

NDT Procedure for Magnetic Particle Inspection

*A Nondestructive testing (NDT) Procedure suitable for General Magnetic Particle Inspections. This is a sample MPT procedure and may be required to be modified as per specific requirements.
NDT Procedure No: TNE-DOC-MPT-04 Rev '01'*



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PROCEDURE FOR MAGNETIC PARTICLE EXAMINATION

Procedure No. TNE-MPT-Doc-04 Rev '01'

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I. Scope:

1.1. This procedure defines the criteria and general requirements to carry out magnetic particle examination on welded joints and weld bevels of ferromagnetic materials in order to detect discontinuities open to the surface.

1.2. This procedure employing yoke technique, with none fluorescent dry or wet systems.

2. Purpose

2.1. To ensure magnetic particle testing is carried out in a controlled defined manner, in accordance with the requirements of Codes and standard referenced below in Reference.

3. Reference

3.1. ASME Code Section V -applicable edition/addenda.

3.2. ASME Code Section I -applicable edition/addenda.

3.3. ASME Code Section VIII, Div I-applicable edition/addenda.

3.4. ANSI/ASME B31.1, B31.3 applicable edition/addenda.

3.5. National Board Inspection Code, NBIC-23, applicable edition.

3.6. AWS D1.1 - applicable edition.

3.7. ASTM-E709-Standard guide for Magnetic Particle Testing.

3.8. Clients specification requirements for acceptance criteria.

3.9. Written Practice No. TNE-MPT-Doc-04 Rev '0'.

In case of conflict between Code requirements and Client's specifications, Code requirements shall prevail.



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4. Definitions

4.1. MPI : Magnetic particle inspection.

4.2. AC : Alternating current

4.3. DC : Direct current

5. Responsibilities:

5.1. The NDT Inspector shall be responsible for conducting and reporting the results of inspection in accordance with project contract.

6. Personnel Qualification:

6.1. All personnel involved in Magnetic Particle Examinations shall be qualified in accordance with the requirements of Trinity NDT written practice No., TNE-MPT-Doc-04 Rev '0'. and (Written Practice for NDE Personnel Qualification).

6.2. When the written practice is revised, the certification of NDE personnel remains valid to the requirements of the previous revision until the expiry date of the personnel qualification certificate; then, recertification to the requirements of the new revision is required.

6.3. The certification of personnel shall be checked by the QA/QC Manager prior to work commencement.

7. Procedures:

7.1. Equipment:

7.1.1 Electromagnetic yokes shall be the adjustable leg type giving an AC magnetic field and shall have a lifting power capable of lifting a test weight of 10 lbs. (4.5 kg).

7.1.2 Permanent magnets either fixed or adjustable pole shall have a lifting power capable of lifting a test weight of 40 lbs. (18 kg).

7.1.3 AC Yokes shall be tested for adequate magnetization strength prior to use each day by being able to pick up a 4.5 kg steel weight. Similarly, DC Yokes shall be tested using an 18 kg steel weight, Results recorded on MT Calibration Report form

7.1.4 Where magnetization field strength is uncertain, an ASME pie gauge may be used to verify adequate magnetization of a part.

7.1.5 When procedure qualification is specified by the referencing code section, this procedure shall be qualified by demonstration and documented on "Procedure Qualification & demonstration record" form. Which shall list all essential and non-essential variables (as per Table T-721 of ASME Code Sec.V) actually used during qualification and range qualified. The records shall be attached to this procedure.

7.2. Material:

7.2.1 Dry and wet particles and suspension vehicles shall be in accordance with SE-709.

7.2.2 Particles shall be used within the temperature range limitation set by the manufacturer of the particles.

7.3. Surface Preparation:

7.3.1 Generally, satisfactory results may be obtained when the surface of the part is in the as-welded, as-rolled, as-cast, heat treated or as forged condition. Surface preparation by grinding, machining, or other methods may be necessary where surface irregularities could mask the interpretation.

7.3.2 Prior to all Magnetic Particles examinations, the weld to be examined and all adjacent areas within at least 25mm (1") shall be dry and free of all dirt, grease, lint, scale, welding flux and spatter, oil, or other extraneous matter that could interfere with the examination.

7.3.3 Cleaning may be accomplished using detergents, organic solvents, descaling solutions, paint removers, sand or grit blasting methods.

7.3.4 If nonmagnetic coatings are left on the part in the area being examined, it shall be demonstrated that indications can be detected through the existing maximum coating thickness applied. When AC yoke technique is used, the demonstration shall be in accordance with Mandatory Appendix I of Article 7.

7.3.5 The uncoated area or weld under examination shall be temporarily coated with a white matt lacquer, sufficiently opaque to assist in contrast of any indications and to offer a smooth surface to allow particles to remain mobile.

7.3.6 Area where electrical contact will be made on the examination piece shall be thoroughly cleaned to provide low resistance electrical connections to reduce the possibility of arc strikes.

7.4. Examination:

7.4.1 All examinations shall be conducted with sufficient field overlap to ensure 100% coverage at the required sensitivity.

7.4.2 The temperature shall not exceed 600°F (316°C) for dry particles and 122°F (50°C) for wet particles.

7.4.3 The method of magnetization shall be done using either electromagnetic yoke or permanent magnet, with pole spacing to be between a minimum of 3 inches (76.2 mm) and a maximum of 8 inches (203.2mm). Shorter spacing may be used to compensate for the geometry of area being examined or increase sensitivity, but leg spacing less than 3 inches (76.2 mm) is not recommended due to the strength of the longitudinal magnetic field at the poles.

7.4.4 The Yoke shall be placed in contact with the surface to be examined and energized.

7.4.5 While maintaining the magnetic field, apply the magnetic particles so that a light, uniform coating settles on the examination surface.

7.4.5.1 Dry Particles:

- a) For electromagnetic yoke, the yoke is energized, and the dry particles are applied to the area between the poles. The application of the dry particles shall be stopped and the excess of the examination medium shall be removed before the yoke is de-energized.
- b) For permanent magnets, the magnet shall be placed across the area, and the dry particles are applied to the area between the poles. The application of the dry particles shall be stopped and the excess of the examination medium shall be removed before the magnet is removed.
- c) For the application of dry particles in either technique, the dry particles shall be introduced to the area very lightly and sparingly so as not to disturb any lightly held particle patterns.
- d) Accumulations of excess dry particles in examinations shall be removed with a light air stream from a bulb or syringe or other source of low Pressure dry air. The examination magnetization field shall be maintained while removing the excess particles.

7.4.5.2 Wet Particles:

- a) For electromagnetic yoke, the yoke is energized after the particles have been applied. The flow of the particles shall stop with the application of current. Wet particle applied from aerosol spray cans may be applied before and/or after magnetizing current is applied.
- b) For permanent magnets, the magnet shall be placed across the area, and the wet particles are applied to the area between the poles. The application of the wet particles shall be stopped before the magnet is removed.
- c) With the wet particles method, care shall be exercised to avoid “flooding” of the area.

7.4.6 The inspection shall be repeated with the magnet/yoke being relocated at approximately perpendicular (90°) to the first magnetization direction forming an "X" pattern, to ensure full coverage of the area under examination.

7.4.7 The adequacy or direction of the magnetizing field, when necessary, shall be demonstrated by using the magnetic particle field indicator. The magnetic particle field indicator described in ASME Section V, Article 7, Fig. T-764.1.1 shall be used.

7.4.8 Good lighting shall be available to ensure shadows do not obstruct the test areas. A minimum light intensity of 100 foot candles (1000 Lux) is required on the surface to be examined to ensure adequate sensitivity during the examination and evaluation of indications.

7.4.9 The light source, technique used, and light level verification is required to be demonstrated one time, documented, and maintained on file.

7.4.10 Demagnetization shall be required after the completion of the examination when the residual magnetic field could interfere with subsequent processing or usage.

7.4.11 When post-examination cleaning is required, it shall be conducted as soon as practical using a process that does not adversely affect the part.

7.5. Interpretation & Evaluation:

7.5.1 All relevant indications shall be interpreted and evaluated in accordance with the appropriate criteria after each individual examination and the results recorded on the MT examination Report form no.

TNE-MTR-02 Rev '0'

7.5.2 All non-relevant indications shall be re-examined by different NDT method to verify that no defect is present.

7.5.3 All indications shall be evaluated in terms of the acceptance standards of the referencing Code Section.

7.6. ACCEPTANCE STANDARDS: **7.6.1** Acceptance criteria for specific codes are listed as below. These acceptance criteria shall apply unless other more restrictive standards are specified by Client.

Code	Rejection Criteria
ANSI/ASME B31.1 &ANSI/ ASME B31.3	<p>Indications $> 1/16"$(1.5mm) shall be considered as relevant</p> <p>1. Linear Indication : Any crack or linear indication</p> <p>2. Rounded indications</p> <p>Indications with dimensions $> 3/16"$(5.0mm) Four or more rounded indication in a line separated by $1/16"$ or less edge to edge.</p> <p>Ten or more rounded indication in any 6 inch of surface with the major dimension of this area not to exceed 6 in.</p>
ASME SEC VIII D1	<p>Indications $> 1/16"$(1.5mm) shall be considered as relevant The following Indications shall be rejectable :</p> <p>1. Relevant linear indication $> 1/16"$ (1.5 mm)</p> <p>2. Relevant rounded indications $> 3/16"$ (5.0 mm)</p> <p>3. Four or more rounded indications in a line separated by $1/16"$ (1.5 mm) or less (edge to edge).</p>
AWS D1.1	An acceptance / rejection criteria is dependent on service condition. Refer to the relevant Project Engineer or the Inspection Department. (Table 6.1 for visual inspection acceptance criteria can be applying in case of no more requirements by Client specification).



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ASME Sec I	Indications $> 1/16"$ (1.5mm) shall be considered as relevant. The following indications shall be rejectable: 1. Relevant linear indication $> 1/16"$ (1.5mm) 2. Relevant rounded indications $> 3/16"$ (5.0mm) 3. Four or more rounded indications in a line separated by $1/16"$ (1.5mm) or less (edge to edge).
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8. Documentation:

8.1. Non-rejectable indications shall be recorded as specified by the referencing Code Section.

8.2. Rejectable indications shall be recorded. As a minimum, the type of indications (linear or rounded), location and extent (length or diameter or aligned) shall be recorded.

8.3. Results of the examination shall be recorded in Magnetic Particle examination report form no. TNE-MTR-02 Rev '0'

9. Attachments:

Magnetic Particle Examination Report TNE-MTR-02 Rev '0'



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