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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 3044D

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Superseding AMS 3044C

MAGNETIC PARTICLES, FLUORESCENT
Wet Method, Dry Powder

1. SCOPE:

1.1 Form:

This specification covers fluorescent magnetic particles in the form of a dry powder.

1.2 Application:

These particles have been used typically as the inspection medium in wet, fluorescent magnetic particle inspection system as defined in ASTM E 1444 using either an oil or conditioned-water vehicle, but usage is not limited to such application.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2641 Vehicle, Magnetic Particle Inspection, Petroleum Base
AMS 2825 Material Safety Data Sheets

SAE J438 Tool and Die Steels

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 96 Water and Sediment in Crude Oil by Centrifuge Method (Field Procedure)
ASTM E 11 Wire-Cloth Sieves for Testing Purposes
ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 1444 Magnetic Particle Examination

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Material:

The product shall be composed of durable fluorescent magnetic particles, suitable for long time use, which have been treated to obtain the fluorescent color specified. This dry powder shall be formulated for use with an aqueous vehicle containing appropriate conditioning agents, a magnetic particle vehicle conforming to AMS 2641, or equivalent odorless oil, and shall disperse evenly and thoroughly in the recommended vehicle.

3.2 Properties:

The product shall conform to the following requirements; tests shall be performed, on the product supplied, in accordance with specified test methods using a test suspension prepared as in 4.3.3.

3.2.1 Contamination: The product shall show no evidence of foreign material, agglomeration, or scum, determined by visual examination of the test suspension at the following times:

3.2.1.1 During preparation of the test suspension as in 4.3.3.

3.2.1.2 After mixing the test suspension, allowing it to stand for not less than 30 minutes, and agitating it slightly.

3.2.1.3 During tests to determine conformance with other characteristics of the product.

3.2.2 Color: The color of the magnetic particles shall be fluorescent in the yellow-green range, unless another color is specified by purchaser. The color shall be determined by observing the indications formed, during the sensitivity test of 3.2.6, in a darkened area where the white light does not exceed 2 foot-candles (20 lx). A mercury-arc ultraviolet (black) light shall be used at a measured intensity of not less than 1,000 µW/cm^2 and a wave length of 320 to 400 nm filtered to peak at 365 nm to activate the fluorescent magnetic particles.

3.2.3 Particle Size: The fluorescent magnetic particles shall be of such size that not less than 98% by weight shall pass through a 3-inch (76-mm) diameter U.S. Standard No. 325 (45 µm) sieve, as defined in ASTM E 11, determined by passing a 1 quart (1 L) sample of thoroughly-mixed test suspension, as in 4.3.3, through the screen/sieve. After the test suspension liquid vehicle has completely passed through the sieve, rinse with 1 quart (1 L) of the original liquid vehicle. Dry the sieve to remove all of the liquid and determine the dry weight of the residual particulate material not passing through the screen/sieve as related to the original weight of the particulate material in the sample, expressed in percentage.

3.2.4 Durability: Fluorescent magnetic particles shall retain their initial sensitivity, color, and brightness of indication after placing not less than 400 mL of thoroughly-mixed test suspension, prepared as in 4.3.3, in a 1 quart (1 L) capacity constant speed blender, operating the blender at approximately 10,000 to 12,000 rpm for a total of 10 minutes, in 2 minute intervals, allowing the suspension to cool for 5 minutes between stirring cycles, and, at the end of the cumulative 10 minute blending, conduct the sensitivity test of 3.2.5.

3.2.5 Sensitivity:

3.2.5.1 (R) Ring Test: The product shall show a seven-hole indication on the ring test specimen defined in 4.3.4, determined by placing the ring on a 1 -inch (25-mm) diameter copper bar and circularly magnetizing the ring in a standard magnetic particle inspection unit by passing 2500 amperes of direct current through the copper bar immediately before flooding the ring with agitated test suspension that has passed the contamination (3.2.1) and concentration (4.3.3) tests. Examine the ring in a darkened area under blacklight as defined in 3.2.2. The test shall be repeated using a sample of test suspension that has been subjected to the durability test of 3.2.4.

3.2.5.2 Flaw-to-Background Test: Obtain a test part or prepare a test specimen, containing flaws of the size expected to be found in production inspection. The surface finish of the test specimen shall be representative of production parts. Magnetize and flood the test specimen as specified in 3.2.5.1, using a sample of agitated test suspension that has passed the contamination (3.2.1) and concentration (4.3.3) tests. View the flaw indications in a darkened area under blacklight as defined in 3.2.2. Indications shall be sharp and distinct. Background fluorescence around the flaws shall be of a level which will neither obscure the flaw indications nor cause difficulty in flaw detection. The test shall be repeated using a sample of test suspension that has been subjected to the durability test of 3.2.4.

3.2.6 Long-Term Durability: Fluorescent magnetic particles shall retain their initial sensitivity, color, and brightness of indication after allowing a 1.5 quarts (1.4 L) of freshly-prepared, thoroughly-mixed test suspension, prepared as in 4.3.3, to stand undisturbed at room temperature for not less than 14 days. Following the dwell, the test suspension shall be well dispersed when stirred and shall meet the requirements of 3.2.1 through 3.2.5.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The manufacturer of the product shall supply all samples for manufacturer's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Contamination (3.2.1), color (3.2.2), particle size (3.2.3), durability (3.2.4), and sensitivity (3.2.5) are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of the product to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 (R) For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing: Shall be as follows:

4.3.1 Acceptance Tests: Sufficient product shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 Lot: A lot shall be all product produced in a single production run from the same batch of raw materials under the same fixed conditions and presented for manufacturer's inspection at one time.

4.3.1.2 (R) A statistical sampling plan, acceptable to purchaser, may be used in lieu of sampling as in 4.3.1.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.3.3 (R) Test Suspension Preparation: The test suspension shall be prepared in accordance with manufacturer's recommendation by adding sufficient dry powder solids to distilled water containing appropriate conditioning agents or AMS 2641 magnetic particle inspection vehicle, usually 0.025 to 0.18 ounce per gallon (0.19 to 1.3 g/L), to produce a suspension concentration of 0. 10 to 0.40 mL of magnetic particles in 100 mL of suspension. The concentration shall be verified by mixing the suspension thoroughly, filling a 100 mL calibrated centrifuge tube as specified in ASTM D 96, allowing the tube to stand undisturbed for at least 30 minutes, and reading, on the calibrated tube, the volume of the particles settled from the suspension.

4.3.4 Tool Steel Test Ring:

4.3.4.1 (R) Material: Shall be hot rolled tool steel, 01 series, conforming to SAE J438, or equivalent. Ring shall be manufactured from 5.5-inch (140-mm) minimum diameter round bar stock.

4.3.4.2 (R) Configuration: Ring configuration, dimensions, and surface finish shall be in accordance with Figure 1. Ring shall have nine side-drilled holes; additional holes may be specified by purchaser.

4.3.4.3 Heat Treatment:

4.3.4.3.1 (R) Prior to machining, each bar shall be normalized by heating slowly to 1500 °F ± 100 (816 °C ± 56), holding at heat for 60 minutes ± 5 per inch (25 mm) of diameter, heating to 1600 °F ± 100 (871 °C ± 56), holding at heat for 60 minutes ± 5 per inch (25 mm) of diameter, and air cooling.

4.3.4.3.2 Ring shall be annealed, after machining, by heating to 1425 to 1500 °F (774 to 816 °C), holding at heat for 60 minutes ± 5, cooling at a rate not more than 40 F (22 C) degrees per hour to 1000 °F ± 100 (538 °C ± 56), and furnace or air cooling to room temperature.

4.3.4.4 (R) Surface oxidation, caused by annealing or normalizing, may be removed by dry blasting using either glass beads or aluminum oxide at 25 to 40 psi (172 to 276 kPa). Part may be protected from rust by applying a coating of oil or grease.

4.3.4.5 (R) Hardness: Hardness, after annealing as in 4.3.4.3.2, shall be 90 to 95 HRB, or equivalent, determined in accordance with ASTM E 18.

4.4 Approval:

4.4.1 Sample product shall be approved by purchaser before product for production use is supplied, unless such approval be waived by purchaser. Results of tests on production product shall be equivalent to those on the approved sample.

4.4.2 Manufacturer shall use ingredients, manufacturing procedures, processes, and methods of inspection on production product that are the same as those used on the approved sample. If necessary to make any changes in ingredients, processing techniques, or manufacturing procedures, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample product. Production product shall not be shipped prior to receipt of reapproval.

4.5 Reports:

The vendor of the product shall furnish with each shipment a report stating that the product conforms to all technical requirements. This report shall include the purchase order number, lot number, AMS 3044D, manufacturer's material designation, and date of manufacture.

4.5.1 A material safety data sheet conforming to AMS 2825, or equivalent, shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results or, if preproduction testing be waived by purchaser, concurrent with the first shipment of the product for production use. Each request for modification of product formulation shall be accompanied by a revised data sheet for the proposed formulation.

4.6 Resampling and Retesting:
(R)

If any sample used in the above tests fails to meet specified requirements, disposition of the product may be based on the results of testing three additional samples for each original nonconforming sample. Failure of any retest sample to meet specified requirements shall be cause for rejection of the product represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 The product shall be packaged in containers of a type and size acceptable to purchaser.
(R)

5.1.2 A lot of magnetic particles may be packaged in small quantities and delivered under the basic
(R) lot approval provided lot identification is maintained.

5.1.3 Each package or container shall be identified with a durable label, that is legible on receipt, with not less than the following information:

MAGNETIC PARTICLES, FLUORESCENT, WET METHOD, DRY POWDER
AMS 3044D
MANUFACTURER'S IDENTIFICATION _____
DATE OF MANUFACTURE _____ * _____
LOT NUMBER _____
QUANTITY _____
MANUFACTURER'S INSTRUCTIONS FOR USE _____ ** _____
APPROPRIATE WARNINGS OR PRECAUTIONARY NOTICES _____

* May be included in the manufacturer's identification or lot number.
** May be on a separate sheet.

5.1.4 Individual packages or containers shall be packed in an exterior shipping container capable of protecting the product, during shipment and storage, against damage from exposure to moisture, weather, or any other normal hazard.

5.1.5 Containers of the product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery.

5.1.6 (R) For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-2073-1, Level C, unless Level A is specified in the request for procurement.

6. ACKNOWLEDGMENT:

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

7. REJECTIONS:

Product not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES:

8.1 The (R) symbol is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this specification. If the symbol is next to the specification title, it indicates a complete revision of the specification.

8.2 Clarification of terms used in AMS are provided in ARP1917.