AEROSPACE
MATERIAL SPECIFICATIONS
SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

AMS 2645E

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FLUORESCENT PENETRANT INSPECTION

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

2. APPLICATION: Detection of surface discontinuities such as cracks, laps, porosity, cold shuts, lack of bond, and similar defects.

3. MATERIALS AND EQUIPMENT:

3.1 Penetrant: Shall be a non-toxic, non-corrosive, highly fluorescent liquid capable of penetrating fine discontinuities. Unless otherwise permitted by purchaser, penetrant shall conform to AMS 3155 except that AMS 3156 shall be used for magnesium and aluminum castings.

3.1.1 If a darkened enclosure is not used for examination, AMS 3157 penetrant shall be used.

3.2 Emulsifier: Shall be composed of suitable oil or oil-like components together with such additives necessary to provide a stable, non-toxic, non-corrosive, oil miscible, oil emulsifying solution.

3.3 Developer: Shall be a highly absorbent, non-fluorescent, and non-toxic powder, capable of being used dry or shall be a similar powder capable of being suspended in water. When the suspension is used, the powder shall be thoroughly mixed with water to a concentration, unless otherwise permitted by purchaser, of not less than 1 lb to 5 gal and a uniform distribution maintained by mechanical agitation.

3.4 Equipment: Shall be so constructed and arranged as to permit uniform, controlled operation.

3.5 Lighting: A darkness booth or similar darkness area with a filtered black light source shall be provided. The black light shall be at least equal to that produced by a 100 w mercury vapor projection spot lamp equipped with a filter to transmit wave lengths of between 3200 and 4000 Angstrom units and absorb substantially all visible light.

4. PREPARATION OF PARTS:

4.1 Parts shall normally be fluorescent penetrant inspected prior to all surface treatments such as plating, anodizing, dichromating, peening, or similar treatments which would tend to close or mask surface discontinuities. Fluorescent penetrant inspection may be performed after surface treatments provided it is demonstrated that the treatment is of such a nature that discontinuities are not obscured.

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4.2 If machined surfaces are to be inspected, they shall be finished with a clean cut to prevent flowing or burnishing of the surface layer, shall be etched with a suitable etchant and properly neutralized or, if permitted by purchaser, shall be abrasive blasted to remove flowed or burnished layers which might mask discontinuities. Parts shall not be abrasive blasted or etched indiscriminately because these processes in themselves tend to mask surface discontinuities.

4.3 All parts shall be cleaned and dried in such a manner as to leave them free from grease, oil, soaps, alkalies, and other substances which would interfere with inspection. Vapor degreasing is generally suitable for this purpose.

4.4 This section shall not be interpreted as prohibiting additional fluorescent penetrant inspections after further processing or after use of parts.

5. PROCEDURE: After preparation, the parts shall immediately be subjected to the following operations:

5.1 Parts shall be immersed in the penetrant, or shall be sprayed or brushed with the penetrant, and shall be allowed to remain immersed in the penetrant or to stand for a sufficient length of time to allow satisfactory penetration into all discontinuities. This time shall, unless otherwise specified, be not less than 5 minutes. The time of immersion or standing will depend upon the character and fineness of the discontinuities, the effectiveness of penetration increasing with time. Parts may be resprayed or reimmersed after standing to increase sensitivity and aid in removal of penetrant.

5.2 Parts shall be removed from the penetrant and cleaned thoroughly using a medium which will remove penetrant from the surfaces of parts; washing with water shall be used when the penetrant is water washable or when an emulsifying agent is applied to surfaces of parts to render the penetrant water washable. When emulsifiers are used, the parts shall be dipped in the emulsifier and removed slowly for draining. Unless otherwise specified, the combined dipping and draining time shall be 1 to 5 minutes. When other than water washable penetrants are used, the penetrant shall be removed with a suitable cleaner or a suitable cleaner and lint-free cloths. During cleaning, the parts may be viewed under a suitable "black light" to ensure complete removal of the penetrant from the surfaces of the part. Excessive cleaning which would remove the penetrant from discontinuities shall be avoided.

5.3 When a wet developer is used, the developer shall be applied to the parts, immediately after washing, by immersing the parts in the tank containing the water-suspended powder or by spraying or flowing the suspension onto the parts. The suspension shall be suitably agitated either during or immediately prior to application to parts. Immersed parts shall be removed from the wet developer; excess developer shall be allowed to drain off all parts. Special care shall be taken to remove excess developer from pockets, recesses, holes, threads, and corners so that the developer will not mask indications.

5.4 When a dry developer or no developer is used, the above operation shall be omitted and the parts dried as in 5.5.

5.5 Parts shall be dried as thoroughly as possible by exposure to clean air. Drying of parts may be accomplished by evaporation at room temperature or by placing the parts in a circulating warm air oven or in the air stream of a hot air dryer. Excessive drying time or part temperatures higher than 180 F (82 C) should be avoided to prevent evaporation of the penetrant.

5.6 When a dry developer is used, the developing powder shall be applied uniformly over the areas of the parts to be inspected by either dusting or powder-box immersion.

5.7 After sufficient time has been allowed to develop indications, parts shall be examined under the "black light" described in 3.5. Examination shall be made in a darkened enclosure unless AMS 3157 penetrant is used, in which instance examination may be made under normal shop lighting but shaded from direct sunlight.

5.8 When greater sensitivity is desired, the parts may be heated to 150 - 180 F (65.6 - 82.2 C) before immersion in the penetrant and/or before "black light" examination. To prevent evaporation, preheated parts must remain fully immersed in the penetrant until cooled.

5.9 Interpretation of the indications revealed by this inspection procedure and final disposition of the parts shall be the responsibility of only qualified personnel having experience with fluorescent penetrant inspection. Procedure for qualification of personnel shall be acceptable to purchaser.

5.10 Parts shall be cleaned if necessary, to remove penetrant and developer.

6. DISPOSITION:

6.1 Parts containing minor discontinuities which would not be considered detrimental to the part under operating conditions may be approved for acceptance without remedial operations at the discretion of authorized personnel.

6.2 If a discontinuity 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 drawing limits, the correction may be made with the approval of authorized personnel after due consideration of the stress distribution within the part and the function of the part itself. If a discontinuity is removed, the spot shall be well blended in such a manner as to minimize surface flow of the material. Swab etching of the blended area before reinspection is recommended wherever practicable. Etched surface shall be polished after reinspection.

6.3 Parts having discontinuities which are considered detrimental to strength or serviceability shall be rejected.

7. MARKING:

7.1 Wherever practicable, the character Ꝑ (P with an F backward) or other marking acceptable to purchaser shall be marked, by etching or impression stamping, on all parts which have satisfactorily passed the fluorescent penetrant inspection, including those parts actually inspected from a lot accepted on a sampling basis.

7.2 Parts accepted on a sampling basis but not actually inspected may be identified by the Ꝑ character enclosed in a circle.

7.3 The letter E may be added to indicate use of the post-emulsification procedure.

7.4 Where impression stamping or etching is not appropriate because of size, finish, or function of the part, identification may be by dyeing or by tagging except that dyeing ø shall not be used on parts intended for liquid oxygen service; when dyeing is used, a maroon dye shall be used on all parts actually inspected and a yellow dye on parts accepted on a sampling basis but not actually inspected.

8. PRECAUTIONS:

8.1 Rinsing in dilute acid during preparation of parts should be avoided or, if used, excess acid on parts shall be neutralized.

8.2 Parts should not be in contact with water during washing any longer than is absolutely necessary. When wet developer is applied by immersion, parts should be dipped into the solution and removed at once.

8.3 Excessive drying time when using heat should be avoided. It is only necessary to remove all moisture.

8.4 Both the penetrant and the dry developer should be kept as free from moisture and contaminating materials as possible. Wet developer suspension should be kept as free from fluorescent-contaminating materials as possible.

8.5 All parts susceptible to corrosion should be protected, after completion of inspection, ø in accordance with instructions supplied by the purchaser.

8.6 Processing and inspection areas and inspectors' hands should be kept as free from fluorescent materials as possible.

9. REPORTS: If marking or dyeing is impracticable, or when permitted by purchaser in lieu of marking or dyeing, vendor shall report on an appropriate form the type of penetrant, emulsifier, and developer used, and percentage of pieces inspected. This report ø shall also include a statement that all parts in the shipment conform to the standards specified by the purchaser.