Designation: E 1208 – 99

Standard Test Method for Fluorescent Liquid Penetrant Examination Using the Lipophilic Post-Emulsification Process[1]

This standard is issued under the fixed designation E 1208; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers procedures for fluorescent liquid penetrant examination utilizing the lipophilic postemulsification process. It is a nondestructive testing method for detecting discontinuities that are open to the surface such as cracks, seams, laps, cold shuts, laminations, through leaks, or lack of fusion and is applicable to in-process, final, and maintenance examination. It can be effectively used in the examination of nonporous, metallic materials, both ferrous and of nonmetallic materials such as glazed or fully densified ceramics and certain nonporous plastics and glass.

1.2 This test method also provides a reference:

1.2.1 By which a fluorescent liquid penetrant examination, lipophilic post-emulsification process recommended or required by individual organizations can be reviewed to ascertain its applicability and completeness.

1.2.2 For use in the preparation of process specifications dealing with the fluorescent penetrant examination of materials and parts using the lipophilic post-emulsification process. Agreement by the purchaser and the manufacturer regarding specific techniques is strongly recommended.

1.2.3 For use in the organization of the facilities and personnel concerned with the liquid penetrant examination.

1.3 This test method does not indicate or suggest standards for evaluation of the indications obtained. It should be pointed out, however, that indications must be interpreted or classified and then evaluated. For this purpose there must be a separate code or specification or a specific agreement to define the type, size, location, and direction of indications considered acceptable, and those considered unacceptable.

1.4 The values stated in inch-pound units are to be regarded as the standard. SI units are provided for information only.

1.5 All areas of this document may be open to agreement between the cognizant engineering organization and the supplier, or specific direction from the cognizant engineering organization.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see Note 12, and Note 17.

2. Referenced Documents

2.1 *ASTM Standards:*

D 129 Test Method for Sulfur in Petroleum Products (General Bomb Method)[2]

D 516 Test Methods for Sulfate Ion in Water[3]

D 808 Test Method for Chlorine in New and Used Petroleum Products (Bomb Method)[2]

D 1552 Test Method for Sulfur in Petroleum Products (High-Temperature Method)[2]

E 165 Test Method for Liquid Penetrant Examination[4]

E 433 Reference Photographs for Liquid Penetrant Inspection[4]

E 543 Practice for Evaluating Agencies that Perform Nondestructive Testing[4]

E 1316 Terminology for Nondestructive Examinations[4]

2.2 *ASNT Documents:*

Recommended Practice SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing[5]

ANSI/ASNT-CP-189 Qualification and Certification of NDT Personnel[5]

2.3 *Military Standard:*[6]

MIL-STD-410 Nondestructive Testing Personnel Qualification and Certification

2.4 *AIA Standard:*

NAS 410 Certification and Qualification of Nondestructive Test Personnel[7]

[1] This test method is under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.03 on Liquid Penetrant and Magnetic Particle Methods.

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[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

[4] *Annual Book of ASTM Standards*, Vol 03.03.

[5] Available from the American Society for Nondestructive Testing, 1711 Arlingate Plaza, Columbus, OH 43228-0518.

[6] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[7] Available from the Aerospace Industries Association of America, Inc., 1250 Eye Street, N.W., Washington, DC 20005.

2.5 *Department of Defense (DoD) Contracts*—Unless otherwise specified, the issue of the documents that are DoD adopted are those listed in the issue of the DoDISS (Department of Defense Index of Specifications and Standards) cited in the solicitation.

2.6 *Order of Precedence*—In the event of conflict between the text of this test method and the references cited herein, the text of this test method takes precedence.

3. Terminology

3.1 *Definitions*—The definitions relating to liquid penetrant examination, which appear in Terminology E 1316, shall apply to the terms used in this test method.

4. Summary of Test Method

4.1 A post-emulsifiable, liquid, fluorescent penetrant is applied evenly over the surface being tested and allowed to enter open discontinuities. After a suitable dwell time, the excess surface penetrant is removed by applying the lipophilic emulsifier and the part is water-rinsed and dried. If an aqueous developer is to be employed, the developer is applied prior to the drying step. A developer is applied to draw the entrapped penetrant out of the discontinuity and stain the developer. The test surface is then examined visually using a black light in a darkened area to determine the presence or absence of indications.

NOTE 1—The developer may be omitted by agreement between purchaser and supplier.

NOTE 2—**Caution:** Fluorescent penetrant examination shall not follow a visible penetrant examination unless the procedure has been qualified in accordance with 9.2, because visible dyes may cause deterioration or quenching of fluorescent dyes.

4.2 Processing parameters, such as precleaning, penetration time, emulsification time, etc., are determined by the specific materials used, the nature of the part under examination (that is, size, shape, surface condition, alloy), type of discontinuities expected, etc.

5. Significance and Use

5.1 Liquid penetrant examination methods indicate the presence, location, and, to a limited extent, the nature and magnitude of the detected discontinuities. This test method is normally used for production examination of critical components or structures when (*a*) removal of excessive amounts of penetrant from discontinuities using a waterwashable process can be a problem and (*b*) the use of a hydrophilic remover is impractical.

6. Reagents and Materials

6.1 *Liquid Penetrant Examination Materials*, for use in the lipophilic post-emulsification process (see Note 3) consist of a family of post-emulsifiable fluorescent penetrant, lipophilic emulsifier, and are classified as Type I Fluorescent, Method B—Post-Emulsifiable, Lipophilic. Intermixing of materials from various manufacturers is not recommended.

NOTE 3—Refer to 8.1 for special requirements for sulfur, halogen, and alkali metal content.

NOTE 4—**Caution:** While approved penetrant materials will not adversely affect common metallic materials, some plastics or rubbers may be swollen or stained by certain penetrants.

6.2 *Post-Emulsifiable Penetrants* are designed to be insoluble in water and cannot be removed with water rinsing alone. They are designed to be selectively removed from the surface by the use of a separate emulsifier. The lipophilic emulsifier, properly applied and given a proper emulsification time, combines with the excess surface penetrant to form a water-washable mixture, which can then be rinsed from the surface, leaving the surface free of fluorescent background. Proper emulsification time must be experimentally established and maintained to assure that over emulsification does not occur, resulting in loss of indications.

6.3 *Lipophilic Emulsifiers* are oil-base liquids used to emulsify the oily penetrant on the surface of the part, rendering it water washable. The rate of diffusion establishes the emulsion time. They are either slow- or fast-acting, depending on both their viscosity and chemical composition, and the surface roughness of the area being examined (see 7.1.5.1).

6.4 *Developers*—Development of penetrant indications is the process of bringing the penetrant out of open discontinuities through blotting action of the applied developer, thus increasing the visibility of the penetrant indications. Several types of developers are suitable for use with the lipophilic penetrant process.

NOTE 5—**Caution:** Aqueous developers may cause stripping of indications if not properly applied and controlled. The procedure should be qualified in accordance with 9.2.

6.4.1 *Dry Powder Developers* are used as supplied (that is, free-flowing, noncaking powder) in accordance with 7.1.8.1(*a*). Care should be taken not to contaminate the developer with fluorescent penetrant, as the penetrant specks can appear as indications.

6.4.2 *Aqueous Developers* are normally supplied as dry powder particles to be either suspended or dissolved (soluble) in water. The concentration, use, and maintenance shall be in accordance with manufacturer's recommendations (see 7.1.8.1(*b*)).

6.4.3 *Nonaqueous, Wet Developers* are supplied as suspensions of developer particles in a nonaqueous solvent carrier ready for use as supplied. Nonaqueous, wet developers form a coating on the surface of the part when dried, which serves as the developing medium for fluorescent penetrants (see 7.1.8.1(*c*)).

NOTE 6—**Caution:** This type of developer is intended for application by spray only.

6.4.4 *Liquid Film Developers* are solutions or colloidal suspensions of resins/polymer in a suitable carrier. These developers will form a transparent or translucent coating on the surface of the part. Certain types of film developer may be stripped from the part and retained for record purposes (see 7.1.8.1(*d*)).

7. Procedure

7.1 The following general procedure applies to the fluorescent liquid penetrant examination, lipophilic post-emulsification process method (see Fig. 1).

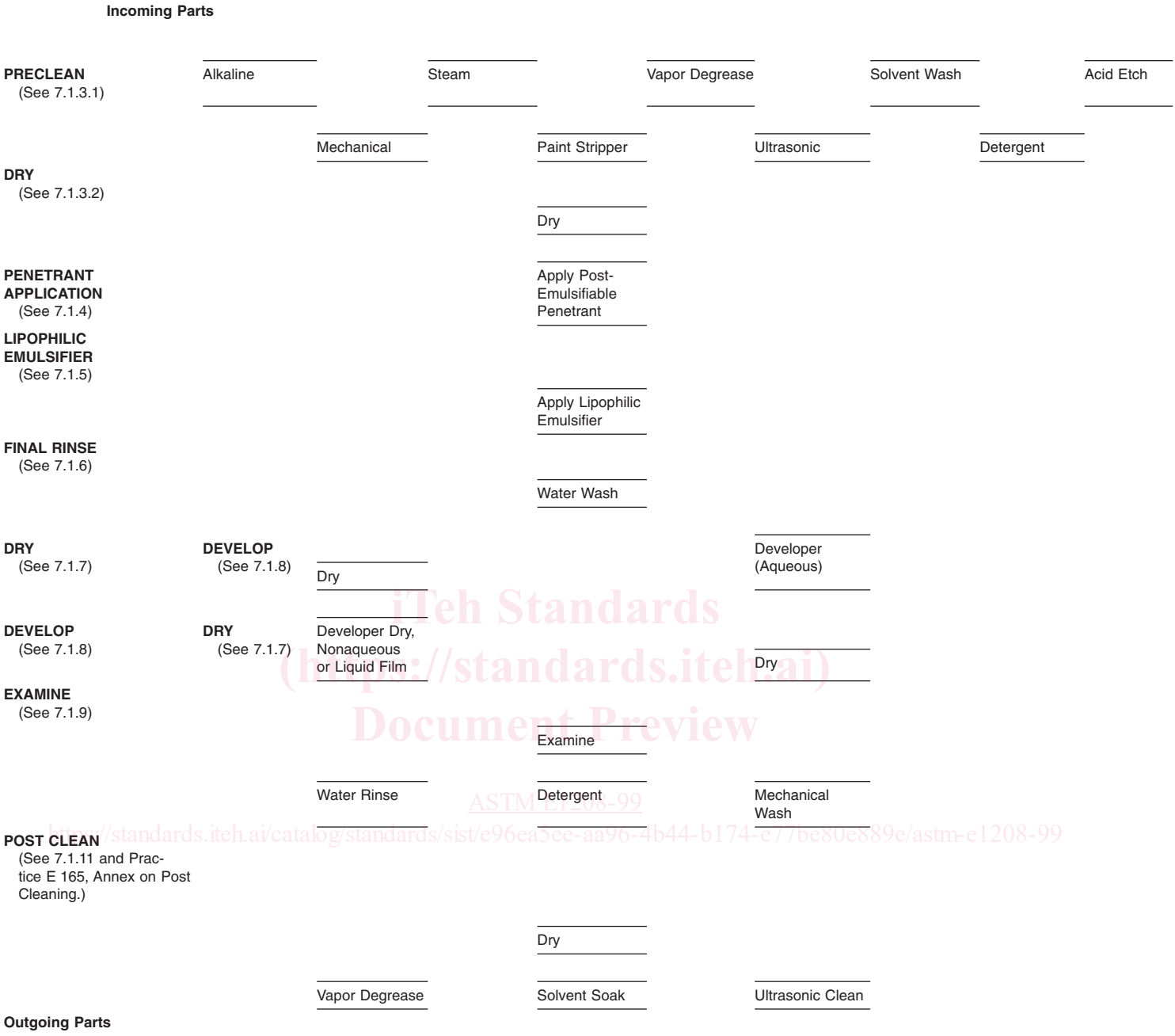

FIG. 1 General Procedure Flowsheet for Fluorescent Penetrant Examination Using the Lipophilic Post-Emulsification Process

7.1.1 *Temperature Limits*—The temperature of the penetrant materials and the surface of the part to be processed should be between 40 and 120°F (4 and 49°C). Where it is not practical to comply with these temperature limitations, qualify the procedure at the temperature of intended use as described in 9.2.

7.1.2 *Surface Conditioning Prior to Penetrant Inspection*—Satisfactory results may be obtained on surfaces in the as-welded, as-rolled, as-cast, or as-forged conditions or for ceramics in the densified condition. These sensitive penetrants are generally less easily rinsed away and are therefore less suitable for rougher surfaces. When only loose surface residuals are present, these may be removed by wiping the surface with clean lint-free cloths. However, precleaning of metals to remove processing residuals such as oil, graphite, scale, insulating materials, coatings, and so forth, should be done using cleaning solvents, vapor degreasing or chemical removing processes. Surface conditioning by grinding, machining, polishing or etching shall follow shot, sand, grit and vapor blasting to remove the peened skin and when penetrant entrapment in surface irregularities might mask the indications of unacceptable discontinuities or otherwise interfere with the effectiveness of the examination. For metals, unless otherwise specified, etching shall be performed when evidence exists that