

RADIANT NDT SERVICES

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MAGNETIC PARTICLE TESTING PROCEDURE

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Revision & Issue date

Revision Number	Issue Date	Changes	Remarks
0	24.01.2014	Initial Issue	
1	28.12.2019	Para 7.2 <i>The minimum light intensity shall be 100 fc or 1076lx</i>	

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1. SCOPE:

- 1.1 This procedure defines the requirements of Magnetic Particle Testing techniques for the detection of surface imperfections in ferromagnetic material, Butt weld and branch connection including the heat affecting zones using the Yoke technique continuous wet or dry method.

2. REFERENCES:

- 2.1 ASME Sec V.Article-7 and SE-709
2.2 ASME-B 31.1
2.4 Written Procedure RNS/WP/001 Rev.1

3. PERSONNEL QUALIFICATION:

The Personnel who carry out Magnetic Particle Examination shall be minimum qualified to NDT level II MT as per ASNT-SNT-TC-1A of RNS Company written practice (RNS/NDT/WP-001) or PCN Level II or ASNT Level III/ PCN Level III.

4. RESPONSIBILITY:

All RNS NDT technician shall be responsible for performing Magnetic Particle Examination according to this procedure. Level III will help them to execute the job technically by briefing procedures and acceptance criteria. Level III will do the approved the NDT Procedure.

5. EQUIPMENT:

5.1 AC Electromagnetic yoke :

The use of alternating current gives the best sensitivity for detecting surface imperfections. The electromagnetic yoke used shall be Y-6 type, Magnaflux or equivalent, operating 110/240 volts with test lift capacity of 10lbs (4.5kg) mild steel at the maximum pole space that will be used.

5.2 DC Yoke :

The equipment that may only be used is DC yoke with pole separation of 75mm to 150mm or (3inch to 6inch). DC operated magnetic yoke and test lift capacity of 40lbs(18.0kg) mild steel.
Note: DC yoke is to use only where the safety concern, The Lifting power of Yokes shall be calibrated at an interval of Six (6) months or whenever a Yoke has been damage.

5.3 Magnetizing Current:

Alternating current shall be used as a power source.

5.4 Calibration of Equipment:

- The magnetizing force of yokes shall be checked at least once in 6 months.
- The above equipment shall also be calibrated whenever the equipment has been subjected to major electrical repair and periodic overhaul or damage.
- Alternating current (AC) electromagnetic yoke shall have a lifting power of at least 10 lbs. (4.5 kg) at the maximum pole spacing that will be used.

5.5 Chemicals (consumables):

The following chemicals (Magnaflux brand) shall be used for magnetic particle examination:
MPI Ink (7 HF) or Equivalent preferably aerosol applications.

White Contrast Paint (WCP-2) or Equivalent preferably aerosol applications.

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6. DETECTING MEDIA:**6.1 General :**

Detecting media may be either in dry powder or liquid form and the magnetic particles shall be either fluorescent or non-fluorescent. The detecting media shall be traceable to a batch certificate or data sheet documenting compliance with a national or international standard, e.g. ASME V

6.2 Dry Particles :

The colour of dry particles (dry powder) shall provide adequate contrast with the surface being examined and they may be of fluorescent or non-fluorescent type. Dry particles shall only be used if the surface temperature of the test object is in range 57°C to 300°C.

6.3 Wet Particles:

The colour of wet particles shall provide adequate contrast with the surface being examined and they are available in both fluorescent and non-fluorescent concentrates. The particles are suspended in a suitable liquid medium such as water or petroleum distillates. When using wet particle system, the temperature range of the wet particle suspension and the surface of the test object should be within 57°C.

6.4 Fluorescent Particles :

With fluorescent particles the testing is performed using an ultraviolet light, called black light. The testing shall be performed as follows:

- The testing shall be performed in darkened area where the visible light is limited to a maximum of 20lx.
- Photo chromatic spectacles shall not be used.
- sufficient time shall be allowed for the operators eyes to become dark adapted in the inspection booth, usually at least 5 min.
- UV radiation shall not be directed in the operator's eyes. All surface which can be viewed by the operators shall not fluoresce.
- The test surface shall be viewed under a UV-A irradiance at the surface inspected shall not be less than 10w/m² (1000 μ W/cm²).

NOTE: For, temperatures below 0°C or above 57°C, procedures approved in accordance with recognized standard for this purpose shall be used.

For, temperatures exceeding 300°C dry particles shall be used. Checking of wet particles concentration shall be carried out based on ASME E709/

CHEMICAL USE :

MACK	Contrast	Wet particle	Dry Particle
MAGNAFLUX	WCP2	7C OR 7HF	8A-RED
ARDROX	890/W	800/3	NA
TASETO	M-1	B-200	NA

6.5 Temperature Limitation:

The chemicals and particles shall be used within the temperature range specified by the Manufacturer Safety Data Sheet (MSDS) of chemicals. If exceeding the temperature range Minimum or maximum shall require qualification and demonstrated by NDT Level III.

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7. VIEWING CONDITION:

7.1 Fluorescent penetrant:

Photo chromatic spectacles shall not be used. Sufficient time shall be allowed for the operator's eyes to become dark adapted in this inspection booth, usually at least 5min.

UV radiation shall not be directed in the operator's eyes.

The test surface shall be viewed under a UV-A radiation source. The UV-A irradiance at the Surface inspected shall not be less than 10W/m^2 ($1000\text{ }\mu\text{W/cm}^2$).

The statement above shall apply to inspections in darkened rooms where visible light is limited to a maximum of 20lx.

7.2 Colour Contrast Penetrant:

The test surface shall be inspected under illumination natural or supplemental white light of the examination surface is required for evaluation of indications. ***The minimum light intensity shall be 100 fc or 1076lx.*** The light intensity natural or supplemental white light source shall be measured With white light meter prior to the evaluation of indications or verified light source light source shall be used. Verification of light sources is required to be demonstrated only one time, documented and maintained on file. The viewing condition shall be such that glare and reflection are avoided.

Calibration:

Light meter shall be calibrated at least once a year or whenever a meter has been repaired.

If meters have not used for one year or more, calibration shall be done before being used.

8. VERIFICATION OF MAGNETIZATION:

The adequacy of the surface flux density shall be established by one or more of the following methods (with a maximum pole spacing used.):

- By using a Pie gauge six line minimum visible.
- By using BC Strip three line minimum visible.
- By verification of standard weight lifting block.

9. OVERALL PERFORMANCE TEST:

Before testing begins, a test is recommended to check the overall performance of the testing. The result shall be designed to ensure a proper functioning of the entire chain of parameters including equipment, the magnetic field strength and direction, surface characteristics, detecting media and illumination.

10. SURFACE PREPARATION:

10.1 Prior to testing the surface shall be free from scale, oil, grease, weld spatter, machining marks, dirt, heavy and loose paint and any other forging matter that can affect the sensitivity. It can be necessary to improve the surface condition e.g by abrasive paper or local grinding to permit accurate interpretation of indication.

10.2 When testing of welds is required, the surface and all adjacent areas within 20mm has to be prepared as described above.

10.3 Satisfactory results are usually obtained when the surfaces are in as welded, as cast as rolled or as forged conditions. However, surface preparation by grinding or machining may be necessary where surface irregularities could mask indications due to discontinuities.

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10.4 Prior to magnetic particle testing the surface to be examined and all adjacent areas within at least 1" shall be dry and free of all dirt, grease, lint, scale, welding flux and spatter, oil or any extraneous matter that could interfere with examination.

10.5 Cleaning may be accomplished using organic solvents.

10.6 If non-magnetic coatings are left of the surface to be examined, the technique shall be demonstrated that the indication can be detected through existing maximum coating thickness applied.

10.7 NDT shall be performed after 48hrs of welding completion.

11. METHOD OF EXAMINATION:

11.1 Examination shall be done by the continuous method

11.2 Apply contrast paint on the examination surface in a thin even coat.

11.3 Apply magnetic field, then apply examination medium (ink) and allow excess to disperse whilst magnetic field remains applied (continuous magnetization).

11.4 Observe and evaluate indications.

11.5 Before the magnetic particle examination is conducted, a check of the examination surface shall be conducted to locate any discontinuity surface openings which may not attract and hold magnetic particles because of their width.

11.6 A minimum of 4 seconds shall be allowed for particle migration before examination.

12. CALIBRATION:

The adequacy of the surface flux density shall be established by one or more of the following Methods (with a maximum pole spacing used.):

- By using a Pie gauge six line minimum visible.
- By using BC Strip three line minimum visible.

Magnetic Strength for Yoke:

- By verification of standard weight lifting block. (4.5Kg for AC and 18Kg for DC)

13. APPLICATION OF DETECTING MEDIA:

For, Dry magnetic particle shall be applied by spraying, flooding or dusting immediately prior to and during the magnetization. Following this, time shall be allowed for indications to form before removal of the magnetic field.

For, Wet magnetic suspension are used, the magnetic field shall be maintained within the object until the majority of the suspension carrier liquid has drained away from the

14. DIRECTION OF MAGNETIZATION:

At least two separate examinations shall be performed on each area. During the second examination, the lines of magnetic flux shall be approximately perpendicular to those used during first examination

15. EXAMINATION COVERAGE:

All examination shall be conducted with sufficient overlap to assure 100% coverage at the required sensitivity.

16. REPAIR & RETESTING:

If retesting is necessary, the entire test procedure, starting with the pre cleaning, shall be repeated.

If, repair by grinding and re-weld, retest area should be an overlap of 100mm on both sides of the repair length shall be tested.

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17. DEMAGNETIZATION:

De magnetization is normally not required, however if specified, this shall be carried out within a method and to a level agreed. Generally by placing the poles on the surface, moving them around the area and slowly withdrawing the yoke while it is still energized.

18. POST EXAMINATION:

Post test cleaning is necessary where magnetic particle material(s) could interfere with subsequent processing. The client should specify when post cleaning is needed and the extent required.

19. EVALUATION OF INDICATIONS:

19.1 Mechanical discontinuities at the surface will be indicated by the retention of the Examination medium. All indications are not necessarily defects; however, certain metallurgical discontinuities and magnetic permeability variations may produce similar indications which are not relevant to the detection of unacceptable discontinuities.

19.2 Any indication which is believed to be non-relevant shall be re-examined to verify whether or not actual defects are present. Surface conditioning may precede the re-examination. Non-relevant indications which would mask indications of defects are unacceptable.

19.3 Relevant indications are those which result from unacceptable mechanical discontinuities. Linear indications are those indications in which the length is more than three times the width. Rounded indications are indications which are circular or elliptical with the length less than three times the width.

19.4 An indication of a discontinuity may be larger than the discontinuity that causes it; however, the size of the indication and not the size of the discontinuity is the basis of acceptance or rejection.

20. ACCEPTANCE CRITERIA:

Acceptance Criteria shall be in accordance with ASME B31.3 Part 136.4.3

Acceptance Standards. Indications whose major dimensions are greater than 1/16in. (2.0 mm) shall be considered relevant. The following relevant indications are unacceptable:

All surface of weld & adjacent area shall be free of:

- i. Relevant linear indications
- ii. Relevant rounded indications with dimensions greater than 3/16in. (5.0 mm)
- iii. Four or more rounded indications in a line separated by 1/16in. (1.5 mm) or less, edge to edge

21. REPORTING:

All the magnetic particle test results shall be recorded in RNS Report Format
(Please see the Appendix A).

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APPENDIX A- SAMPLE TEST REPORT