



Designation: E1418 – 05

# Standard Test Method for Visible Penetrant Examination Using the Water-Washable Process<sup>1</sup>

This standard is issued under the fixed designation E1418; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

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

1.2 This test method also provides the following references:

1.2.1 A reference by which visible penetrant examination procedures using the water-washable process can be reviewed to ascertain their applicability and completeness.

1.2.2 For use in the preparation of process specifications dealing with the visible, water-washable liquid penetrant examination of materials and parts. Agreement between the user and the supplier 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 criteria for evaluation of the indications obtained. It should be noted, however, that after indications have been produced, they must be interpreted or classified and then evaluated. For this purpose there must be a separate code, specification, or a specific agreement to define the type, size, location, and orientation of indications considered acceptable, and those considered unacceptable.

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

1.5 *Basis of Application*—There are areas in this test method that may require agreement between the cognizant

engineering organization and the supplier, or specific direction from the cognizant engineering organization. These areas are identified as follows:

- 1.5.1 Penetrant type, method and sensitivity,
- 1.5.2 Accept/reject criteria,
- 1.5.3 Personnel qualification requirements,
- 1.5.4 Grit blasting,
- 1.5.5 Etching,
- 1.5.6 Indication/discontinuity sizing,
- 1.5.7 Total processing time, and
- 1.5.8 Marking of parts.

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.*

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

- D129 Test Method for Sulfur in Petroleum Products (General Bomb Method)
- D516 Test Method for Sulfate Ion in Water
- D808 Test Method for Chlorine in New and Used Petroleum Products (Bomb Method)
- D1552 Test Method for Sulfur in Petroleum Products (High-Temperature Method)
- E165 Practice for Liquid Penetrant Examination for General Industry
- E433 Reference Photographs for Liquid Penetrant Inspection
- E543 Specification for Agencies Performing Nondestructive Testing
- E1316 Terminology for Nondestructive Examinations

2.2 *ASNT Standards*:

- Recommended Practice SNT-TC-1A for Nondestructive Testing Personnel Qualification and Certification<sup>3</sup>

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.03 on Liquid Penetrant and Magnetic Particle Methods.

Current edition approved January 1, 2005. Published January 2005. Originally approved in 1991. Last previous edition approved in 2004 as E1418 - 04. DOI: 10.1520/E1418-05.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from The American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlington Lane, Columbus, OH 43228-0518.

**ANSI/ASNT-CP-189** Standard for Qualification and Certification of NDT Personnel<sup>3</sup>

2.3 *Military Standard:*

**MIL-STD-410** Nondestructive Testing Personnel Qualification and Certification<sup>4</sup>

2.4 *AIA Standard:*

**NAS-410** Certification and Qualification of Nondestructive Test Personnel<sup>5</sup>

2.5 *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:*

3.1.1 The definitions relating to liquid penetrant examination that appear in Terminology **E1316**, shall apply to the terms used in this test method.

### 4. Summary of Test Method

4.1 A liquid penetrant is applied evenly over the surface being examined and allowed to enter open discontinuities. After a suitable dwell time, the excess surface penetrant is removed with water and the surface is dried prior to the application of a developer. A developer is then applied, drawing the entrapped penetrant out of the discontinuities and staining the developer. If an aqueous developer is to be employed, the developer is applied prior to the drying step. After application of the developer, a suitable development time is allowed to permit the entrapped penetrant to exit from the discontinuities. The test surface is then examined visually under adequate illumination to determine the presence or absence of indications.

4.2 The selection of specific water-washable penetrant process parameters depends upon the nature of the application, conditions under which the examination is to be performed, availability of processing equipment, and type of materials to perform the examination. (**Warning**—A controlled method for applying water and disposing of the water is essential.)

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

### 5. Significance and Use

5.1 Liquid penetrant examination methods indicate the presence, location, and, to a limited extent, the nature and magni-

tude of the detected discontinuities. This test method is normally used for production examination of large volumes of parts or structures, where emphasis is on productivity. This test method offers a wide latitude in applicability when extensive and controlled conditions are available.

### 6. Reagents and Materials

6.1 *Visible, Water-Washable Liquid Penetrant Examination Materials*, consisting of applicable visible penetrants as recommended by the manufacturer, and are classified as Type II Visible Method A—Water-Washable (see **Note 1**). (**Warning**—While approved penetrant materials will not adversely affect common metallic materials, some plastics or rubber may be swollen or stained by certain penetrants.)

**NOTE 1**—Refer to **8.1** for special requirements for sulfur, halogen, and alkali metal content.

6.2 *Water-Washable Penetrants*, designed to be directly water-washable from the surface of the part, after a suitable penetrant dwell time. Because the emulsifier is “built-in” to the water-washable penetrant, it is extremely important to exercise proper process control in removing excess penetrant to ensure against overwashing. Water-washable penetrants can be washed out of discontinuities if the washing step is too long or too vigorous. Some penetrants are less resistant to overwashing than others.

6.3 *Developers*—Development of penetrant indications is the process of bringing the penetrant out of open discontinuities through the blotting action of the applied developer, thus increasing the visibility of the penetrant indications. Several types of developers are suitable for use in the visible penetrant water-washable process.

6.3.1 *Aqueous Developers*, 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 the manufacturer’s recommendations (see **7.1.7.1**). (**Warning**—Aqueous developers may cause stripping of indications, if not properly applied and controlled. The procedure should be qualified in accordance with **9.2**.)

6.3.2 *Nonaqueous, Wet Developers*, normally supplied as suspensions of developer particles in a volatile solvent carrier and are ready for use as supplied. They are applied to the surface by spraying after the excess penetrant has been removed and the surface has dried. Nonaqueous wet developers form a white coating on the surface of the part when dried and serve as a contrasting background for visible penetrants (see **7.1.7.2**). (**Warning**—This type of developer is intended for application by spray only.)

6.3.3 *Liquid Film Developers*, 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 developers will fix indications and may be stripped from the part and retained for record purposes (see section **7.1.7.3**).

### 7. Procedure

7.1 The following general procedures applies to the water-washable, visible penetrant examination method (see **Fig. 1**).

<sup>4</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098

<sup>5</sup> Available from the Aerospace Industries Association of America, Inc., 1250 Eye Street, N.W., Washington, DC 20005.

Incoming Parts

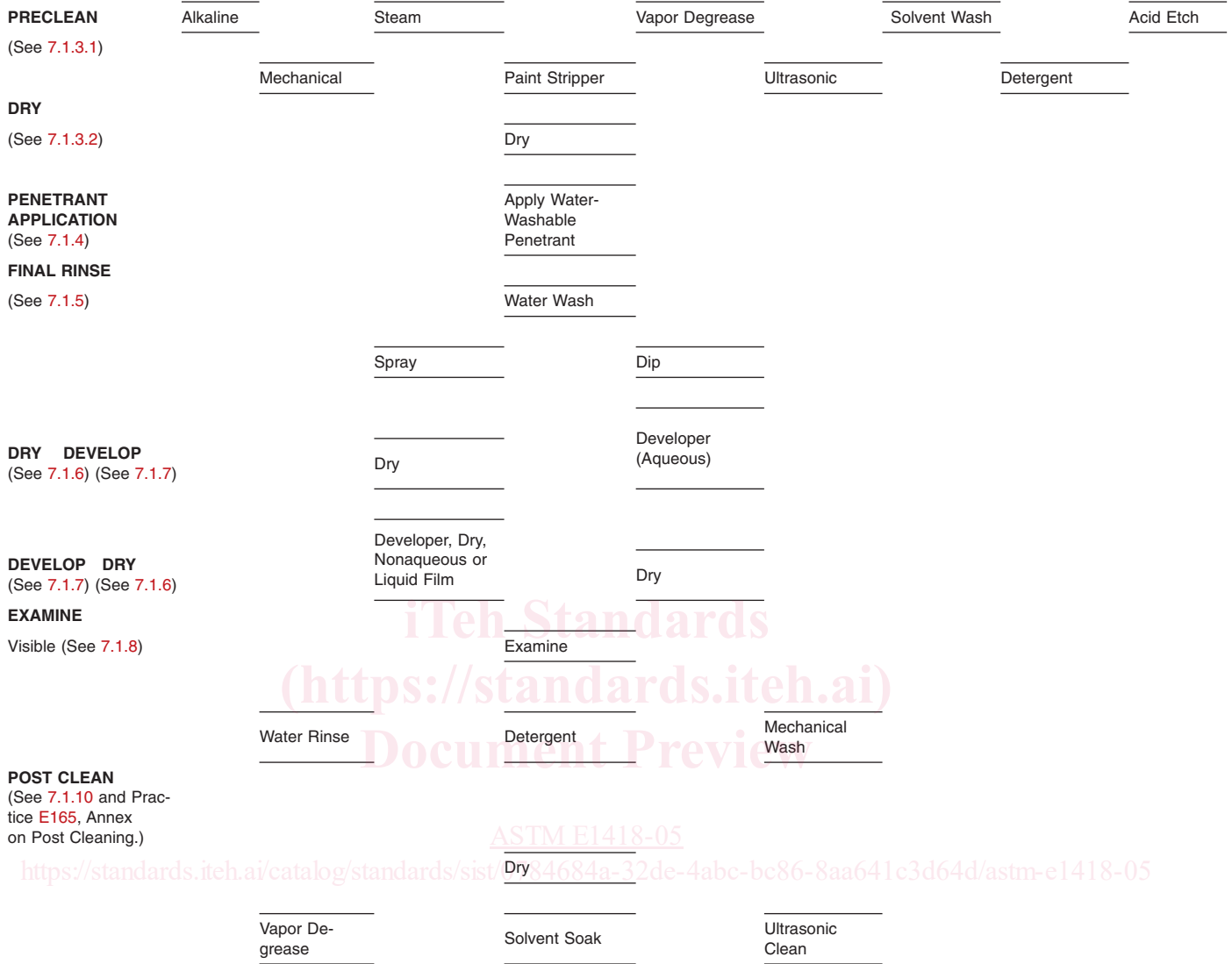


FIG. 1 General Procedure Flowsheet for Visible Penetrant Examination Using the Water-Washable Process

7.1.1 *Temperature Limits*—The temperature of the penetrant materials and the surface of the part to be processed should be from 40 to 125°F [4 to 52°C]. When it is not practical to comply with these temperature limitations, the procedure must be qualified at the temperature of intended use as described in 9.2.

7.1.2 *Surface Conditioning Prior to Penetrant Examination*—Satisfactory results can usually be obtained on surfaces in the as-welded, as-rolled, as-cast, or as-forged conditions (or for ceramics in the densified condition). When only loose surface residuals are present, these may be removed by wiping with a clean lint-free cloth. However, pre-cleaning of metals to remove processing residuals such as oil, graphite, scale, insulating materials, coatings, etc. should be done using cleaning solvents, vapor degreasing, or chemical removing processes. Surface conditioning by grinding, machining, pol-

ishing, 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, perform etching when evidence exists that previous cleaning, surface treatments, or service usage have produced a surface condition that degrades the effectiveness of penetrant examination. (See Annex A1.1.1.8 in Test Method E165 for precautions).

NOTE 2—When agreed between purchaser and supplier, grit blasting without subsequent etching may be an acceptable cleaning method. (Warning—Sand or shot blasting may possibly close indications and extreme care should be used with grinding and machining operations.)

NOTE 3—For structural or electronic ceramics, surface preparation by grinding, sand blasting and etching for penetrant examination is not