



**NPI-Quality Training Center**, 13339 NE Airport Way, Suite 100  
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Office (503) 287.5255 Fax (503) 287.5992

## **Level I & II Magnetic Particle Testing**

### **Training Course – MT- 100**

**COURSE:** A 32 hour formal classroom training per SNT-TC-1A  
Recommended Training Course Outline-TC-2 and NAS-410

### **REFERENCE & TRAINING MATERIAL:**

1. ASNT - Magnetic Particle Testing Classroom Training Book
2. NPI - Power Point Presentation Magnetic Particle Training Material
3. EPRI NDE Center Videotape; Manufacturing Discontinuities - Casting and Forming
4. AWS D1.1 American Welding Society
5. ASTM E-709 - Magnetic Particle Examination
6. ASTM E-1444 - Magnetic Particle Examination
7. ASNT CP-105-2006 ASNT Standard Training Outlines for Qualification of Nondestructive Testing Personnel
8. USAF T.O. 33B-1-1 Technical Manual Nondestructive Inspection Methods
9. University of Iowa - NDT Education Resources, Online

## **Level I Training**

### **Section 1 (2.0 hours)**

#### **Introduction**

- A. Course Objectives
- B. Class rules and policies
  1. Grading System
    - a. Quizzes
    - b. Final Comprehension Examination
  2. Attendance
  3. Schedule
  4. Conduct
  5. Certification of Completion
- C. Safety
- D. Qualification and Certification Process of NDT Personnel
- E. Brief history of NDT and Magnetic Particle examination
- F. Purpose of Magnetic Particle Testing
- G. Advantages of Magnetic Particle Testing



## **Level I Training**

### **1.0 Principles of Magnets and Magnetic Fields (2.0 hours)**

- 1.1 Theory of Magnetic Fields
  - 1.1.1 Earth's Magnetic Field
  - 1.1.2 Magnetic fields around magnetized material
- 1.2 Theory of Magnetism
  - 1.2.1 Magnetic Poles
  - 1.2.2 Laws of magnetism
  - 1.2.3 Materials influenced by magnetic fields
  - 1.2.4 Magnetic characteristics of nonferrous materials
- 1.3 Terminology associated with Magnetic Particle Testing

### **2.0 Characteristics of Magnetic fields (1.0 hour)**

- 2.1 Bar magnet
- 2.2 Ring magnet

### **3.0 Effect of Discontinuities of Materials (1.5 hours)**

- 3.1 Surface cracks
- 3.2 Scratches
- 3.3 Subsurface defects

### **4.0 Magnetization by Means of Electric Current (2.0 hours)**

- 4.1 Circular field
  - 4.1.1 Field around a straight conductor
  - 4.1.2 Right-hand rule
  - 4.1.3 Field in parts through which current flows
  - 4.1.4 Discontinuities commonly discovered by circular fields
- 4.2 Longitudinal field
  - 4.2.1 Field produced by current flow in a coil
  - 4.2.2 Field direction in a current-carrying coil
  - 4.2.3 Field strength in a current-carrying coil
  - 4.2.4 Discontinuities commonly discovered by longitudinal fields
  - 4.2.5 Advantages of longitudinal magnetization
  - 4.2.6 Disadvantages of longitudinal magnetization

### **5.0 Selecting the Proper Method of Magnetization (1.0 hour)**

- 5.1 Alloy, shape and condition of part
- 5.2 Type of magnetizing current
- 5.3 Direction of magnetizing current
- 5.4 Sequence of operations
- 5.5 Value of flux density



## **Level I Training**

### **6.0 Inspection materials (1.0 hour)**

- 6.1 Wet particles
- 6.2 Dry particles

### **7.0 Principles of demagnetization (1.5 hours)**

- 7.1 Residual magnetism
- 7.2 Reasons for requiring demagnetization
- 7.3 Longitudinal and circular residual fields
- 7.4 Basic principles of demagnetization
- 7.5 Retentivity and coercive force
- 7.6 Methods of demagnetization

### **8.0 Magnetic Particle Testing equipment (1.5 hours)**

- 8.1 Equipment-selection considerations
  - 8.1.1 Type of magnetizing current
  - 8.1.2 Location and nature of test
  - 8.1.3 Test materials used
  - 8.1.4 Purpose of test
  - 8.1.5 Area inspected
- 8.2 Manual inspection equipment
- 8.3 Medium- and heavy-duty equipment
- 8.4 Stationary equipment
- 8.5 Mechanized inspection equipment

### **9.0 Discontinuities Types, Indications and Interpretations Detected by Magnetic Particle Testing (2.5 hours)**

- 9.1 Inclusions - metallic and nonmetallic
- 9.2 Blowholes and pipes
- 9.3 Porosity
- 9.4 Bursts and Flakes
- 9.5 Cracks
- 9.6 Laminations
- 9.7 Laps and seams
- 9.8 Forging
- 9.9 Nonrelevant indications



## **Level II Training**

### **1.0 Principles (1.5 hours)**

- 1.1 Theory
  - 1.1.1. Flux patterns
  - 1.1.2. Frequency and voltage factors
  - 1.1.3. Current calculations
  - 1.1.4. Surface flux strength
  - 1.1.5. Subsurface effects
- 1.2 Magnets and magnetism
  - 1.2.1 Distance factors versus strength of flux
  - 1.2.2 Internal and external flux patterns
  - 1.2.3 Phenomenon action at the discontinuity
  - 1.2.4 Heat effects on magnetism
  - 1.2.5 Material hardness versus magnetic retention

### **2.0 Flux fields (2.0 hours)**

- 2.1 Direct current
  - 2.1.1 Depth of penetration factors
  - 2.1.2 Source of current
- 2.2 Direct pulsating current
  - 2.2.1 Similarity to direct current
  - 2.2.2 Advantages
  - 2.2.3 Typical fields
- 2.3 Alternating current
  - 2.3.1 Cyclic effects
  - 2.3.2 Surface strength characteristics
  - 2.3.3 Safety precautions
  - 2.3.4 Voltage and current factors
  - 2.3.5 Source of current

### **3.0 Effects of Discontinuities on Materials (1.5 hours)**

- 3.1 Design factors
  - 3.1.1. Mechanical properties
  - 3.1.2. Part use
- 3.2 Relationship to load-carrying ability

### **4.0 Magnetization by Means of Electric Current (1.5 hours)**

- 4.1 Circular techniques
  - 4.1.1 Current calculations
  - 4.1.2 Depth-factor considerations
  - 4.1.3 Precautions B safety and overheating
  - 4.1.4 Contact prods and yokes
  - 4.1.5 Discontinuities commonly detected



## **Level II Training**

- 4.2 Longitudinal technique
  - 4.2.1 Principles of induced flux fields
  - 4.2.2 Geometry of part to be inspected
  - 4.2.3 Shapes and sizes of coils
  - 4.2.4 Use of coils and cables
  - 4.2.5 Current calculations
  - 4.2.6 Discontinuities commonly detected

### **5.0 Selecting the Proper Method of Magnetization (1.5 hours)**

- 5.1 Alloy, shape and condition of part
- 5.2 Type of magnetizing current
- 5.3 Direction of magnetic field
- 5.4 Sequence of operations
- 5.5 Value of flux density

### **6.0 Demagnetization Procedures (1.0 hour)**

- 6.1 Need for demagnetization of parts
- 6.2 Current, frequency and field operations
- 6.3 Heat factors and precautions
- 6.4 Need for collapsing flux fields

### **7.0 Equipment (1.5 hours)**

- 7.1 Portable type
- 7.2 Stationary type
- 7.3 Automatic type
- 7.4 Multidirectional units
- 7.5 Liquids and powders
- 7.6 Ultraviolet radiation
- 7.7 Light-sensitive instruments

### **8.0 Types of Discontinuities (1.5 hours)**

- 8.1 In castings
- 8.2 In ingots
- 8.3 In wrought sections and parts
- 8.4 In welds

### **9.0 Evaluation Techniques (2 hours)**

- 9.1 Use of standards
  - 9.1.1. Needs for standards and references
  - 9.1.2. Comparison of known with unknown
  - 9.1.3. Specifications and certifications
  - 9.1.4. Comparison techniques



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- 9.2 Defect appraisal
  - 9.2.1 History of part
  - 9.2.2 Manufacturing process
  - 9.2.3 Possible causes of defect
  - 9.2.4 Use of part
  - 9.2.5 Acceptance and rejection criteria

### **10.0 Quality Control of Equipment and Processes (2.0 hours)**

- 10.1 Malfunctioning of equipment
- 10.2 Proper magnetic particles and bath liquid
- 10.3 Bath concentration
  - 10.3.1 Setting test
  - 10.3.2 Other bath-strength tests
- 10.4 Tests for Ultraviolet radiation intensity