# Procedure for Magnetic Particle Testing

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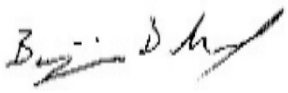
| **Originator** |  | Benjamin Boudreaux, ASNT NDT Level III, certification no. 148993 UT, MT,VT, PT | **Date** | Aug. 08, 2016 |
| **Approval** |  | Corey Navarro, President | **Date** | Aug. 08, 2016 |

## Revision History

| Revision level | Description of Revisions | Date |
| --- | --- | --- |
| Original | Procedure for Magnetic Particle Testing was created | 8-08-2016 |
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**1. Scope**

1.1 This procedure establishes the steps and details to be followed for the examination of ferromagnetic material, both structural and non-structural welds, drilling or production equipment, raw, semi-finished, and machined surfaces. Continuous (active), true-continuous and residual techniques with the wet visible, wet fluorescent and dry particle applications are discussed in this procedure for the detection of surface breaking or near surface discontinuities in ferromagnetic materials.

**2. Referenced Documents**

2.1 ASTM E1444 – Standard Practice for Magnetic Particle Testing, latest edition

2.4 ASTM E709 – Standard Guide for Magnetic Particle Testing, latest edition

2.5 ASME Section V, Article 7 – Standard for Magnetic Particle Testing, latest edition

2.6 ASNT SNT-TC-1A – R.P. for the Qualification and Certification of NDT Personnel, latest edition

2.7 AWS D1.1 – Structural Welding Code – Steel, latest edition

**3. Personnel Qualification**

3.1 Personnel performing inspections to this procedure shall be qualified and certified in accordance with ASNT SNT-TC-1A latest edition and the Company's personnel qualification procedure, QMS-P-005, latest edition.

3.2 Only those personnel certified Level II or higher in the method being employed are allowed to perform inspections in accordance with this procedure.

**4. Definitions**

4.1 True-continuous technique - is the technique whereby the particle medium is applied just as the electrical magnetizing current is turned on; the particle application is then diverted with the electrical current remaining on and the actual inspection performed also with the current remaining on

4.2 Indirect magnetization - is the technique in which the magnetizing electrical current flows through an electrical conductor; the test specimen does not become part of the electrical circuit

4.3 Continuous technique - is the technique whereby the particle medium is applied just as the electrical magnetizing current is turned on; the particle application is then diverted with the electrical current remaining on for not less than 3 seconds or with the addition of at least two shots; inspection may then be performed with the electrical magnetizing current turned off

4.4 Residual technique - is the technique whereby the electrical magnetizing current is turned on and a residual field is then induced in the test specimen; the current is then de-energized and the particle medium is then applied, then diverted and the inspection performed; inspection is then performed with the electrical magnetizing current turned off

**5. Technique**

5.1 This procedure recognizes the following techniques:

- **Technique 1** - Yoke, AC, True-Continuous, Visible Wet, Visible Dry Inspection

- **Technique 2** - Yoke, AC, True-Continuous, Wet Fluorescent Inspection

- **Technique 3** - Coil/ Cable Wrap, AC, DC, FWDC or HWDC, True-Continuous or Continuous or Residual, Wet Fluorescent or Visible Dry Inspection

- **Technique 4** - Central Conductor, AC, DC, FWDC or HWDC, True-Continuous or Continuous or Residual, Wet Fluorescent or Visible Dry Inspection

5.2 Residual techniques are typically, not as sensitive as continuous and true-continuous techniques.

**6. Inspection Equipment**

6.1 The following equipment will be required as applicable regardless of the technique used.

6.1.1 Cleaning equipment: Appropriate cleaning agents may include degreasers, detergents, soap and water, brushes, buffers, scrapers or paint stripper

6.1.2 Mirrors, as applicable

6.1.3 Field Indicator: Type G Castrol strip or Pie gauge as described in ASTM E709 and E1444

6.1.4 White light meter

6.1.5 Fluorescent light meter

6.1.6 Centrifuge (100mL)

6.1.7 White light source

6.1.8 Fluorescent UV-A light source (Black light)

6.2 The following equipment depends on the technique used.

Technique 1 and 2 – AC Yoke
– 10 # test block for the AC yoke
– Black visible wet particle, Yellow, Red, Gray, Blue visible dry particle or Fluorescent wet particle
– White highlighter for use with the visible wet and dry applications when necessary

Technique 3 – AC, DC, FWDC or HWDC Coil or Cable Wrap (Copper Cable)
– Pocket gauss meter
– Yellow, Red, Gray, Blue visible dry particle or Fluorescent wet particle

– Main Magnetizing Unit: Portable or fixed bench units with adequate power supply. All current (amperage) meters shall exhibit a re-calibration sticker. OR
– Capacitor Discharge Unit (Residual or Continuous field inspection): Capacitor discharge (CD) units shall be classed and used as in API RP 5A5, if applicable. A 10,000 A (peak), "short duration" capacitor discharge may be used

Technique 4 – Copper cable or copper or aluminum rod
– Pocket gauss meter
– Yellow, Red, Gray, Blue visible dry particle or Fluorescent wet particle
– Main Magnetizing Unit: Portable or fixed bench units with adequate power supply. All current (amperage) meters shall exhibit a re-calibration sticker. OR
– Capacitor Discharge Unit (Residual or Continuous field inspection): Capacitor discharge (CD) units shall be classed and used as in API RP 5A5, if applicable. A 10,000 A (peak), "short duration" capacitor discharge may be used

## 7. Preparation

### 7.1 Lighting Requirements

7.1.1 Minimum White Light Level

When conducting visible magnetic particle inspection the minimum ambient white (daylight, or indoor facility) light intensity at the inspection surface shall be 100 foot candles (1076 lux), or customer-stated requirements if higher.

7.1.2 Minimum Black Light Level

When conducting fluorescent magnetic particle inspection the UVA (Black light) bulbs must be mercury vapor 100 W minimum bulbs with minimum intensity at a distance of 15" of 1000 microwatts/ $cm^2$. Allow sufficient time (e.g. 10 minutes) for bulbs to warm up to provide full intensity. The black light shall operate only in the UV-A part of the light spectrum.

7.1.2.1 Lenses: Photosensitive eye glasses/lenses shall not be worn by the inspector performing UV-A light inspections.

7.1.3 Darkened Examination Area

When conducting fluorescent magnetic particle inspection a black light tent, or a cape should be used to provide a darkened area. Black light tents are preferred. The white light intensity in the viewing area shall not be more than 2 foot candles (21.5 lux). Five minutes must be allowed for eye adaptation to the darkened area.

### 7.2 Cleaning Requirements

7.2.1 All surfaces or welds to be inspected plus 1" of adjacent material shall be cleaned such that grease, oil, scale, dirt, paint, slag, weld spatter or any other foreign matter deemed by the Level II as obstructing the inspection is removed.

7.2.2 Upon completion of the cleaning operations the areas to be inspected must be completely dry prior to the start of the inspection.

**7.3 Particle Requirements**

7.3.1 Wet Fluorescent Particle

7.3.1.1 Suspension fluid shall be a solvent with low sulfur content; Safety clean, Varsol or water. Other comparable solutions may be used. (Gasoline or diesel shall not be used.) Surface tension reducers shall be added to water solutions. Premixed aerosol spray may be used.

7.3.1.2 Particle Concentration: Wet fluorescent particle strength shall range from a minimum of 0.1 to 0.4 ml/100 ml of solution, measured utilizing a centrifuge tube for 60 minutes (30 minutes with water). Particle concentration shall be checked prior to the commencement of a job, and at least every 8 hours thereafter.

7.3.2 Wet Visible Particle

7.3.2.1 Suspension fluid shall be a solvent with low sulfur content; Safety clean, Varsol or water. Other comparable solutions may be used. (Gasoline or diesel shall not be used.) Surface tension reducers shall be added to water solutions. Premixed aerosol spray may be used.

7.3.2.2 Particle Concentration: Wet visible particle strength shall range from a minimum of 1.2 to 2.4 ml/100 ml of solution, measured utilizing a centrifuge tube for 60 minutes (30 minutes with water). Particle concentration shall be checked prior to the commencement of a job, and at least every 8 hours thereafter.

7.3.2.3 Contrast: Particles shall have a high contrast with the inspected surface. Nonmagnetic surface contrast paint may be applied to uncoated surfaces to enhance particle contrast. The contrast coating shall be very light with just enough to contrast with the particles. In any case the coating shall not exceed 0.002” (2 mils).

7.3.3 Visible Dry Particle

7.3.3.1 Contrast: Dry particles shall have a high contrast with the inspected surface. Nonmagnetic surface contrast paint may be applied to uncoated surfaces to enhance particle contrast. The contrast coating shall be very light with just enough to contrast with the particles. In any case the coating shall not exceed 0.002” (2 mils).

7.3.3.2 Particle Sizes: Dry particles shall meet the requirements of API RP 5A5 and ASME.

**7.4 Equipment Calibration Requirements**

7.4.1 The following equipment shall be calibrated or have the calibration verification performed not less than every 6 months or anytime there is question as to the accuracy of the equipment.

7.4.1.1 AC Yoke

7.4.1.2 Fixed Coil (Shall have the number of turns marked on the coil)

7.4.1.3 White light meter

7.4.1.4 Fluorescent light meter

7.4.1.5 Pocket gauss meter

7.4.1.6 Main magnetizing unit

7.4.1.7 Capacitor discharge unit

7.4.2 Calibrated equipment must be serialized and evidence of calibration or calibration verification must be maintained.

7.4.3 Concerning the 10lb. test block; these blocks must be serialized and have evidence that the weight was verified on a calibrated scale not less than every 3 years. No major deformity in the block shall be tolerated.

7.4.4 Yokes shall be verified as being able to lift the 10lb. block.

7.4.4.1 The AC Yoke must be able to lift the 10lb. block at the maximum leg spacing to be used.

7.4.4.2 Regardless of the inspection technique the yoke shall never be used with a leg spacing of less than 2".

7.4.4.3 AC yokes are typically used to examine weld preparation areas, welds in pressure retaining or structural materials using dry, fluorescent and wet visible particles. Yokes may also be used to examine larger parts such as forgings or castings prior to final machining, including weld repairs. Field strength of the magnetic yoke shall be verified.

**7.5 Inspection system verification requirements**

7.5.1 Regardless of the technique used, the employment of either the Castrol Strip or Pie-gauge shall always be used to verify system performance, sensitivity and field direction.

7.5.2 The strip shall be held on the part at least once per ten similar areas inspected. In use, a magnetic particle indication shall be visible on all 3 slots in the strip.

**7.6 General Inspection Requirements**

7.6.1 Dry particle inspections cannot be performed in windy conditions. Surfaces shall be cleaned and dry at the start of any inspection so performing any of these techniques in the rain is prohibited.

7.6.2 If the part or material to be inspected is found to have a residual field that will interfere with the examination the part must be either demagnetized to the degree that it will not interfere with the inspection process or enforced with the magnetizing equipment.

**7.7 Length to Diameter Ratio Requirements**

7.7.1 For parts with an L/D ratio equal to or greater than 4”

$NI = 35000 / (L/D) + 2)$

7.7.2 For parts with an L/D ratio less than 4, but greater than 2”

$NI = 45000 / (L/D)$

Where: N is the number of effective coil turns
*I* is the current in Amperes (A)
L/D is the ratio of the length to diameter of the component of circular section

7.7.3 Concerning coils; a coil with the rated capability to induce a longitudinal magnetic field of at least 1,200 A/T per inch of connection OD is required however; consideration for effective diameters must be considered as described in the applicable ASTM standards.

**7.8 Temperature Requirements**

7.8.1 Solution/Part Temperature Limits: The temperature of the solution shall not exceed 110°F (43°C). The surface under examination shall not exceed 135°F (57°C). The temperatures of the solution and part surface shall be within ±25°F (±14°C) of each other.

**7.9 Polarity Check for Coil Utilization**

7.9.1 Technician shall determine polarity of the existing magnetic field, if any, in each end of the part to be tested utilizing a pocket gauss meter. Each end of the part shall be marked as positive “+” or negative “-“, as applicable.

7.9.2 The coil shall be placed on the part so as to reinforce the field and not oppose it.

**8. Procedure**

Regardless of the technique employed, 1” of the adjacent material shall be inspected. In the case of weld inspection 1” of the parent material measured from either toe of the weld shall be inspected.

**8.1 Technique 1 - Yoke, AC, True-Continuous, Visible Wet, Visible Dry Inspection**

**8.1.1 Visible Wet Inspection:** A longitudinal magnetic field will be induced by way of the AC yoke. Lighting requirements should be met prior to the start of the inspection.

8.1.1.1 A white, flat, contrasting background may be applied using a very thin layer of contrast aerosol highlighter.

8.1.1.2 Wet magnetic particles shall be applied over the areas to be inspected just as the application of the magnetizing field is induced. Particle application shall then be diverted with the current remaining on so as to allow the inspection to take place with the current remaining

on.

8.1.1.3 For inspection of weld areas, the yoke shall be positioned approximately 45° to the weld axis with the weld centered between the yoke pole pieces. The second magnetization shall be conducted with the induced magnetic field oriented approximately 90° to the first. Inspection shall progress along the weld with each new movement indexed to the last position of the yoke poles. This progression shall be such that each new area of inspection overlaps the previous area of inspection to ensure 100% coverage at the required sensitivity.

8.1.1.4 Inspection of large surfaces may be accomplished in any random pattern desired provided that the first and second inspections are oriented at 90° to each other and the full area of inspection is covered with overlapping patterns of inspection.

**8.1.2 Visible Dry Inspection:** A longitudinal magnetic field will be induced by way of the AC yoke. Lighting requirements should be met prior to the start of the inspection.

8.1.2.1 A white, flat, contrasting background may be applied using a very thin layer of contrast aerosol highlighter.

8.1.2.2 Dry magnetic particles shall be applied by lightly dusting the areas to be inspected during the application of the magnetizing field. Particle application shall then be diverted with the current remaining on so as to allow the inspection to take place with the current remaining on.

8.1.2.3 For inspection of weld areas as well as large surfaces the requirements listed in sections 8.1.1.3 and 8.1.1.4 will apply.

**8.2 Technique 2 - Yoke, AC, True-Continuous, Wet Fluorescent Inspection**

**8.2.1 Wet Fluorescent Inspection:** A longitudinal magnetic field will be induced by way of the AC yoke along with the employment of the black light. Lighting requirements should be met prior to the start of the inspection.

8.2.1.1 Wet fluorescent magnetic particles shall be applied either by spraying or flowing over the areas to be inspected just as the magnetizing field is induced. The black light will be used in a darkened area during the entire time of the inspection process. Particle application shall then be diverted with the current remaining on so as to allow the inspection to take place with the current remaining on.

8.2.1.2 For inspection of weld areas as well as large surfaces the requirements listed in sections 8.1.1.3 and 8.1.1.4 will apply along with the required use of the black light and darkened area.

**8.3 Technique 3 – Coil/ Cable Wrap/ AC, DC, HWDC, FWDC/ True-Continuous, Continuous, Residual/ Wet Fluorescent, Visible Dry Inspection**

8.3.1 **Technique 3A Coil or Cable Wrap/ True-Continuous/ Wet Fluorescent Inspection**: A longitudinal magnetic field will be induced by way of the coil or cable wrap. The black light shall be employed

during this inspection process. Lighting requirements shall be met prior to the start of the inspection. Determine if a residual field exists in the parts to be inspected. If so determine the polarity of the existing magnetic field, if any, in each end of the test piece using the Pocket Gauss Meter. The coil shall be placed so as to enforce the existing field.

8.3.1.1 Parts longer than the diameter of the coil shall be examined in sections. The inspection area shall be limited to half of the coil diameter up to 9" on each side of the coil.

8.3.1.2 When using Cable Wraps; three wraps will usually be sufficient for inspection.

8.3.1.3 Wet fluorescent magnetic particles shall be applied either by spraying or flowing over the areas to be inspected just as the magnetizing field is induced. The particle application will then be diverted with the current remaining on and the inspection performed with the current remaining on.

8.3.1.4 A Castrol strip or Pie gauge will be used to confirm that the coil or cable wrap has been able to produce the indications required.

8.3.1.5 The black light will be used in a darkened area during the entire time of the inspection process. When inspecting threads the last engaged thread of roots of pins and boxes should receive particular attention. A mirror shall be used to inspect thread roots and surfaces in the box connections as well as the Pin IDs. Unless the pipe is vertical, each length shall be rolled to allow 360° examination and to allow areas under solution “puddles” to be inspected.

8.3.1.6 For inspection of Slip/ Upset areas, on drill pipe and the like, DC coils must be able to produce transverse, and three-dimensional flaws. The inspected area includes the first 36” from the pin tool joint shoulder and the first 48” from the box shoulder. If slip cuts are found beyond the first 48” then 6” on either side of the slip cuts shall be inspected. If this method is applied to HWDP, the area also includes the first 36” of tube on either side of the center upset. This area should be considered as minimum.

8.3.1.7 When inspecting smaller parts, in relation to the size of the coil diameter, parts may be turned inside the coil to achieve bi-directional inspection requirements, however, care shall be taken and the Castrol strip and/ or Pie-gauge check shall be performed in both directions.

8.3.2 **Technique 3B Coil or Cable Wrap/ Continuous/ Wet Fluorescent Inspection**: A longitudinal magnetic field will be induced by way of the coil or cable wrap. The black light shall be employed during this inspection process. Lighting requirements shall be met prior to the start of the inspection. Determine if a residual field exists in the parts to be inspected. If so determine the polarity of the existing magnetic field, if any, in each end of the test piece using the Pocket Gauss Meter. The coil shall be placed so as to enforce the existing field.

8.3.2.1 Parts longer than the diameter of the coil shall be examined in sections. The inspection area shall be limited to half of the coil diameter up to 9" on each side of the coil.

8.3.2.2 When using Cable Wraps; three wraps will usually be sufficient for inspection.

8.3.2.3 Wet fluorescent magnetic particles shall be applied either by spraying or flowing over the areas to be inspected just as the magnetizing field is induced. The particle application will then be diverted with the current remaining on for at least 3 seconds or with the administration of two more shots.

8.3.2.4 A Castrol strip or Pie gauge will be used to confirm that the coil or cable wrap has been able to produce the indications required. The current will be de-energized. The strip or gauge will then be monitored to ensure that the residual field is strong enough to hold the particles in place in order for the inspection process to occur.

8.3.2.5 The inspection shall then be performed. The black light will be used in a darkened area during the entire time of the inspection process. When inspecting threads the last engaged thread of roots of pins and boxes should receive particular attention. A mirror shall be used to inspect thread roots and surfaces in the box connections as well as the Pin IDs. Unless the pipe is vertical, each length shall be rolled to allow 360° examination and to allow areas under solution “puddles” to be inspected.

8.3.2.6 The Pocket Gauss meter and Castrol strip or Pie-gauge shall be used to ensure a residual field was induced in the part to be inspected and is strong enough to hold the indications.

8.3.2.7 For inspection of Slip/ Upset areas, on drill pipe and the like, DC coils must be able to produce transverse and three-dimensional flaws. The inspected area includes the first 36” from the pin tool joint shoulder and the first 48” from the box shoulder. If slip cuts are found beyond the first 48” then 6” on either side of the slip cuts shall be inspected. If this method is applied to HWDP, the area also includes the first 36” of tube on either side of the center upset. This area should be considered as minimum.

8.3.2.8 When inspecting smaller parts, in relation to the size of the coil diameter, parts may be turned inside the coil to achieve bi-directional inspection requirements, however, care shall be taken and the Castrol strip and/ or Pie-gauge check shall be performed in both directions.

8.3.3 **Technique 3C Coil or Cable Wrap/ Residual/ Wet Fluorescent Inspection**: A longitudinal magnetic field will be induced by way of the coil or cable wrap. The black light shall be employed during this inspection process. Lighting requirements shall be met prior to the start of the inspection. Determine if a residual field exists in the parts to be inspected. If so determine the polarity of the existing magnetic field, if any, in each end of the test piece using the Pocket Gauss Meter. The coil shall be placed so as to enforce the existing field.

8.3.3.1 When using Cable Wraps; three wraps will usually be sufficient for inspection.

8.3.3.2 The coil shall be energized and allowed time to induce a residual field in the part to be inspected. After the coil is de-energized wet fluorescent magnetic particles shall be applied either by spraying or flowing over the areas to be inspected.

8.3.3.3 With the current de-energized a Castrol strip or Pie gauge will be used to confirm that the coil or cable wrap has been able to produce the indications required. The Pocket Gauss meter, strip and/ or gauge will then be monitored to ensure that the residual field is strong enough to form and hold the particles in place in order for the inspection process to occur.

8.3.3.4 The inspection shall then be performed. The black light will be used in a darkened area during the entire time of the inspection process.

8.3.3.5 For inspection of Slip/ Upset areas, on drill pipe and the like, DC coils must be able to produce transverse and three-dimensional flaws. The inspected area includes the first 36” from the pin tool joint shoulder and the first 48” from the box shoulder. If slip cuts are found beyond the first 48” then 6” on either side of the slip cuts shall be inspected. If this method is applied to HWDP, the area also includes the first 36” of tube on either side of the center upset. This area should be considered as minimum.

8.3.3.6 When inspecting smaller parts, in relation to the size of the coil diameter, parts may be turned inside the coil to achieve bi-directional inspection requirements, however, care shall be taken and the Castrol strip and/ or Pie-gauge check shall be performed in both directions.

8.3.4 **Technique 3D Coil or Cable Wrap/ True-Continuous/ Visible Dry Inspection**: A longitudinal magnetic field will be induced by way of the coil or cable wrap. Lighting requirements should be met prior to the start of the inspection. Determine the polarity of the existing magnetic field, if any, in each end of the test piece using the Pocket Gauss Meter. The coil should be placed so as to enforce the existing field.

8.3.4.1 The number of turns shall be marked on the coil. Parts longer than the diameter of the coil shall be examined in sections. The inspection area shall be limited to half of the coil diameter up to 9" on each side of the coil.

8.3.4.2 When using Cable Wraps; three wraps will usually be sufficient for inspection.

8.3.4.3 Visible dry magnetic particles shall be applied by lightly dusting the areas to be inspected during the application of the magnetizing field. The particle application will then be diverted with the current remaining on.

8.3.4.4 With the current on a Castrol strip or Pie gauge will be used to confirm that the coil or cable wrap has been able to produce the indications required.

8.3.4.5 The inspection shall then be performed.

8.3.5 **Technique 3E Coil or Cable Wrap/ Continuous/ Visible Dry Inspection**: A longitudinal magnetic field will be induced by way of the coil or cable wrap. Lighting requirements shall be met prior to the start of the inspection. Determine the polarity of the existing magnetic field, if any, in each end of the test piece using the Pocket Gauss Meter. The coil shall be placed so as to enforce the existing field.

8.3.5.1 The number of turns shall be marked on the coil. Parts longer than the diameter of the coil shall be examined in sections. The inspection area shall be limited to half of the coil diameter up to 9" on each side of the coil.

8.3.5.2 When using Cable Wraps; three wraps will usually be sufficient for inspection.

8.3.5.3 Visible dry magnetic particles shall be applied by lightly dusting the areas to be inspected during the application of the magnetizing field. The particle application will then be diverted with the current remaining on for at least 3 seconds or with the administration of two more shots.

8.3.5.4 A Castrol strip or Pie gauge will be used to confirm that the coil or cable wrap has been able to produce the indications required. The current will be de-energized. The strip or gauge will then be monitored to ensure that the residual field is strong enough to hold the particles in place in order for the inspection process to occur.

8.3.5.5 The inspection shall then be performed.

8.3.6 **Technique 3F Coil or Cable Wrap/ Residual/ Visible Dry Inspection**: A longitudinal magnetic field will be induced by way of the coil or cable wrap. Lighting requirements shall be met prior to the start of the inspection. Determine the polarity of the existing magnetic field, if any, in each end of the test piece using the Pocket Gauss Meter. The coil shall be placed so as to enforce the existing field.

8.3.6.1 The number of turns shall be marked on the coil.

8.3.6.2 When using Cable Wraps; three wraps will usually be sufficient for inspection.

8.3.6.3 A residual field shall be induced in the part to be inspected. Visible dry magnetic particles shall be applied by lightly dusting the areas to be inspected after the magnetizing current has been de-energized.

8.3.6.4 A Pocket Gauss meter, Castrol strip and/ or Pie gauge will be used to confirm that the coil or cable wrap has been able to produce a residual field strong enough to produce the indications required.

8.3.6.5 Inspection shall be performed.

8.4 **Technique 4 - Central Conductor/ True-Continuous, Continuous, Residual/ Wet Fluorescent, Visible Dry Inspection**

8.4.1 **Technique 4A Central Conductor/ True-Continuous/ Wet Fluorescent Inspection**: A circular magnetic field will be induced by way of the central conductor. A black light shall be used for this inspection process. Lighting requirements shall be met prior to the start of the inspection.

8.4.1.1 The central conductor shall be run through whatever item is to be inspected. The ends shall then be hooked up to the main magnetizing unit.

8.4.1.2 Care shall be taken to ensure all electrical connections are tight and that no arcing onto the test specimen will occur. 300 to 800 amps/inch of part diameter is the recommended amperage range.

8.4.1.3 The test specimen shall then be sprayed or flowed over with the particle just as the electrical magnetizing current is energized. The particle flow shall then be diverted with the electrical magnetizing current remaining on.

8.4.1.4 The Castrol Strip must be employed to verify adequate field strength and direction.

8.4.1.4.1 The Castrol Strip shall be placed at the furthest possible area away from the Central Conductor in which the inspection will occur. No inspection is allowed to occur beyond this point.

8.4.1.4.2 If this area does not encompass the entire part to be inspected the part must be re-positioned after inspection so that the Central Conductor can again be employed closer to the areas remaining in need of inspection. The employment of the Castrol Strip will be repeated as described in the previous section.

8.4.1.4.3 Inspection shall be performed.

8.4.2 **Technique 4B Central Conductor/ Continuous/ Wet Fluorescent Inspection**: A circular magnetic field will be induced by way of the central conductor. A black light shall be used for this inspection process. Lighting requirements shall be met prior to the start of the inspection.

8.4.2.1 The central conductor shall be run through whatever item is to be inspected. The ends shall then be hooked up to the main magnetizing unit.

8.4.2.2 Care shall be taken to ensure all electrical connections are tight and that no arcing onto the test specimen will occur. 300 to 800 amps/inch of part diameter is the recommended amperage range.

8.4.2.3 The test specimen shall then be sprayed or flowed over with the particle just as the electrical magnetizing current is energized. The particle flow shall then be diverted with the electrical magnetizing current remaining on for not less than 3 seconds.

8.4.2.4 The Castrol Strip must be employed to verify adequate field strength and direction.

8.4.2.4.1 The Castrol Strip shall be placed at the furthest possible area away from the Central Conductor in which the inspection will occur. No inspection is allowed to occur beyond this point.

8.4.2.4.2 If this area does not encompass the entire part to be inspected the part must be re-positioned after inspection so that the Central Conductor can again be employed closer to the areas remaining in need of inspection. The employment of the Castrol Strip will be repeated as described in the previous section.

8.4.2.4.3 Inspection shall be performed.

8.4.3 **Technique 4C Central Conductor/ Residual/ Wet Fluorescent Inspection**: A circular magnetic field will be induced by way of the central conductor. A black light shall be used for this inspection process. Lighting requirements shall be met prior to the start of the inspection.

8.4.3.1 The central conductor shall be run through whatever item is to be inspected. The ends shall then be hooked up to the main magnetizing unit or CD box.

8.4.3.2 Care shall be taken to ensure all electrical connections are tight and that no arcing onto the test specimen will occur. 300 to 800 amps/inch of part diameter is the recommended amperage range.

8.4.3.3 The central conductor shall be energized so as to induce a residual field in the part to be inspected. The current shall then be turned off. The particle shall then be sprayed or flowed over the part to be inspected. If using a CD Box allow enough shots, typically two, so as to induce an adequate residual field.

8.4.3.4 The Castrol Strip must be employed to verify adequate field strength and direction.

8.4.3.4.1 The Castrol Strip shall be placed at the furthest possible area away from the Central Conductor in which the inspection will occur. No inspection is allowed to occur beyond this point.

8.4.3.4.2 If this area does not encompass the entire part to be inspected the part must be re-positioned after inspection so that the Central Conductor can again be employed closer to the areas remaining in need of inspection. The employment of the Castrol Strip will be repeated as described in the previous section.

8.4.3.4.3 Inspection shall be performed.

8.4.4 **Technique 4D Central Conductor/ True-Continuous/ Visible Dry Inspection**: A circular magnetic field will be induced by way of the central conductor. Lighting requirements shall be met prior to the start of the inspection.

8.4.4.1 The central conductor shall be set up the same as listed in sections 8.4.1.1 and 8.4.1.2.

8.4.4.2 The test specimen shall then be lightly dusted with the dry particle just as the electrical magnetizing current is energized. Particle application shall be diverted with the electrical magnetizing current remaining on.

8.4.4.3 The Castrol Strip must be employed to verify adequate field strength and direction.

8.4.4.4 The steps listed in section 8.4.1.4.1 & 8.4.1.4.2 shall then be performed.

8.4.4.5 Inspection will then be performed.

8.4.5 **Technique 4E Central Conductor/ Continuous/ Visible Dry Inspection**: A circular magnetic field will be induced by way of the central conductor. Lighting requirements shall be met prior to the start of the inspection.

8.4.5.1 The central conductor shall be set up the same as listed in sections 8.4.1.1 and 8.4.1.2.

8.4.5.2 The test specimen shall then be lightly dusted with the dry particle just as the electrical magnetizing current is energized. Particle application shall be diverted with the electrical magnetizing current remaining on for not less than 3 seconds.

8.4.5.3 The Castrol Strip must be employed to verify adequate field strength and direction.

8.4.5.4 The steps listed in section 8.4.1.4.1 & 8.4.1.4.2 shall then be performed.

8.4.5.5 Inspection will then be performed.

8.4.6 **Technique 4F Central Conductor/ Residual/ Visible Dry Inspection**: A circular magnetic field will be induced by way of the central conductor. Lighting requirements shall be met prior to the start of the inspection.

8.4.6.1 The central conductor shall be set up the same as listed in sections 8.4.1.1 and 8.4.1.2.

8.4.6.2 The central conductor shall be energized and allowed to induce a residual field. The current will then be turned off and the test specimen shall be lightly dusted with the dry particle. Particle application shall be diverted. If using a CD Box allow enough shots, typically two, so as to induce an adequate residual field.

8.4.6.3 The Castrol Strip must be employed to verify adequate field strength and direction.

8.4.6.4 The steps listed in section 8.4.1.4.1 & 8.4.1.4.2 shall then be performed.

8.4.6.5 Inspection will then be performed.

**8.5 Bi-directional Inspection**

8.5.1 All areas to be inspected must be magnetized in two (2) directions approximately 90° apart unless otherwise specified by the client in writing. Bi-directional inspection can be achieved by using two separate longitudinal fields in perpendicular directions to one another.

**8.6 Demagnetization Check**

8.6.1 The Pocket Gauss Meter shall be used to ensure that the test specimen has been demagnetized when required by the client to do so. Because of the nature of circular magnetization parts should be left with a longitudinal field in order to determine sufficiency of demagnetization operations.

8.6.2 When demagnetization is performed test specimens shall not be left with more than (+/-) 3 gauss unless otherwise specified by the client.

**9. Post Cleaning**

9.1 Unless otherwise specified, parts will be cleaned after the inspection to remove remaining particle solution.

**10. Evaluation and Acceptance Criteria**

10.1 All discontinuities found shall be evaluated in accordance with the applicable code or specification as dictated by the client. Minimum evaluation will be as follows.

10.1.1 Indications shall be determined to be relevant or non-relevant.

10.1.1.1 Relevant indications shall be defined as an indication due to a leakage field which is caused by an actual discontinuity in the test specimen with a dimension greater than 1/16", unless otherwise stated by the applicable code.

10.1.1.2 Non-relevant indications shall be defined as indications due to a leakage field which may or may not be caused by an actual discontinuity which is (≤) 1/16", unless otherwise stated by the applicable code. Non-relevant indications may also be defined as false indications caused by part geometry or some other anomaly other than a leakage field.

10.1.2 Once relevance is determined indications shall then be defined in terms of type, either linear or round.

10.1.2.1 Linear indication is defined as an indication having one dimension at least three times greater than another.

10.1.2.2 Round indication is defined as an indication having a dimension less than three times greater than another.

10.2 The client is ultimately responsible for dictating the applicable reject criteria. The following is a list of possible applicable codes that this procedure may be applied to.

10.2.1 API 6A – PSL Level 2, 3, 4

10.2.2 AWS D1.1 Clause 6

10.2.3 API 1104

10.2.4 API 16A

10.2.5 ASME Section 8

10.2.6 TH Hill DS-1 Volume 3 and/ or 4

10.3 Unless otherwise specified non-relevant indications shall be checked for relevance by employing the PT method or by redressing the area in question and re-inspecting using the same method and technique.

**11. Reporting**

11.1 All rejected findings shall be reported to the client or client representative immediately.

11.2 Frontline Testing and Inspection personnel will produce a report at the end of each job with the following minimum information.

11.2.1 Name of inspector (printed and signed)

11.2.2 Inspector's certification level, method and type (ASNT, EN-473 as applicable)

11.2.3 Date of inspection

11.2.4 Location of inspection

11.2.5 Description of test specimens

11.2.6 Results of inspection (acceptable or rejected) including indication types and location

11.2.7 Inspection procedure number including revision level

11.2.8 Acceptance criteria including revision level

11.2.9 Test equipment serial number and calibration due date (as applicable)

11.2.10 Inspection technique and variables (light intensity, particle concentration, amperage)

11.2.11 Report number

11.2.12 Traceability of test specimens (part number, revision level, serial number, weld number as applicable)

11.2.13 Welder symbol if applicable

11.2.14 Particle type

11.2.15 Client representative name and date (if applicable)

11.2.16 Customer name

11.2.17 Customer project name, if applicable

11.2.18 Customer PO or job number, if applicable

11.2.19 Drawing number and revision, if applicable