Sara OPERATING PROCEDURE	Procedure No.
Title: MAGNETIC PARTICLES TESTING	SSE/QAD/ MT-1/97

V.P. of Manufacturing	V.P. of Engineering	Director of QA/QC	V.P. of Sales/ Marketing	Revision Description	Release Date	Rev. No

Written By | **Revised By** | **Approved By;**

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ASNT & ACCP
D.K. JAIN

1.0 PURPOSE

To provide a detailed procedure for the inspection of parts using Magnetic Particles Testing

2.0 APPLICABILITY

The requirements of this procedure are directive in nature to all personnel:

2.1 Defining design requirements for Magnetic Particles Examination.

2.2 The performance of Magnetic Particles testing for purposes of final product acceptance.

3.0 REFERENCE DOCUMENTS

3.1 NOV Sara Quality Assurance Manual

3.2 SDP-27-009, "Control of Non conforming Products"

3.3 American Society of Mechanical Engineers (ASME)

3.3.1 Section V - "Nondestructive Testing"

3.3.2 Section VIII, Division 1 - "Rules for Construction of Pressure Vessels"

3.4 American Petroleum Institute (API)

3.4.1 Specification 6A – "Specification for Wellhead and Christmas Tree Equipment"

3.4.2 Specification 16A - "Specification for Drill through Equipment"

3.4.3 Specification 7K – "Specification for Drilling Well Servicing"

3.4.4 Specification 11E – "Specification for Pumping Units"

3.4.5 Specification 16D – "Control Systems for Drilling Well Control Equipment"

3.4.6 Specification 16C – "Specification for Choke and Kill Systems"

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3.5 American Society for Testing and Materials (ASTM

3.5.1 E-709 "Standard Guide for Magnetic Particles Testing"

3.6 American Welding Society (AWS)

3.6.1 D1.1 – "Structural Welding Code"

3.7 American Society of Nondestructive Testing (ASNT)

3.7.1 SNT-TC-1A – "Recommended Practice for Qualification and Certification of Personnel in Nondestructive Testing"

4.0 GENERAL

This procedure covers method, technique and acceptance norms for Magnetic Particle Testing of ferromagnetic materials for Surface and Sub-surface discontinuities. The intent of this procedure is to provide the required controls for the use of Magnetic Particles Testing.

5.0 RESPONSIBILITY

5.1 Design Engineering is responsible for including this procedure as a design requirement when Magnetic Particles Examination is specified on product drawings. This requirement is effective with the original release of this procedure.

5.2 Manufacturing Engineering is responsible for including this procedure as a requirement on Process Routers in accordance with design requirements.

5.3 Quality Control is responsible for initiating subcontractor Purchase Orders for Magnetic Particles Examination per the design requirements and this procedure.
(R) - Indicates revised item

5.4 The subcontractor supplying nondestructive testing services is responsible for compliance to the purchase order requirements and the requirements of this procedure.

5.5 The NDE Level III personnel is responsible for approving Magnetic Particles Examination Procedures.

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6.0 METHODS

6.1 General

6.1.1 Magnetic Particles Examination is performed where specified by the applicable Engineering drawing, Quality Assurance Plan, or Nonconformance Report disposition.

6.1.2 The following requirements apply to subcontractor MT personnel – If it is sub contracted to outside agency.

6.1.2.1 Technicians' qualifications shall be approved by the Level III and provided to the Sara file in the Quality Records Department.

6.1.2.2 Technicians performing and/or interpreting MT examination for final product acceptance purposes shall be certified in accordance with the requirements of ASNT SNT-TC-1A - NDT Level I or II - MT minimum.

6.1.2.3 All subcontract MT examinations shall be accompanied by a report of Nondestructive Testing listing acceptance criteria and status.

6.1.3 MT Examination- Subcontract Purchase Orders shall specify the Sara part number, work order number, serial number, and applicable Examination Procedure/ Acceptance. Criteria paragraph number.

6.2 MAGNETIC PARTICLES EXAMINATION PROCEDURES/ACCEPTANCE CRITERIA

6.2.1.1 Sara products. Accompanying this description is a listing of the acceptance criteria for the examination procedure.

6.2.1.2 MT subcontractors must use the examination method and acceptance criteria in performing the examination.

6.2.2 Magnetic Particles Examination of ASME Boiler and Pressure Vessel Code Section VIII Division -1 for Welds

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7.0 NDT PERSONNEL

All persons performing MPI shall receive training and shall be certified in accordance with Company's written practice, developed as per the recommended guidelines of SNT-TC-1A.

A level I certified technician shall perform work only under the direction of a level II/ Level-III, Final interpretations shall be performed by a level II or level III. All reports and technique sheets shall be prepared by a level II, and the technique sheet shall be approved by a level III.

8.0 IDENTIFICATION

Identification methods shall be established which will enable the report to identify the component and the area with respect to each other at any time.

9.0 SURFACE CONDITION

In general satisfactory results may be obtained, when the surface of the part under examination is in as welded, as rolled, as cast as or forged condition. The surface preparation is necessary, where surface irregularities could mask indications of unacceptable discontinuities.

9.1 PRE-EXAMINING CLEANING :

The surface to be examined and adjacent areas within at least 1" shall be dry and free from dirt, lint, scale, welding flux and spatters, oil or other foreign material that could interfere with the interpretation of the test. If the coating is left on the part, it must be demonstrated that the indication can be detected through the maximum coating thickness applied.
Typical cleaning agents which will be used are detergents, organic solvents, and descaling solution and paint remover.

9.2 DRYING :

After cleaning, the surface under examination shall be dried by normal evaporation or with forced hot air, for dry particle inspection.

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9.3 SURFACE TEMPERATURE

Dry Particles. Magnetic particles examination shall not be performed if the surface temperature of the part exceeds 316° C. or as recommended by the powder manufacturer.

Wet Particles. The particle shall be suspended in a suitable liquid medium. The temperature of the wet particle suspension and the surface of the part shall not exceed 57°C. or as recommended by the powder manufacturer.

10.0 EQUIPMENT:

Current Transformers: For Prod Method.
Electromagnets: AC / DC

11.0 CALIBRATION OF EQUIPMENT:

11.1 Frequency of Calibration

The equipment shall be calibrated once in a year or whenever the equipment has been subjected to major electric repair, periodic overhaul or damage.

11.2 Procedure

11.2.1 The ampere meters of a current source unit shall be verified by taking reading at least at three different current output levels encompassing the usable range. It should not deviate more than + 10 %.

11.2.2 Electro Magnet equipment shall be calibrated using weight lifting a weight of 40 Lbs. (18 Kg) for D.C. current and 10 Lbs. (4.5Kg) for A. C. current at least.

12.0 Examination Medium

The examination medium shall consist of finely divided ferromagnetic particles which have high permeability and low retentivity characteristics, size as per the requirement given in SE-709... They shall be of suitable color, size and shape to readily produce magnetic particle indications. The color of particles shall provide adequate contrast with the surface being examined.

The concentration of wet particles as per the recommendation of powder manufacturer.

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13.0 Light Intensity

Fluorescent Particle Examination shall be conducted in a darkened area (Max Light Intensity-20 Lux) using filtered black light. (U.V Lamp having minimum Light Intensity 1000 micro watt/cm square.).

Non Fluorescent Particle Examination shall be conducted in the daylight or visible light. There shall be sufficient light (Min Light Intensity-1000 Lux) at the surface to be examined.

14.0 MAGNETIZATION:

A suitable and appropriate means for producing the necessary magnetic flux in the part shall be employed. Current transformers can be utilized in coil mode for longitudinal magnetization and prods or central conductor for circular magnetization. Electromagnets can be oriented in perpendicular directions to simulate longitudinal and circular fields.

15.0 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 the first examination.

16.0 EXAMINATION COVERAGE:

All examinations shall be conducted with sufficient overlap to assure 100% coverage.

17.0 TECHNIQUE REQUIREMENT:

17.1 Prod Technique:

17.1.1 Magnetization Current: - Direct or rectified magnetizing current shall be used. The current shall be 100 to 125 amp/in. of prod spacing for section 19 mm thick or greater. For sections less than 19 mm thick, the current shall be 90 to 110 amp/in. of prod spacing.

17.1.2 Prod spacing: - 3 in. to 8 in.

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18.0 EVALUATION OF INDICATIONS:

18.1 All indications shall be evaluated in terms of the acceptance standards as below, only after eye adaptation for 5 minutes.

18.2 Indications will be revealed by retention of magnetic particles. However all such indications are not necessarily imperfections, since excessive surface roughness, magnetic permeability variations (such as at the edge of heat affected zones), etc. may produce similar indications.

18.3 An indication of an imperfection may be larger than the imperfection that causes it; however, the size of the indication is the basis for acceptance evaluation. Only indications which have any dimension greater than1. 5mm (1/16") shall be considered relevant.

18.4 A linear indication is one of circular or elliptical shape with a length equal to or greater than 3 times the width.

18.5 A rounded indication is one of circular or elliptical shape with a length equal to or less than three times its width.

18.6 Any questionable or doubtful indication shall be re-examined to determine whether they are relevant.

19.0 ACCEPTANCE STANDARDS:

19.1 Unacceptable Defects and Repair Requirement:
All linear discontinuities are unacceptable shall be removed and repaired. If repairs are made the repaired area shall be examined by the same method.

19.2 Treatment of Imperfections Believed Non-relevant:-
Re examination by the same method or by the use of other N. D. T methods and / or by surface conditioning like cleaning / grinding it will be proved that no unacceptable discontinuity is present.

20.0 MARKING OF FLAWS:

Where necessary, flaws shall be indicated by an approved means such as red-wax pencil.

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21.0 POST INSPECTION CLEANING:

Where necessary Post Inspection Cleaning will be performed by employing in any one of the following methods:

(i) The use of compressed air to blow off dry magnetic particles.
(ii) Drying wet particles and subsequent removal by brushing or compressed air.
(iii) Removal of wet particles by flushing with solvent.

22.0 DEMAGNETIZATION:

Demagnetization will be performed where retained magnetization could interfere with subsequent processing or with service requirements, by any one of the following methods:

(i) Withdrawal from alternating current coil.
(ii) Decreasing alternating current.
(iii) Reversing and reducing direct current.

23.0 REPORTING OF RESULTS

The results and parameters used for magnetic particle testing shall be reported in "Report for Magnetic Particle Examination ".

24.0 SAFETY ASPECTS.

It is the responsibility of user to establish appropriate safety and health practices, as applicable, prior to use.

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