AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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AMS 2640E

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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. APPLICATION: 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.

2.1 When this specification number appears on the drawing or is required by written instructions, 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, except that if plating thickness is sufficient to prevent detection of defects, the inspection shall be performed immediately prior to plating. If surface treatments are to be applied, 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.

2.2 Either fluorescent or non-fluorescent magnetic particle inspection may be used unless one or the other is specifically called for on the drawing or in other inspection procedure instructions.

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

3.1 Materials and Control:

3.1.1 Liquid Vehicle: Shall be a light petroleum distillate conforming to AMS 3160 or equivalent.

3.1.2 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. The magnetic substance shall conform to the requirements of either 3.1.3.1 or 3.1.3.2.

3.1.3 Suspension: The viscosity of the vehicle portion of the suspension shall never exceed 5.0 centistokes (42.5 SUS) at operating temperature. Suitable means shall be provided for agitating the suspension.

3.1.3.1 The non-fluorescent paste suspension shall consist of magnetic substance of sufficient concentration in the liquid vehicle to provide 1.0-1.4 oz by weight of solids per gallon of suspension as applied.

3.1.3.2 The fluorescent paste suspension shall consist of fluorescent magnetic substance of sufficient concentration in the liquid vehicle to provide 0.10-0.20 oz by weight of solids per gallon of suspension as applied.

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

3.1.4.1 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 it stand for 30 min., or until the solid matter is apparently all down. Decant the clear liquid as far as practicable 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 hr to settle out a second time. Read the volume of the solids in the tube. A volume of 1.7-2.4 ml of non-fluorescent magnetic substance as solids is equivalent to a concentration of approximately 1.0-1.4 oz by weight of solids per gallon of suspension. A volume of 0.09-0.20 ml of fluorescent magnetic substance as solids is equivalent to a concentration of approximately 0.10-0.20 oz 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.

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

3.1.5 Renewal of Suspension: A suspension shall be discarded and replaced before the vehicle exceeds a viscosity of 5.0 centistokes (42.5 SUS), or when it becomes discolored by oil or contaminated with lint or other foreign substance to the extent that proper distribution and concentration of the suspension or the intensity, character, or definition of the deposit of the magnetic substance is affected.

3.2 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 (continuous method) or after the part has been magnetized and the current turned off (residual method).

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

4.1 Material: The magnetic substance shall be suitable for the purpose and in the form of a dry powder.

4.2 Operation: The powder shall be sprayed or dusted directly on the part and lightly tapped or otherwise vibrated in order to obtain efficient distribution. Care shall be exercised to avoid 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. The most effective magnetizing method shall be used.

5. PROCEDURE:

5.1 Magnetic particle inspection shall be performed on a part in such a manner as to ensure satisfactory detection of all defects. A complete inspection test shall consist of one or more distinct magnetizing, inspection, and demagnetizing operations so conducted that the lines of force will be approximately at right angles to any discontinuity that may be in the part.

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5.2 When the fluorescent magnetic particle process is used, the parts shall be examined in a darkened area under suitable "black light".

5.3 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.

5.4 Oil holes and other openings which lead to areas from which the magnetic substance cannot be easily removed should be plugged with grease, or similar non-abrasive material readily soluble in engine oil, before the part is magnetized.

5.5 Direct current, as produced by batteries, generators, or rectifiers, shall be used for magnetizing unless alternating current is proven to be satisfactory for specific applications.

5.6 The magnetic field shall be induced in a part by one or more methods and of varying directions. The two methods used to produce such magnetic fields are: (1) Bi-Polar or Longitudinal, (2) Circular. The longitudinal method is produced by placing a part between the poles of an electro-magnet or within a solenoid coil. The circular method is produced by passing a high amperage, low voltage current through the part or through a conductor which might be placed through an opening in the part. The magnetic field 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 by the wet process, unless the dry process has been specifically approved for certain special conditions.

5.7 The current used for magnetizing should not be such that saturation results. Size and shape of parts under test shall be considered and current of satisfactory value selected to adequately magnetize various sections of the part. In some cases it may be necessary to magnetize a part by sections to produce the proper flux density and to prevent misinterpretation of the resulting indications. Saturation may be identified by excessive accumulations of magnetic substance at slight changes of section or by pronounced indication of grain flow.

5.8 It may be feasible to magnetize several parts simultaneously in the same magnetic field. This may be done by placing several parts in a coil in the same position or by means of a conductor placed through a hole in the part. An example of this method would be placing a number of nuts, washers, etc. on a bar conductor.

5.9 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.

5.10 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.

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