AERONAUTICAL MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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AMS2640B

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MAGNETIC PARTICLE INSPECTION

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. PURPOSE: To detect the presence of small grinding or quenching cracks, seams, non-metallic inclusions, and other defects on and immediately below the surface of magnetizable materials.

3. APPLICATION: (a) To steel parts when this specification number appears on the drawing or is required by written instructions.

(b) Magnetic particle inspection shall be performed on parts which have been fully heat treated and whose surfaces have been completely finish machined and electroplated when specified. If surface treatments are applied, then an inspection may be performed before such treatments. If surface treatments are of the type which may cause cracks, then an inspection shall be performed after such treatments, using a magnetic substance with a suitable color. This paragraph shall not be interpreted as prohibiting additional magnetic particle inspections during manufacture of parts.

(c) Magnetic particle inspection shall be performed on a part in such a manner as to insure satisfactory detection of all defects. A complete inspection test shall consist of one or more distinct magnetizing, inspection, and demagnetizing operations so conducted that any defects are adequately indicated.

4. WET PROCESS: All material and parts shall be inspected by the wet process, unless otherwise specified, using either the continuous or the residual method as warranted by the particular material or part undergoing inspection.

(a) Materials and Control.-

(1) Liquid Vehicle.- Shall be a light petroleum distillate conforming to AMS 3160.

(2) Magnetic Substance.- Shall be suitable for the purpose and preferably in the form of a paste, but dry powder may be used provided satisfactory dispersion in the liquid vehicle is effected.

(3) Suspension.- Shall consist of the magnetic substance in the liquid vehicle in such quantity that the concentration is 0.85-1.25 ounces by weight of solids per gallon of suspension as applied. The viscosity of the vehicle portion of the suspension shall never exceed 5.0 centistokes, (42.5 S.U. Secs.), at operating temperature. Suitable means shall be provided for agitating the suspension.

(4) Test of Suspension.- The suspension shall be tested as often as necessary to maintain proper control; the following is a satisfactory method:

Fill a 100-ml graduated cone or pear-shaped centrifuge tube to the 100-ml mark with the suspension directly from the hose or other device used for pouring it over the part in making a test, demagnetize, and let is stand for 30 minutes, or until the solid matter is apparently all down. Decant the clear liquid as far as practicable ϕ without loss of magnetic substance. Refill the tube containing magnetic substance with a suitable hydrocarbon solvent such as AMS 3160 or benzol, shake well and let stand 1 hour to settle out a second time. Read the volume of the solids in the tube. A volume of 1.5 - 2.1 ml of magnetic substance as solids is equivalent to a concentration of approximately 0.85 - 1.25 ounces by weight of solids per gallon of suspension. This test shall not be construed to represent a measure of the total amount of the magnetic substance present in the tank, much of which may be lying unmixed on the bottom.

Note: Other methods of test which produce equivalent results may be substituted for the above method.

(5) Renewal of Suspension.- A suspension shall be discarded and replaced before the vehicle exceeds a viscosity of 5.0 centistokes, (42.5 S.U. Secs.), or when it becomes discolored by oil or contaminated with lint or other foreign sub- ϕ stance to the extent that proper distribution and concentration of the suspension or the intensity, character or definition of the deposit of the magnetic substance are interfered with.

(b) Operation.- The suspension shall be applied to the magnetized part by flowing from a hose, pouring or immersion, either while the magnetizing current is flowing (the continuous method), or after the part has been magnetized and the current turned off (the residual method).

5. DRY PROCESS: May be used when permitted by the Inspection and Engineering Departments for special applications where it might offer certain advantages.

(a) Material.-

(1) Magnetic Substance.- Shall be suitable for the purpose and in the form of a dry powder.

(b) Operation.- The powder shall be sprayed or dusted directly on the part and lightly tapped or otherwise vibrated in order to obtain efficient distribution. ϕ Care shall be exercised in avoiding excessive use of powder as such use will interfere with effective indication of defects. Care shall be used in removing excess powder to avoid disturbing indications present. Whichever magnetizing method is more effective shall be used.

6. PROCEDURE: (a) The surfaces of all materials and parts shall be properly cleaned to free them from oil, grease, dirt, or other contamination which might interfere with the proper distribution and concentration, or with the intensity, character, or definition of the deposit of the magnetic substance.

(b) Oil holes and other openings which lead to areas from which the magnetic substance cannot be easily removed should be plugged with grease, or ϕ similar nonabrasive material readily soluble in engine oil, before the part is magnetized.

(c) Direct current, as produced by batteries, generators or rectifiers, shall be used for magnetizing.

(d) The magnetic field shall be induced in the part being tested by placing the part between the poles of electro-magnets or within a solenoid coil carrying direct current (Bi-Polar or Longitudinal Method); or by passing a high-amperage low-voltage direct current through the part or through an adjacent conductor (Circular Method). The magnetic flux shall be of suitable intensity and direction to reveal all indications which might be cause for rejection. The magnetic substance shall be applied to the magnetized part preferably by the wet process but the dry process may be used under special conditions when specifically approved.

(e) Over magnetization may obscure indications and shall be guarded against. Size of parts under test shall be considered. Over-magnetization may be recognized by indications showing, for example, grain-flow and/or metallic segregation inherent in parts under test.

(f) It may be feasible to magnetize several parts simultaneously in the same magnetic field by means of a coil or by means of a conductor through a hole in the parts or by current through the parts placed either in series or parallel. If parts are in parallel, they shall be spaced at least 1/2 inch apart and all of them shall make equally good contact.

(g) Parts shall be satisfactorily demagnetized after each magnetizing and inspection operation, unless subsequent magnetizations are of sufficient intensity to mask the effects of the preceding magnetizations. Parts shall be satisfactorily demagnetized after the final inspection.

(h) The inspected parts shall be cleaned at this or some subsequent stage to remove the retained magnetic substance, and any material used to plug oil holes.

7. MARKING: Wherever practicable the letter "M" shall be legibly marked on all parts which have satisfactorily passed the magnetic particle inspection, except those completely ground, polished or otherwise finished because of functional operation. Small parts may be marked with a suitable dye or lacquer.

8. DISPOSITION: (a) Parts containing certain minor indications which would not be considered detrimental to the part under operating conditions may be approved for acceptance without remedial operations, at the discretion of the Inspection and Engineering Departments.

(b) If a defect should be of such nature and so located that its removal would not adversely affect the serviceability of the part, although local sections might be outside the drawing limits, then the correction may be made with the approval of the Inspection and Engineering Departments after due consideration of the stress distribution whihin the part together with the function of the part itself. If a defect is removed, the spot shall be well blended and polished and then completely reinspected.

(c) Parts having defects which are considered detrimental to their strength and serviceability shall be rejected.