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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	8/30/2016	Initial issue. Supersedes KSL PT Procedure 16-30-007.	David Bingham, <i>ES-EPD</i>	Larry Goen, <i>ES-DO</i>

Contact the Welding Standards POC for upkeep, interpretation, and variance issues.

ITM-1306-NDE-PT-101	<u>Welding POC and Committee</u>
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1.0 Purpose & Scope

This procedure provides for the detection and evaluation of discontinuities open to the surface, such as cracks, linear, round and other types of surface discontinuities utilizing the Liquid Penetrant (PT) Method. Specifically, it addresses the use of the Solvent-Removable, Visible Dye technique (Type II, Method C), with Non-aqueous Wet Developer, as specified by ASTM E 165 and the ASME Boiler and Pressure Vessel Code Section V, Article 6.

2.0 Authority and Applicability

- A. **Authority.** This document is issued under the authority of the Laboratory Director to direct the management and operation of the Laboratory, as delegated to ADE as provided in the [Prime Contract](#). This procedure is issued under the authority of the ES-DO. It applies to Liquid Penetrant Nondestructive Examinations as described herein, performed within the scope defined in Section 1.0.

Issuing Authority (IA) and Responsible Manager (RM)/Office: Conduct of Engineering Office Director.

- B. **Applicability.** This procedure applies to Liquid Penetrant Examination activities performed by LANL-authorized NDE inspectors listed with LANL Engineering Standards Manual Chapter 13.

3.0 Personnel Qualification and Training

A. Qualification/Certification

Personnel performing Liquid Penetrant Testing in accordance with this procedure shall meet the following minimum qualifications of being certified or approved as either:

- Level II or Level III in accordance with ESM Chapter 13, Volume 6, WGIN 2-02, which is written based upon the guidelines of ASNT SNT-TC-1A.
- Level I in accordance with ESM Chapter 13, Volume 6, WGIN 2-02, and working under the direct supervision of a Certified Level II or Level III.

4.0 Materials and Equipment

- A. **Penetrant.** Penetrant materials may be purchased in bulk. However, in such cases the penetrant materials cleanliness and traceability shall be maintained when

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transferring material from one container to another. Intermixing of materials from various manufacturers is prohibited.

- B. **Materials.** Materials can only be decanted into clean containers. Previously-used containers shall be cleaned before introduction of penetrant materials by use of a solvent such as acetone or isopropyl alcohol.
- C. **Developer.** Developer must be applied by spraying. Developer therefore cannot be purchased in bulk for field use and aerosol cans must be used. For stationary installations, an air paint sprayer may be used. The reservoir must be cleaned with solvent such as acetone or isopropyl alcohol before introducing the developer.
- D. **Cleaner/Remover.** The system Cleaner/Remover may not be used for cleaning of the containers for penetrant materials. Final precleaning should be accomplished using a solvent such as isopropyl alcohol or acetone to remove any residues left by the system Cleaner/Remover.
- E. **Material Certification.** Certification of the penetrant material compliance with the requirements of ASTM E 165 and ASME Boiler and Pressure Vessel Code Section V shall be obtained. Residual sulfur and halogens shall be limited to a maximum of 1% by weight. Certification of isopropyl alcohol or acetone is not required if the material is lab- or reagent-grade.
- F. **Safety.** Penetrant materials can be flammable, and care must be taken to avoid all sources of ignition. In particular, the fumes and vapors associated with developer are very flammable. Penetrant inspection shall not be performed around or near open sources of ignition.
- G. **Material Selection:** Only penetrant materials listed in this procedure are permitted to be used. The following materials are approved for use with this procedure:

Magnaflux Products

- Penetrant: Spotcheck SKL-SP2
- Developer: Spotcheck SKD-S2
- System Remover: Spotcheck SKC-S

NOTE: *No other penetrant materials may be used with this procedure. The penetrant materials are an essential variable for Liquid Penetrant Examination per the ASME Code; consequently, no other materials may be utilized without qualification and revision of this procedure.*

5.0 Surface Preparation

In general, satisfactory results may be achieved when the surface to be inspected is in the as-welded, as-rolled, as-cast, or as-forged condition. Surface preparation by grinding, machining, or other methods may be required to remove surface irregularities.

- A. **Precleaning.** All parts or areas of parts shall be clean and dry prior to penetrant application. The surface to be examined and adjacent areas within 1 inch of the area to be inspected shall be cleaned. "Clean" shall mean that the surface is free of rust, scale, welding flux, weld spatter, grease, paint, oily films, dirt, and residues from previous penetrant examinations, and so forth, that might interfere with the penetrant inspection.
- B. **Method.** Cleaning of the area to be examined may be done by use of detergents, organic solvents, or vapor degreasing. Cleaners must not leave a residue that could interfere with the subsequent penetrant inspection. Certification of reagent-grade acetone or isopropyl alcohol used for precleaning is not required. As a final precleaning step, the system Remover or a solvent such as acetone or isopropyl alcohol shall be used to clean the surface.
- C. **Drying.** After cleaning, drying of the surface to be examined shall be accomplished by normal evaporation or with forced hot air, as appropriate. . The part shall be dried for a minimum of five (5) minutes, or longer if needed, to ensure that the surface is completely dry prior to penetrant application.
- D. **Special Requirements.** Examination of surfaces that require a specific surface finish shall be finished prior to the final Liquid Penetrant Examination prescribed by the applicable specifications. Penetrant inspection shall always be conducted prior to surface peening.

6.0 Procedure, General Requirements

- A. **Temperature.** The test surface and materials shall be maintained in the temperature range of 40 °F to 125 °F throughout the examination period. Higher or lower temperatures are permitted only when the penetrant materials have been qualified for the temperature to be used during the examination. Documentation of that qualification shall be included with the test report.
- B. **Lighting.** Lighting shall be a minimum of 100 fc (1076 lx) at the surface of the part during evaluation. The light meter used for verification of lighting acceptability shall have been calibrated within the past year.

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- C. **Deviation from Procedure.** Any deviation or failure to comply with the steps in this procedure shall be cause for reprocessing of the part or component.

7.0 Procedure, Specific Requirements

- A. **Penetrant Application.** Upon completion of all surface preparation, the penetrant shall be applied by spraying, dipping, or brushing.
- B. **Coverage.** The surface in the area of interest shall be coated completely and the full coating maintained for the required penetration (dwell) time. The dwell time shall be a minimum of 10 minutes. Dwell times should not exceed one hour, but may if the surface is rewetted as needed and there is no sign of the penetrant drying or becoming sticky.
- C. **Excess Penetrant Removal.** After the appropriate dwell time, excess penetrant shall be removed, insofar as possible, by wiping with a clean, lint free cloth or absorbent paper. Repeat the process until most traces of penetrant have been removed. The remaining traces are removed using cloth or paper lightly moistened with solvent.

NOTE: *Flushing the test surface with solvent is never permitted except during initial precleaning and final cleaning of the part or component.*

- D. **Drying.** After removal of excess penetrant, the surface shall be allowed to dry for a minimum of five minutes, and a maximum of ten minutes, by normal evaporation.
- E. **Developing.** Developer shall be applied as soon as possible after excess penetrant removal and drying of the surface. Developer shall be applied by spraying only. No other method of application is permitted by this procedure. The developer shall be applied in light coats, with no “blotching” or drops of developer. Ideally, the developer will “flash” dry almost immediately after application. Developing time for final evaluation begins immediately after the application and drying of the developer.

8.0 Interpretation and Evaluation of Indications

The true size and type of discontinuities are difficult to evaluate if the penetrant diffuses excessively into the developer. The evaluation process therefore begins immediately upon application of developer, and as a consequence the Inspector will monitor the behavior of indications during the development process. Final inspection of the test surface and evaluation of indications shall begin 10 to 60 minutes after applying the developer.

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- A. **Lighting.** Visible light level at the examination site of 100 fc (1000 lux) is required.
- B. **Final Interpretation.** Final interpretation shall be made not less than 10 minutes nor more than 60 minutes after application of the developer. If bleed-out does not alter the examination results, longer periods are permitted. The use of the longer interpretation time shall be documented in the test report. Because a discontinuity is difficult to characterize if its indication has diffused excessively into the developer, the part and development of indications shall be observed throughout the development and interpretation time.
- C. **Acceptance Criteria.** Acceptance criteria shall be provided by the NDE requestor and shall be documented on the NDE Inspection Report.

9.0 Post Examination Cleaning

Post-inspection cleaning shall be accomplished as soon as possible after Evaluation and Documentation. Post-inspection cleaning should leave no penetrant material residue, and shall not be injurious to the part.

10.0 Responsibilities

QA-PM is primary performing organization.¹ Performance may be subcontracted by QA-PM, or by owners with QA-PM permission. Use by other LANL groups (e.g., Applied Engineering Technology AET-6) NDE group with permission of LANL Level III or Welding Program Administrator.

- A. **Responsible Line Manager (RLM).** The RLM shall ensure only those personnel who meet the requirements of this procedure are permitted to perform inspections/activities covered by this procedure. Personnel performing inspections shall be qualified and certified in accordance with Paragraph 3.0 of this procedure.
- B. **Test Personnel.** Personnel performing examinations per this procedure are expected to verify that their certification in the Liquid Penetrant method is current. It is the responsibility of test personnel certified to Level I, II, or III to perform the dye penetrant tests described herein and record the results of that examination. Personnel certified to Level II or III shall supervise the examination, when performed by a Level I, and evaluate the results of this examination. Personnel performing PT testing shall wear appropriate safety and

¹ Should responsible organizations change, applies to successor organizations.

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protective equipment during field-testing as noted in the Integrated Work Document and have the appropriate personal protective equipment (PPE) as defined in the Material Safety Data Sheet (MSDS).

11.0 Implementation

As noted throughout.

12.0 Documents and Records

Test reports generated as a result of this procedure shall be maintained in accordance with LANL records policies. The test object owner shall ensure that records are appropriately stored and are traceable to the part that has been examined.

13.0 Acronyms and Definitions

Acronym/ Term	Description
ASME	American Society of Mechanical Engineers
ASTM	ASTM International, formerly American Society for Testing and Materials
Inspection	A phase of quality control, which by means of examination, testing, observation, or measurement determines the conformance of materials, supplies parts, components, appurtenances, systems, processes, or structures to predetermined quality requirements. For this procedure, examination and inspection may be considered to have the same definition.
Liquid Penetrant Examination	A nondestructive test that uses suitable liquids to penetrate discontinuities open to the surfaces under test and, after appropriate treatment, indicates the presence of discontinuities.
NDE	Non-destructive examination
NDT	Non-destructive testing
Penetrant materials	The specified penetrant, solvents, cleaning agents, and developer used in the examination process.
PT	Penetrant testing
Test personnel	Personnel qualified and certified Section 3.0 of this procedure
Testing	The determination or verification of the capability of an item to meet specified requirements by subjecting the item to a set of physical, chemical, environmental, operating conditions.

For other definitions, see LANL [Definition of Terms](#) or [Acronyms and Names](#).

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14.0 History

This document supersedes any conflicting requirements in O&M Criterion 419, [Inspections and Testing of Pressure Vessels and Pressure Relief Valves](#), but the Criterion remains in force and effect for each nuclear and high-hazard facility until they complete any necessary Unreviewed Safety Question (USQ) or Unreviewed Safety Issue (USI) review determinations.

15.0 References

ASTM E 165-12, *Standard Recommended Practice for Liquid Penetrant Inspection Method*

American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code, Section V, Nondestructive Examination.*

ASNT SNT-TC-1A, 2011, *Qualification and Certification of NDT Personnel.*

16.0 Forms

ITM-1306-NDE-PT-101-FM01, Penetrant Testing Inspection Report

17.0 Contact

POC: Welding Program Administrator (ES-EPD)

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