

TAM International, Inc.

QI-8.2.4-12 Visible Magnetic Particle Inspection

Approved by Quality Assurance Manager

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Revision Level: B

Page 1 of 5

1.0 Purpose

- 1.1 This instruction establishes the guidelines used to perform visible wet or dry magnetic particle inspection on ferromagnetic steels and welds to determine surface and sub-surface acceptability.

2.0 Scope

- 2.1 The techniques described in the instruction may be applied to ferromagnetic, raw material, semi-finished, and finished materials. These instructions may be used to determine acceptability of finished welds.
- 2.2 This instruction covers the wet visible technique using white contrast paint background and contrasting magnetic particles or dry particles. Use of these methods may be performed either outdoor or indoors, provided there is sufficient lighting.

3.0 Reference Documents

- 3.1 ASME Boiler & Pressure Vessel Code Section V, Article 7 latest edition.
- 3.2 ASME Boiler & Pressure Vessel Code Section V, Article 25 SE-709 latest edition.
- 3.3 ASTM E-709 Latest edition.
- 3.4 ASNT TC-1A Latest edition.

4.0 Personnel

- 4.1 Personnel performing an examination to this instruction shall be qualified and certified in accordance with minimum requirements of ASNT-TC-1A Level II "Procedure for Qualification and Certification of Nondestructive Testing Personnel", latest edition.
- 4.2 Only ASNT-TC-1A Level II or III shall interpret test results.

5.0 Responsibility and Authority

- 5.1 The technician performing these inspections shall be responsible for carrying out the tests in accordance with the instructions detailed in this instruction.
- 5.2 Authority to deviate from this instruction is assigned to the responsible NDT Level III.

- 5.3 This instruction and all revisions shall be reviewed and approved by the Engineering Manager or designee.

6.0 Current Types

- 6.1 Alternating Current (AC) shall be used to find discontinuities open to the surface.
- 6.2 Direct Current (DC) shall be used when both surface and subsurface discontinuities require detection.

7.0 Equipment and Materials

- 7.1 Electromagnetic yokes with fixed or articulating legs shall be used. The yokes shall be calibrated at least annually and capable of the following:
 - 7.1.1 AC yokes shall have a lifting force of at least 10 lbs. At the maximum pole spacing they will be used.
 - 7.1.2 DC yokes shall have a lifting force of at least 30 lbs. At the maximum pole spacing, they will be used.
 - 7.1.3 At any time it is determined that the yokes cannot meet the above requirements or malfunctioned is suspected, repairs shall be make. Upon successful completion of repairs, recalibration shall be performed.
- 7.2 Magnetic Particle field indicator (pie gauge or control strip).
- 7.3 A Gauss Meter, calibrated at least annually and after repair or any time, a malfunction is suspected.
- 7.4 Light meter capable of measuring visible light intensity in foot-candles. This meter shall be calibrated every six months per NIST standards or equipment.
- 7.5 All calibrations shall be performed with equipment traceable to NIST standards.
- 7.6 Magna Flux WCP-81 Contrast Aid Paint or equivalent may be used to enhance visibility.
- 7.7 Magna Flux MPI-80 Pre-mixed Wet visible magnetic particles or equivalent shall be used for wet or Magna Flux “Red” Powder or equivalent for dry applications.
 - 7.7.1 Manufacturer certification of concentration shall be accepted when pre-mixed solutions are used.

- 7.7.2 If a check of the concentration is requested it shall be checked by settling volume measurements using an ASTM pear-shaped centrifuge tube. After agitating the solution for 30 minutes, pour 100 ml into the centrifuge tube and allow settling for approximately 60 minutes. The settling volume of particles shall be between 1.2 and 2.4 ml per 100 ml.

8.0 Surface preparation

- 8.1 The examination surface shall include the area of interest plus at least one-inch (1”) adjacent surface. The area of interest shall be clean, dry, and free of contaminants such as oil, grease, rust, loose scale, paint and weld splatter, etc.
- 8.2 Cleaning of the test surface may be accomplished by using detergents, organic solvents, grinding, or sand blasting, if needed.

9.0 Magnetization Techniques

- 9.1 All examinations shall be conducted with sufficient overlap to assure 100% coverage of the examination area.
- 9.2 At least two separate examinations shall be performed on each area with magnetic fields approximately perpendicular (90 degrees) to each other. The following technique shall be used.
 - 9.3.1 Yoke technique
 - 9.3.1.1 For the yoke technique, magnetization is accomplished by positioning the legs of the yoke over the area being inspected and energizing in the yoke. The yoke is then positioned with the legs approximately perpendicular to the first position.
 - 9.3.1.2 AC yokes having fixed current with no adjustment field strength are considered adequate when the required 10-pound weight can be lifted.
 - 9.3.1.3 DC yokes may have current adjustment. This adjustment shall be set at the level required to lift the 50-pound weight.

10.0 Inspections Area Lighting

- 10.1 The examination shall be performed under visible light of not less than 100 foot-candles intensity as measured per paragraph 7.4.

11.0 Particle Application

- 11.1 Prior to magnetizing and particle application the area to be inspected may be coated with white contrasting background paint. A thin even layer shall be sprayed on the part and allowed to dry.
- 11.2 The magnetizing force shall be applied continuously during particle application.
- 11.3 The particles shall be applied on the examination area while continuous magnetization is applied. Proper sequencing of operation (part magnetization and timing of bath application) is essential of the indication, and may require formation and retention, multiple current shots to be applied. The last shot should be applied after the particle spray has been stopped and while the particle bath is still on the part. Care shall be taken to prevent excessive application over critical surfaces and to cease application of the suspension prior to removing the magnetizing force.

12.0 Evaluation of indications

- 12.1 The evaluation of indications shall be performed under visible light as noted in paragraph 7.4.
- 12.2 Relevant indications are defined as indications with a length greater than 1/6" either linear or rounded. Indications determined to be relevant shall be further evaluated to determine if they are rejectable or acceptable.
- 12.3 Discontinuities shall be evaluated per the acceptance standard of the referencing code section and/or manufacturer's specification, procedure or engineering prints. If no acceptance criteria is specified the default shall be as follows:
 - No cracks or non-fusion
 - No single indication greater than 1/8" linear or rounded
 - No more than 6 relevant indications with a 1/16" or less separation in a 1" distance in any direction.
- 12.4 Discontinuities on or near the surface are indicated by retention of the particles. However, localized surface irregularities due to machining marks or other surface conditions may produce false indications.
- 12.5 Broad areas of particle accumulation and false indications that could mask true discontinuities shall be conditioned and re-examined to the extent necessary to make proper evaluation.

13.0 Post Cleaning and Demagnetization

- 13.1 Post cleaning of parts will be done to the extent required by the client. Post cleaning may be done with the same techniques as pre-cleaning.

- 13.2 If required, demagnetization will be performed when required by the client. If required the residual field shall be reduced to 3 gauss or less by any suitable demagnetization technique.

14.0 Reports

- 14.1 A Magnetic Particle Test Report for all inspections performed is required.

- 14.2 The following information as a minimum shall be recorded on the report in addition to information the client may require:

- * Customer Name
- * Purchase order number
- * Date of inspection
- * Inspection procedure number and revision
- * Referencing code section or specification for acceptance criteria
- * Part description
- * Work order number (if provided)
- * Part number (if provided)
- * Serial number (if provided)
- * Heat number (if provided)
- * Quantity of parts inspected
- * Areas of parts inspected
- * Magnetizing equipment used including Manufacturer, Model Serial number Calibration date.
- * Magnetic Techniques (s) including amperes and current type.
- * Magnetic Particles used including brand name, batch number and concentration level.
- * Name, Certification level and signature of technician performing inspection.
- * Result of examination (acceptable/unacceptable) if recordable indications are detected, give their locations, orientation and length. Sketches shall be used if needed to clarify locations.

Rev	Date	Description	Prepared By:	Reviewed By / Approved By	Date
A	5/23/05	New Document	Thomas Young	T. Young	5/25/05
B	10/09/14	Annual Review, Add Revision Box, Remove Review Date	Thomas Young	Greg Fletcher	