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400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 2645H
Superseding AMS 2645G

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FLUORESCENT PENETRANT INSPECTION

1. SCOPE:

1.1 Purpose: This specification establishes a procedure for detection of defects by use of a fluorescent, penetrating liquid.

1.2 Application: Detection of discontinuities such as cracks, laps, porosity, cold shuts, lack of bond, and similar defects which are open to the surface.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 3155 - Oil, Fluorescent Penetrant, Solvent Soluble
AMS 3156 - Oil, Fluorescent Penetrant, Water Soluble
AMS 3157 - Oil, Fluorescent Penetrant, High Fluorescence, Solvent Soluble
AMS 3158 - Solution, Fluorescent Penetrant, Water Base

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 Penetrant: Shall be a nontoxic, noncorrosive, highly fluorescent liquid capable of penetrating fine discontinuities. Except as specified in 3.1.1.1 and 3.1.1.2 penetrant shall, unless otherwise permitted by purchaser, conform to AMS 3155 except that AMS 3156 shall be used for magnesium and aluminum castings.

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

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3.1.1.2 When the drawing states that a part is to be used in liquid oxygen system or when instructions issued by purchaser so indicate, AMS 3158 penetrant shall be used.

3.1.2 Emulsifier: Shall be composed of suitable oil or oil-like components together with such additives as are necessary to provide a stable, nontoxic, noncorrosive, oil-miscible, oil-emulsifying solution. Emulsifier shall not be used when AMS 3156 or AMS 3158 penetrant is used.

3.1.3 Developer: Shall be a highly absorbent, nonfluorescent, and nontoxic powder, capable of being used dry or shall be a similar powder capable of being suspended in water. The developer used with AMS 3158 penetrant shall be compatible with liquid oxygen as measured by impact sensitivity test agreed upon by purchaser and vendor. 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 0.2 lb per gal (24 kg/m^3) and a uniform distribution maintained by mechanical agitation.

3.1.4 Check of Materials:

3.1.4.1 The penetrant, the emulsifier, and the developer shall be checked as often as necessary to maintain proper control.

3.1.4.2 The penetrant shall be discarded if it shows a noticeable loss in penetrating power or marked contamination, or when wax begins to form on the sides of the tank and dip basket.

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

3.3 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 (320 and 400 mm) and absorb substantially all visible light; the intensity of the light at normal working distance shall be as specified by the purchaser but in no case shall be lower than 580 µW/cm^2 as measured with an appropriate black light meter.

3.4 Preparation of Parts:

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

3.4.2 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.

3.4.3 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.

3.5 Procedure: After preparation, the parts shall immediately be subjected to the following operations:

3.5.1 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 sufficient time to allow satisfactory penetration into all discontinuities. This time shall, unless otherwise specified, be not less than 5 minutes. The time for 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 re-immersed after standing to increase sensitivity and aid in removal of penetrant.

3.5.2 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, or shall be sprayed with the emulsifier and drained. 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 removal of the penetrant from the surfaces of the part. Excessive cleaning which would remove the penetrant from discontinuities shall be avoided.

3.5.3 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.

3.5.4 When a dry developer or no developer is used, the operation of 3.5.3 shall be omitted and the parts dried as in 3.5.5.

3.5.5 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 80°C (180°F) should be avoided to prevent evaporation of the penetrant.

3.5.6 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.

3.5.7 After sufficient time has been allowed to develop indications, parts shall be examined under the "black light" described in 3.3. 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.

3.5.8 When greater sensitivity is desired, the parts may be heated to 65° - 85°C (150° - 185°F) before immersion in the penetrant and/or before "black light" examination. To prevent evaporation, preheated parts shall remain fully immersed in the penetrant until cooled.

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Disposition:

4.1.1 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.

4.1.2 Parts having discontinuities considered detrimental to strength or serviceability shall be rejected.

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

4.1.4 Parts containing discontinuities of such nature and location that their removal would not adversely affect the serviceability of the part, although local sections might be outside drawing limits, may have such discontinuities removed with the approval of authorized personnel after due consideration of the stress distribution within the part together with the function of the part itself. If a discontinuity is removed, the spot

4.1.4 (Continued):

shall be blended in such a manner as to minimize surface flow of the material and reinspected. Swab etching of the blended area before reinspection is recommended wherever practicable. Etched surface shall be polished after reinspection.

4.2 Responsibility for Inspection: The inspection source shall be responsible for performing all required tests and identifying the parts tested and ø accepted as required by 5.1 or for providing reports of tests as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure conformance to the requirements of this specification.

4.3 Sampling: Shall be as agreed upon by purchaser and the inspection source. ø

4.4 Reports: If marking or dyeing as in 5.1 is impracticable, or when permitted by purchaser in lieu of marking or dyeing, vendor shall report on an appropriate form the penetrant, emulsifier, and developer used and the number of pieces tested in each lot. The report shall also include a statement that all parts in the shipment conform to standards specified by the purchaser.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Parts which have satisfactorily passed the fluorescent penetrant inspection described herein shall be identified as follows:

5.1.1 Wherever practicable, the character "ꟻ" (P with an F backward) or other ø marking acceptable to purchaser shall be marked, by etching or impression stamping, on all parts actually inspected including those parts from a lot accepted on a sampling basis.

5.1.2 Parts accepted on a sampling basis but not actually inspected may be identified by the character "ꟻ" (P with an F backward) enclosed in a circle.

5.1.3 The letter "B" may be added to indicate use of the postemulsification procedure.

5.1.4 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 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.