

<b>ISPEC-MPICM</b>	<b>Title: Calibration &amp; Maintenance Procedures for MPI Equipment</b>		
	No:	Rev <b>1</b>	Page <b>1</b> of <b>4</b>
Trinity Forge & Machine  Mansfield, Texas	Written by: Jun Peng 12/14/2016		Responsible Department
	Last change by:	Date	Quality Assurance
	Approved by: Tim Ellis	Effective date:	1/6/17
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### 1. Scope:

This procedure details the requirements for the control and maintenance of the equipment and materials employed in the wet fluorescent magnetic particle inspection at Trinity Forge & Machine. The checks and/or verifications required by this document shall be completed at the internals stated and, prior to the final acceptance of products.

Failure of any of the verifications listed herein shall constitute corrective measures on the systems involved. Should the failure result in suspected impact to products, actions deemed necessary up to and including notifications to customer(s) shall be undertaken.

### 2. Applicable Specifications:

- 2.1 Trinity ISPEC-MPIWI Magnetic Particle Inspection Work Instruction
- 2.2 ASTM E1444 & A275 Standard Practice for Magnetic Particle Inspection
- 2.3 AMS 2640 Magnetic Particle Inspection

### 3. Materials:

- 3.1 Magnetic Particles: Magnaglo 14A (Fluorescent Particles) – AMS 2641 (Type 1)
- 3.2 Liquid Carrier: Magnaflux Carrier II – AMS 2644

### 4. Checks Before Each Shift (When in Use): Record in “QC OF THE MAGNETIC PARTICLE INSPECTION SYSTEM”

#### 4.1 Suspension Tests:

4.1.1 Determination of wet particle concentration – Agitate the particle suspension a minimum of 30 minutes to insure a uniform distribution of particles throughout the bath. Place a 100 ml sample of the agitated suspension in a pear-shaped centrifuge tube (of the size and shaped specified in ASTM D96, except graduated to 1 ml in 0.05 ml increments). Demagnetize the sample and allow the tube to stand undisturbed for at least 60 minutes. Read the volume of settled particles. If the concentration is out of the tolerance stated in Table 1, add particles or suspension vehicle, as required to obtain the specified concentration. If the settled particles appear to be loose agglomerates (formation of particle clusters) rather than a solid layer, take a second sample. If the second sample also appears agglomerated, replace the entire suspension.

4.1.1.1 Besides checking before each shift, particle concentration shall be determined upon start up, and whenever the bath is changed or adjusted. Particle concentration must be maintained as stated in Table I.

Table I  
Concentration- ml Solids per 100 ml of Suspension

<u>Magnetic Particles</u>	<u>Required Concentration</u>
Magnetic (Magnaglo 14A)	0.10 ~ 0.40 ml/100mL

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4.1.2 Brilliance – An unused sample of the carrier/particle mixture shall be used as a standard to compare the brilliance of the in-use mixture. Particle brilliance noticeably less than that of the standard is unacceptable. The sample of unused material shall be stored in a manner which will not degrade the fluorescence of the particle.

#### 4.2 System Effectiveness:

4.2.1 A Ketos test ring shall be processed employing the continuous magnetization method at the amperages specified in Table II. The ring is to be tested using circular magnetization on a 1" diameter copper conductor. The ring shall be approximately centered on the conductor. The ring is to be examined within one minute of the current/test solution application cycle. The minimum indications specified in Table II shall be revealed.

Table II  
Ketos Test Ring Requirements

Amperage	Minimum Hole Indications
1400	3
2500	5
3400	6

4.2.2 Records are to indicate the actual numbers of indications observed. Upon completion of the system effectiveness test, the test ring is to be demagnetized and cleaned such that the remnant indications are not present when viewed in UV lighting.

#### 4.3 Lighting:

4.3.1 Black light intensities – The black light intensity at the examination surface shall be 1000  $\mu\text{W}/\text{cm}^2$  or greater when measured with a suitable black light meter. The black light shall produce a minimum intensity of 1000  $\mu\text{W}/\text{cm}^2$  when measured at 380 mm (15 inches) from source.

### 5. Checks Before Each Shift (When in Use): Record in "QC OF THE MAGNETIC PARTICLE INSPECTION SYSTEM"

#### 5.1 Bath Cleanliness:

Take samples from the tank, look it under black lights to check whether there is oil contamination. Also, compare the sample with the new clean flow samples. If oil contamination or dirty is detected, change the whole flow in the tank.

#### 5.2 Lighting:

5.2.1 Ambient white light – The ambient white light in the darkened area for fluorescent magnetic particle inspection shall be a maximum of 2 foot candles (fc) when measured at the approximate test surface location with an approximate white light meter.

5.2.2 Visible light intensity – The visible white light intensity employed for assisting in the interpretation of fluorescent particle indication shall be a minimum of 100 foot candles (fc) when measured at the approximate test surface with an approximate white light meter.

#### 5.3 Yokes:

5.3 Dead weight check – Yokes and permanent magnets (when allowed) shall be dead weight checked before each shift. Alternative current and permanent magnet yokes currently in Trinity possession shall have a lifting force of at least 10 lbs (4.5 kg), with a 2- to 6- inch (50- to 150-mm) spacing between legs.

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**6. Six Months Checks (Conducted by approved calibration service. The calibrations certificate shall be kept in Calibration Log maintained by Quality Assurance).**

6.1 Ammeter accuracy - To check the equipment ammeter, a calibrated ammeter shall be connected in series with the output circuit. Comparative readings shall be taken a minimum of three output levels encompassing the useable range of the equipment. The equipment meter reading shall not deviate by more than +/-10% from the current value shown by the calibrated ammeter.

6.2 Timer control check – The timer used to control current duration is to be verified accuracy by means of comparison with a calibrated timing device. The MT beach timer is to be compared on the average of 10 timed pulses; an accuracy of +/- 01 seconds is required.

6.3 Internal short test – The horizontal MT unit shall be tested for internal electrical shorting in the following manner: a) A non-conductive block will be clamped in the contact heads with the amperage control at maximum setting, pulse the bench and observe the ammeter for deflection. Any ammeter deflection indicates a short; b) Remove the non-conductive block and fully extend the contact heads, repeat the maximum setting pulse and observe the ammeter once again; deflection on the ammeter indicates a short.

6.4 Working Magnetometer (field indicator) – The working field indicator shall be tested by comparison to the Master Field Indicator. The working unit shall be within +/- 0.1 gauss of the master indicator reading.

6.5 Test solution viscosity – The viscosity of the petroleum distillate suspension shall not exceed 3.0 centistokes at the temperature of use when tested in accordance with a procedure meeting ASTM D445 requirements.

6.6 Quick Break Circuitry – The quick break circuit on the horizontal MT unit shall be tested by employing a Magnaflux Quick Break Tester (p/n 148335 or equivalent). Adjust the bench to approximately 2000 amps with the coil circuit activated; place the tester in the coil and pulse 20 times, allowing a 4~5 seconds between the pulses. The tester's neon light will indicate the quick circuit is operating properly.

6.7 Master Ammeter/Shunt – The master ammeter/shunt is to be calibrated across the full range of use by an approved calibration service.

6.8 Light Meters – All white light and black light meters are to be calibrated across the full range of use by an approved calibration service.

6.9 Master Magnetometer – The master magnetometer shall be calibrated by an approved calibration service. This indicator shall be verified across its entire working range. A maximum deviation of +/- 0.1 gauss is acceptable.

6.10 Hall Effect Gauss Meter – This unit shall be calibrated (at minimum) for use in the range of 30 to 60 gauss, the accuracy shall be at +/-2% in the DC mode.

6.11 Master Timer – The master shall be verified accurate to be within +/- 0.1 seconds by an approved calibration service.

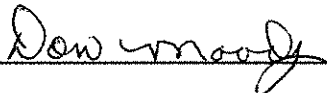
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**7. General Information:**

8.1 Any calibration/verification which fails to meet the specified criteria shall constitute corrective actions and the recording of a valid calibration/verification prior to the final acceptance of any product, per the terms of TOP-RCHCK.

8.2 The purchase requests for calibration service outside Trinity Forge & Machine shall state the usable range of the gage/meter and an allowable tolerance. Vendor certificates shall state compliance to their documents & applicable regulatory documents.

8.3 Light meters, magnetic field indicators, ammeters, ammeter shunts, and timers shall be calibrated and maintained in compliance with the requirements of ANSI Z540-1.

Level III NDT Approval: 

Date: 1-9-17

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