



Designation: E1418 – 21

Standard Practice for Visible Penetrant Testing Using the Water-Washable Process¹

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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes procedures for visible liquid penetrant examination utilizing the water-washable process. It is a nondestructive practice 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 practice 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 practice 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 practice 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.

1.3.1 The user is encouraged to use materials and processing parameters necessary to detect conditions of a type or severity which could affect the evaluation of the product.

1.4 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are

mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *Basis of Application*—There are areas in this practice 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards*:²

- D129 Test Method for Sulfur in Petroleum Products (General High Pressure Decomposition Device Method)
- D516 Test Method for Sulfate Ion in Water
- D808 Test Method for Chlorine in New and Used Petroleum Products (High Pressure Decomposition Device Method)
- D1552 Test Method for Sulfur in Petroleum Products by High Temperature Combustion and Infrared (IR) Detection or Thermal Conductivity Detection (TCD)

¹ This practice 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.

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² 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.

E165/E165M Practice for Liquid Penetrant Testing for General Industry

E433 Reference Photographs for Liquid Penetrant Inspection

E543 Specification for Agencies Performing Nondestructive Testing

E1219 Practice for Fluorescent Liquid Penetrant Testing Using the Solvent-Removable Process

E1316 Terminology for Nondestructive Examinations

2.2 ASNT Standards:³

Recommended Practice SNT-TC-1A for Nondestructive Testing Personnel Qualification and Certification

ANSI/ASNT-CP-189 Standard for Qualification and Certification of NDT Personnel

2.3 Other Standards:

ISO 9712 Non-destructive Testing—Qualification and Certification of NDT Personnel—General Principles⁴

AMS 2644 Inspection Material, Penetrant⁵

2.4 AIA Standard:⁶

NAS410 Certification and Qualification of Nondestructive Test Personnel

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 practice and the references cited herein, the text of this practice 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 practice.

4. Summary of Practice

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

6. Reagents and Materials

6.1 *Visible, Water-Washable Liquid Penetrant Testing 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). Penetrant materials shall conform to AMS 2644 unless approved by the contract or Level III. (**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. The developer used shall provide a contrasting white background. 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.)

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

⁴ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

⁵ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

⁶ Available from the Aerospace Industries Association of America, Inc., 1250 Eye Street, N.W., Washington, DC 20005.