Quality Assurance
Procedure QAP 5930

Method of Test For

Magnetic Particle Inspection Procedure; Continuous Yolk, Dry, Visible Particles

1. SCOPE

1.1 This written procedure conforms to SNTC- TC-1A - 4.3, ASTM E709, and AASHTO/AWS D1.5M/D1.5:2015. Additional specific requirements are detailed, which, while maintaining conformance to the above referenced specifications, further control variables of the procedure to assure high sensitivity, accurate and meaningful evaluations. Examination of discontinuities applicable to in-process and final quality of welds and base metals shall be performed as necessary, using magnetic particle testing.

1.2 Surface examinations of ferromagnetic base metals and welds shall be performed by the magnetic particle method where test specimen geometry allows evaluation. This method shall be applied to detect discontinuities that are open to the surface (subsurface discontinuities can not be reliably detected, e.g. cracks greater than 1/64 inch from the surface). Significant subsurface slag inclusions may interrupt the flux lines producing an indication.

The prod method is virtually never used, as arc strikes can be induced by the prods. Also, the equipment is portably cumbersome. Alternate Current (A.C.) yolks are preferred. Indications shall require excavation or suitable nondestructive methods for subsurface evaluation (UT, RT).

1.3 Examination of the following quenched and tempered steels shall not be performed earlier than 48 hours after the completion of welding: ASTM A514, ASTM A517, ASTM A852 gr 70,100.

1.4 Magnetic particle examination shall not be performed when the surface temperature of the part exceeds 600 degrees C (Curie temperature).

2. PERSONNEL

2.1 Personnel performing magnetic particle testing shall meet the criteria set forth in the AASHTO/AWS D1.5M/D1.5 current edition.

3. REFERENCE

3.1 ASSHTO/AWS D1.5M/D1.5 current edition

3.2 ASTM E 709,Vol. 03.03

4. APPARATUS

4.1 Electromagnetic AC/HW Yokes (Parker Contour Probe).

4.2 40 pound (18.18 kg.) test plate.

4.3 110 volt AC power source for electromagnetic yolks.

4.4 Hand operated bellows and powder bulb.

4.5 Solvent cleaners.

4.5.1 Isopropyl alcohol.

4.6 Examination Medium:

4.6.1 Dry magnetic particles of high permeability and low retentivity shall be used, and shall be of such size and shape as to either: (1) clearly develop the test pattern in the Magnetic Field Indicator,or (2) clearly resolve cracks in the Colorado MT-1 Standard.

4.6.2 Magnaflux No. 8A red.

4.7 Clean cloth rags.

4.8 Wire brushes or composite grinding wheels.

4.9 Compressed air.

4.10 Ammeter.

4.11 Lighting, White and black.

5. **PROCEDURE**

5.1 The test area shall be clean, dry, and free from contaminants (oil, grease, loose rust, loose scale, lint, thick paint, sand, flux and spatter). This shall be accomplished by brushing, grinding or solvent wiping as necessary. Remaining oily or greasy films may be removed by dusting the surface with talc and wiping with a dry lint-free cloth. If tests must be made through paint, the contact areas preferably should have the paint removed, otherwise, test sensitivity shall be established on the MT-2 Standard. Paint thickness on the test surface shall not exceed 2 mil DFT.

5.2 At least two separate examinations shall be performed on each area. During the second examination, the flux lines shall be approximately perpendicular to the first examination.

5.3 All examinations shall overlap to assure 100% coverage at the required sensitivity.

5.4 The intensity of light on the test area shall be 32.5 foot-candles minimum. Illumination from a standard 3 volt (2 D cells) can meet this criteria.

5.5 For Quality Assurance purposes, minimally check the lifting power of the yolk. Otherwise when possible, check the lifting power prior to and after magnetic particle testing on a daily basis. HWAC electromagnetic yolks shall lift 10 pounds (18.8 kg) at the maximum pole spacing to be used.

5.6 Place the toggle switch to A.C.

5.7 Place yolk poles on the surface. The maximum pole spacing shall be 4 inches. Turn current ON.

5.8 Apply the magnetic particles in such a manner that a light uniform, dust-like coating settles upon

the surface of the test part while magnetized. The particles shall be dispersed in the air above the test surface and float to the magnetized surface. The particles shall not be forcibly applied to the surface. It is important to watch the magnetized area as the particles fall to the surface and form the indication.

5.9 After application of the particles, the yolk shall be applied to the test surface at least in two orientations 90 degrees apart. The yolks shall be manipulated (drag) on the test surface so as to maximize the signal- to- noise ratio. Before turning off the current, excess dry powder shall be removed by means of a light, dry-air current without disturbing the particles attracted by flux leakage. Observe the particles pattern as the excess are removed. Induced residual magnetism will significantly lower sensitivity to detect small defects after the first test. Therefore, interpretation should be made on the first examination.

6. EVALUATION

6.1 Relevant indications shall be verified for interpretation by use of the 10x-30x magnifier, penetrant testing, or fluorescent magnetic particle tests. Indications from apparent subsurface flaws shall preferably be verified ultrasonically. Otherwise, excavation shall be required.

6.2 Sufficient time for indication, formation, and examination should be allowed between successive magnetization cycles.

6.3 Perform a second examination of the same area with the yolk poles positioned approximately at a right angle to the first examination.

7. ACCEPTANCE STANDARDS

7.1 All base metal and arc strikes shall not contain any linear indications (shall be considered to be cracks).

7.2 Sections of welds shall have no linear indications (shall be considered cracks or a lack of fusion). The following conditions are unacceptable:

7.2.1 Any type of crack

7.2.2 For welds subject to tensile loading under any condition, the greatest dimension of any porosity or fusion type discontinuity that is 1/16 inch or larger in greatest dimension shall not exceed the size, B, indicated in Figure 1 of AASHTO/ AWS D 1.5:2015 for the effective throat or size weld involved. The distance from any porosity or fusion type discontinuity described to another such discontinuity, to an edge, or to the toe or root of any intersecting web-flange weld shall not be less than the minimum clearance allowed, C, indicated in Figure 1 of AASHTO/ AWS D1.5 current edition for the size discontinuity under examination.

7.2.3 For welds subject only to compressive stress and specifically indicated as such on the design drawings, the greatest dimension of porosity or fusion type discontinuity that is 1/8 inch or larger in greatest dimension shall not exceed the size, B, nor shall the space between adjacent discontinuities be less than the minimum clear distance allowed, C, as indicated by Figure 2 of AASHTO/AWS D1.5M/D1.5 current edition for the size of discontinuity under examination.

7.2.4 However, discontinuities having a greatest dimension of less than 1/16 inch shall be unacceptable if the sum of their greatest dimension exceeds 3/8 inch in any linear inch of weld.

7.2.5 The limitations given by Figures 1 and 2 of AASHTO/AWS D1.5M/D1.5 current edition for 1 1/2 inch weld size shall apply to all weld sizes greater than 1 1/2 inch.

7.3 Defects shall be repaired in accordance with AASHTO/AWS D1.5M/D1.5 current edition. The repair area shall be re-examined in accordance with this procedure.

8. **RECORD**

8.1 Record the location and results on a CDOT Report. When circumstances warrant permanent records, the following methods should be used:

8.1.1 Place transparent adhesive tape onto the indication. Place tape on a contrasting substrate record sheet.

8.1.2 Photograph. Record the length and axis orientation with respect to the weld.