



Designation: E1417/E1417M – 21^{ε1}

Standard Practice for Liquid Penetrant Testing¹

This standard is issued under the fixed designation E1417/E1417M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

^{ε1} NOTE—Table 1 was updated editorially in December 2021.

1. Scope*

1.1 This practice establishes the minimum requirements for conducting liquid penetrant examination of nonporous metal and nonmetal components.

NOTE 1—This practice replaces MIL-STD-6866.

1.2 The penetrant examination processes described in this practice are applicable to in-process, final, and maintenance (in-service) examinations. These processes are applicable for the detection of discontinuities, such as lack of fusion, corrosion, cracks, laps, cold shuts, and porosity, that are open or connected to the surface of the component under examination.

1.3 Caution must be exercised in the usage of elevated temperature with components manufactured from thermoplastic materials. Also, some cleaners, penetrants, and developers can have a deleterious effect on nonmetallic materials such as plastics. Prior to examination, tests should be conducted to ensure that none of the cleaning or examination materials are harmful to the components to be examined.

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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

NOTE 2—Throughout this document, the term *blacklight* has been changed to *UV-A* to conform with the latest terminology in Terminology E1316. *Blacklight* can mean a broad range of ultraviolet radiation; fluorescent penetrant examination only uses the UV-A range.

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.

Current edition approved Sept. 1, 2021. Published October 2021. Originally approved in 1991. Last previous edition approved in 2020 as E1417/E1417M – 20. DOI: 10.1520/E1417_E1417M-21E01.

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 The following documents form a part of this practice to the extent specified herein:

2.2 *ASTM Standards*:²

D95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

D6304 Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration

E165/E165M Practice for Liquid Penetrant Testing for General Industry

E203 Test Method for Water Using Volumetric Karl Fischer Titration

E543 Specification for Agencies Performing Nondestructive Testing

E1135 Test Method for Comparing the Brightness of Fluorescent Penetrants

E1316 Terminology for Nondestructive Examinations

E2297 Guide for Use of UV-A and Visible Light Sources and Meters used in the Liquid Penetrant and Magnetic Particle Methods

E3022 Practice for Measurement of Emission Characteristics and Requirements for LED UV-A Lamps Used in Fluorescent Penetrant and Magnetic Particle Testing

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.

*A Summary of Changes section appears at the end of this standard



2.3 ASNT Standards:³

ANSI/ASNT-CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel
SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

2.4 Military Standards:^{4,5}

MIL-STD-6866 Inspection, Liquid Penetrant
QPL-AMS-2644 Qualified Products List, Inspection Material, Penetrant

2.5 ANSI/ISO/EN Standards:⁶

ANSI/NCSL Z540.3 General Requirement for Calibration Laboratories and Measuring Test Equipment
EN 4179 Qualification and Approval of Personnel for Non-destructive Testing
ISO 9712 Non-destructive Testing-Qualification and Certification of NDT Personnel
ISO 10012 Measure Management Systems—Requirements for Measurement Processes and Measuring Equipment
ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

2.6 AIA Standard:⁷

NAS 410 Certification and Qualification of Nondestructive Test Personnel

2.7 SAE Standards:⁸

AMS 2175 Castings, Classification and Inspection of
AMS 2644 Inspection Material, Penetrant
AMS 3158 Solution, Fluorescent Penetrant Water Base for LOX Compatibility

2.8 *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 terminology relating to liquid penetrant examination that appears in Terminology E1316 shall apply to the terms used in this practice.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *aerospace, n*—any component that will be installed on a system that flies.

3.2.2 *cognizant engineering organization, n*—reference Terminology E1316.

³ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

⁴ Copies of specifications, standards, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.

⁵ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

⁶ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁷ Available from Aerospace Industries Association (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209, <http://www.aia-aerospace.org>.

⁸ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

3.2.3 *component, n*—the part(s) or element(s) of a system described, assembled, or processed to the extent specified by the drawing.

3.2.4 *final examination, n*—the final examination performed for the acceptance of the item.

3.2.4.1 *Discussion*—Any change to the item's surface such as machining, grinding, welding, heat treatment, or etching by subsequent manufacturing operation, may render the previous examination invalid, requiring reexamination of all affected surfaces, unless otherwise approved in the contract.

3.2.5 *in-process, adj*—that which occurs during manufacturing before a component is in final form.

3.2.6 *in-service, adj*—refers to components that are in use or storage for their intended function.

3.2.7 *reprocess, v*—repeat, after cleaning, the application and appropriate processing of penetrant, emulsifier (as required), and developer (as required).

3.2.8 *supplier, n*—the organization contracted to supply the material, parts, or assembly.

3.2.9 *turbine engine critical components, n*—any component on turbine engine designated by the manufacturer as “critical.”

4. Significance and Use

4.1 This practice establishes the basic parameters for controlling the application of the liquid penetrant method. This practice is written so it can be specified on the engineering drawing, specification, or contract. It is not a detailed how-to procedure to be used by the inspector and, therefore, must be supplemented by a detailed procedure that conforms to the requirements of this practice. Practice E165/E165M contains information to help develop detailed requirements.

5. Classification

5.1 Penetrant examination processes and materials are classified in accordance with the material classification contained in AMS 2644. Penetrant systems covered by this practice shall be of the following types, methods, and sensitivity levels:

5.1.1 Type:

5.1.1.1 *Type I*—Fluorescent dye.

5.1.1.2 *Type II*—Visible dye.

5.1.2 Method:

5.1.2.1 *Method A*—Water washable.

5.1.2.2 *Method A(W)*—Water washable-water containing.

5.1.2.3 *Method B*—Post-emulsifiable, lipophilic.

5.1.2.4 *Method C*—Solvent-removable.

5.1.2.5 *Method D*—Post-emulsifiable, hydrophilic.

5.1.3 *Sensitivity*—(These levels apply to Type I penetrant systems only. Type II penetrant systems have only a single sensitivity and it is not represented by any of the levels listed as follows):

5.1.3.1 *Sensitivity Level 1/2*—Very low.

5.1.3.2 *Sensitivity Level 1*—Low.

5.1.3.3 *Sensitivity Level 2*—Medium.

5.1.3.4 *Sensitivity Level 3*—High.

5.1.3.5 *Sensitivity Level 4*—Ultraprecise.

5.2 Developers shall be of the following forms: