuous or simultaneous method. Remanence method . Flux indicators Choice of the detection media. products indicators



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	6.1 Treatment of the components after Test Residual field Basic principle of demagnetization Demagnetization. Industrial methods of demagnetization Cleaning of the components	6.1 Treatment of the components after Test Residual field. Conditions requiring demagnetization. Level of residual field Basic principle of demagnetization Demagnetization. Industrial methods of demagnetization and influence of terrestrial magnetic field Cleaning of the components	6.1 Treatment of the components after Test Demagnetization Principle, minimal value of the magnetic field of demagnetization, frequency, effect of skin and calculation of magnetizing coil Level of residual field according to the later use of material Influence of terrestrial magnetic field Cleaning of the components
7.0 Evaluation And Reporting	7.0 Classification of the indications Welding according to EN 1290 Casting according to EN 1369 Forging according to EN 10228-1 Rolled products Viewing conditions according to reference block Verification the indication quality (EN ISO 3059) Report of simple welding, forging, rolled products and casting imperfections	7.0 Test report Check test report Basic of evaluation Viewing conditions (EN ISO 3059) according to reference block, other used reference blocks, calibration of test units, batch test report Evaluation and verification the indication quality Report of imperfections according to EN 1290, EN 1369, EN 10228-1	7.0 Test report Written procedure with check of test reports: Welding according to EN 1290 Casting according to EN 1371 Forging according to 10228-2 Basics of evaluation, viewing conditions (EN ISO 3059) according to reference block, other used reference blocks calibration of test units Evaluation verification the indication quality
8.0 Assessment	NOT APPLICABLE	Assessment of discontinuities Influence of manufacture and material	Assessment of discontinuities Influence of manufacture and material



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9.0 Quality aspects	9.0 Personnel qualification (according to EN ISO 9712) Equipment verification	9.0 Personnel qualification (according to EN ISO 9712) Equipment verification Written instructions Traceability of documents A review of applicable NDT application and product standards	9.0 Personnel qualification (according to EN ISO 9712) Equipment verification Format of working procedures Traceability of documents A review of applicable NDT application and product standards
10.0 Environmental and Safety conditions	10.0 Health and Safety Electric risks hazards Risks related to the products (magnetic inks) Risks related to the ultraviolet radiation Disposal of the effluents and environmental conditions (concepts) Safety data sheet	10.0 Health and Safety Electric risks hazards Risks related to the products (magnetic inks) Risks related to the ultraviolet radiation Disposal of the effluents and environmental conditions (concepts) Safety data sheet	10.0 Health and Safety Electric risks hazards Risks related to the products (magnetic inks) Risks related to the ultraviolet radiation Disposal of the effluents and environmental conditions (concepts) Harmfulness and toxicity of the products Treatment and rejection of the effluents, environmental conditions Fire hazards Risks related to the ultraviolet radiations New techniques
11.0 Developments	(Not applicable)	Special installation and equipment	Creative and innovative special installations