

WP 13-QA1001

Revision 7

Liquid Penetrant Examination

Technical Procedure

EFFECTIVE DATE: 03/12/10

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APPROVED FOR USE

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NDE LEVEL III

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INTRODUCTIONS^{1,2}

This procedure provides guidance for performance of the Liquid Penetrant Inspection (PT). Liquid penetrant inspection provides a method for the detection of discontinuities open to the surface in nonporous ferrous and non-ferrous materials. This method of Nondestructive Examination (NDE) is limited to inspection of nonporous metallic and nonmetallic materials for detection of discontinuities open to the surface using the Type II (visible dye), Method C (Solvent Removable), Form E (non-aqueous) developer technique.

Drawings, engineering specifications, or other parent documentation will specify the extent of liquid penetrant inspection, the acceptance standards, and any other applicable inspection requirements.

This procedure is performed in conjunction with general examination/inspection/test requirements contained in WP 13-QA1006.

Performance of this procedure generates the following records, as applicable:

- EA13QA1001-1-0, Liquid Penetrant Inspection Report – Visible Solvent Removable Method
- EA13QA1001-2-0, Liquid Penetrant Inspection Report Log

Record copies of the completed EA13QA1001-1-0 will be kept with the parent document (documentation which requires the inspection, e.g., work order). Quality Assurance Inspection Services will retain the record copy of EA13QA1001-1-0 not initiated by a parent document.

All records generated by the implementation of this procedure will be handled, stored, and dispositioned in accordance with the department/section's Records Inventory and Disposition Schedule.

Washington TRU Solutions LLC (WTS) recognizes that the terms examination, testing and inspection are terms commonly used as synonyms in nondestructive testing. For uniformity and consistency the term inspection will be used when describing the application of nondestructive test methods.

REFERENCES

BASELINE DOCUMENTS

- AMS-2644, *Military Specification Inspection Materials, Penetrants*
- ASME Section III, *Nuclear Vessels*
- ASME Section V, *Nondestructive Testing*

- ASME Section VIII, *Unfired Pressure Vessels Recommended Practice*
- ASTM E 165, *Standard Test Method for Liquid Penetrant Examination*
- ASTM E270, *Standard Definitions of Terms Relating to Liquid Penetrant Inspection*
- ASTM E 1220, *Test Method for Visible Liquid Penetrant Examination Using the Solvent-Removable Process*
- ASTM E 1316, *Standard Terminology for Nondestructive Examinations*
- ASTM E1417 *Standard Practice for Liquid Penetrant Examination*
- AWS Structural Welding Codes (AWS D1.1, AWS D1.3, AWS D1.6, etc.)
- MIL-I-25135, *Aerospace material Inspection Material, Penetrant*
- WP 13-1, Washington TRU Solutions LLC Quality Assurance Program Description
- WP 15-RM, WIPP Records Management Program

REFERENCED DOCUMENTS

- WP 02-RC3108, Request for Disposal
- WP 04-IM1000, Issues Management Processing of WIPP Forms
- WP 12-IH.02-2, WIPP Industrial Hygiene Program-Confined Spaces
- WP 12-IS.01-1, Attachment 1, Job Hazard Analysis Form
- WP 13-QA.06, Quality Assurance Department Qualification and Certification of Nondestructive Examination Personnel
- WP 13-QA1006, Quality Assurance Plant Inspections
- WP 13-QA3004, Nonconformance Report
- WP 15-PM3526, Receipt Discrepancies

EQUIPMENT

- All penetrant products will be complete penetrant systems (families), as listed in QPL-MIL-I-25135 or QPL-AMS2644, with manufacturer traceable batch numbers. Mixing of penetrant materials from different families or manufacturers is prohibited. The following materials are approved for use with this procedure:

Manufacturer	APPROVED GROUPINGS		
	PENETRANT	CLEANER	DEVELOPER
Magnaflux	SKL-SP1	SKC-S	SKD-S2
Magnaflux	SKL-WP	SKC-S	SKD-S2
Sherwin	DP-40	DR-60 or DR-62	D-100
Sherwin	DP-50	DR-60 or DR-62	D-100
Ardrox	907PB	9PR50C	9D1B

- If inspection is on austenitic stainless steels, titanium, or nickel base alloys, then the inspection materials (cleaner, penetrant, and developer) residual sulfur and halogen content must not exceed 1% by weight in sulfur, and chlorine plus fluorine content.
- Equivalent equipment/materials shall meet the approval of the NDE Level III.
- Calibrated thermometer to verify penetrant materials and the surface of the part to be inspected are between 40°F (4°C) and 125°F (52°C).

NOTE

A calibrated light meter is only required for the one-time light level verification. A change in light source or technique will require re-verification and demonstration.

- Calibrated light meter for the one-time light level verification noted in Subsection 1.0.
- Lint free cloth or absorbent paper
- Light source capable of producing a minimum of 100 foot candles
- Personnel Protective Equipment (PPE), i.e. gloves, safety glasses, etc. (Reference PPE table found in Precautions and Limitations section below.)

PRECAUTIONS AND LIMITATIONS

- This procedure should be performed in a well-ventilated area. Breathing fumes from cleaner, penetrant, or developer can cause dizziness, nausea, drowsiness, loss of consciousness, or loss of coordination. If this

procedure must be used in an enclosure, Industrial Safety should be contacted for an evaluation.

- Nitrile rubber or impermeable gloves should be worn to prevent skin contact with cleaner, penetrant, or developer. Prolonged or frequent contact with cleaner, penetrant, or developer can cause dermatitis.
- This procedure should NOT be performed where heat, sparks, or other ignition sources are present. Cleaner, developer, and penetrant materials are flammable, and may be ignited in the presence of ignition sources.
- PPE is required as follows:

HAZARD	REQUIRED PPE
Poorly ventilated spaces	Respirator with organic vapor cartridge or other cartridge as specified in the penetrant manufacturer's Material Safety Data Sheets (MSDSs)
Confined, unventilated spaces	Full face mask with separate air supply
Eye injury	Safety glasses or goggles
Skin injury	Nitrile rubber or impermeable gloves

- NO aerosol cans are allowed in the Waste Handling Bay in Waste Handling mode (Remote-Handled or Contact-Handled). Prior to performing a penetrant inspection, the inspector shall verify the particular area is NOT in Waste Handling mode. Waste Handling mode verification will be by contacting the WIPP Site Facility Shift Manager (FSM) or designee.
- Personnel Qualifications – All personnel conducting liquid penetrant inspection to this procedure shall be qualified, at a minimum, as a NDE Level II inspector, or a qualified NDE Level I inspector working directly with a qualified Level II or Level III, in accordance with WP 13-QA.06.
- Penetrant materials must not have exceeded the manufacturer's recommended shelf life.

PERFORMANCE

1.0 LIGHTING

NOTE

The surface under inspection shall have sufficient lighting (natural or artificial white light). Sufficient lighting is defined by the ability to detect a 1/32 inch (0.8 mm) black line on an 18 percent neutral gray card or a 1/32 inch increment on a Starrett machinist's scale or equivalent under the conditions of inspection. The minimum light intensity at the surface being inspected shall be 100 foot candles.

- 1.1 Demonstrate sufficient lighting, one time, for each light source and technique used for that light source.
 - 1.1.1 Verify light level using a calibrated light meter.
 - 1.1.2 Document the demonstration on EA13QA1006-1-0 and maintain on file.
 - 1.1.3 If light source or technique is changed, reverify and demonstrate sufficient lighting.

2.0 TIME OF INSPECTION

- 2.1 When visual inspection is required, ensure that visual inspection is completed prior to liquid penetrant inspection.
- 2.2 If inspecting A514, A517, and A709 Grades 100 and 100W steels, ensure that not less than 48 hours have passed after completion of all welding, prior to visual inspection (or liquid penetrant inspection).

3.0 TEMPERATURE

- 3.1 Verify, using a calibrated thermometer, that the temperature of the penetrant materials and the surface of the part to be inspected are between 40°F (4°C) and 125°F (52°C).
- 3.2 Ensure that the temperature range is maintained throughout the inspection.
- 3.3 If it is not practical to comply with these temperature limitations, request an addendum to this procedure, qualified at the temperature of intended use as described in the governing code and/or parent documents and approved by the NDE Level III prior to use. In the event an addendum is required, EA13QA1006-1-0 may be used to document the new qualified temperature and maintained on file.

4.0 CLEANING AND SURFACE CONDITION

NOTE

If permitted by the parent document and it will not interfere with the inspection, the surface may be precleaned with typical cleaning agents such as detergents, organic solvents, descaling solutions, and paint removers. Degreasing and ultrasonic cleaning methods may also be used. Cleaning solvents residual sulfur and halogen content must not exceed 1% by weight in sulfur, and chlorine plus fluorine content, if material to be cleaned is an austenitic stainless steel, titanium, or nickel based alloy.

4.1 Ensure, prior to penetrant inspection, that surfaces to be examined and all adjacent areas within one inch on each side of the area of interest are free of grease, dirt, scale, rust, paint, oil, weld flux, spatter, or any contaminant that may obscure openings or interfere with the inspection.

4.1.1 Avoid cleaning by harsh abrasive methods such as shot blasting, sand blasting, filing, metal scraping, or high-speed rotary brushes. If an abrasive cleaning method is used, special surface conditioning requirements, such as acid etching, is required prior to penetrant testing. Surface conditioning solvents or chemicals shall be used in accordance with the applicable JHA, MSDS, and the manufacturer's instructions and precautions.

4.2 Divide large surface areas into smaller inspection areas, when necessary.

5.0 DRYING – PRIOR TO PENETRANT APPLICATION

NOTE

Parts may be air-dried after cleaning. Forced air may be used provided that the surface to be inspected remains within the temperature envelope (40 °F to 125 °F).

5.1 Allow a minimum of 5 minutes drying time.

5.2 Ensure the cleaning solution has evaporated prior to the application of the penetrant.

6.0 PENETRANT APPLICATION

6.1 Apply the penetrant by dipping, brushing, or spraying.

NOTE

In no case shall the penetrant be allowed to dry during the dwell time. Any drying of penetrant during the dwell time shall require complete cleaning and reprocessing.

- 6.2 Accomplish complete coverage of the surface under inspection and maintain for a minimum of 10 minutes to a maximum of 30 minutes.
- 6.3 Re-apply penetrant as necessary during the dwell time to prevent drying of penetrant on the part.

7.0 PENETRANT REMOVAL

NOTE

Cleaning solvents (i.e., Isopropyl Alcohol, Acetone, etc.) may only be used for pre-cleaning and post-cleaning operations and may not be used during the excess penetrant removal operation. Only an approved penetrant remover may be used during excess penetrant removal. Cleaning solvents residual sulfur and halogen content must not exceed 1% by weight in sulfur, and chlorine plus fluorine content, if material to be cleaned is an austenitic stainless steel, titanium, or nickel based alloy.

NOTE

Flushing the surface with cleaner following the application of penetrant and prior to developing is prohibited.

- 7.1 Remove all, or the majority of the penetrant, with a clean, dry, lint free cloth or absorbent paper. If all the penetrant cannot be removed with the dry cloth or paper, the cloth or paper shall be slightly dampened with cleaner and surfaces lightly wiped to remove the remaining traces.
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NOTE

Surfaces may be dried by normal evaporation, blotting, or wiping. Forced air may be used provided that the surface to be inspected remains within the temperature envelope (40 °F to 125°F).

- 7.2 Allow a minimum of 5 minutes drying time.
- 7.3 Ensure the cleaning solution has evaporated prior to the application of the developer.

8.0 DEVELOPING

- 8.1 Apply developer as soon as possible after penetrant removal and part drying.

8.1.1 Agitate developers prior to application and periodically during use. Agitation of all spray cans and suspension type wet developers is mandatory.

8.1.2 When the parts are completely dry, apply thin uniform coating of developer to the entire surface being inspected.

- Developer shall be applied by spraying, except where safety or restricted access precludes it. Under such conditions, developer may be applied by brushing.
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- Pools of wet developer on the surface under inspection shall not be permitted.

8.2 Allow a minimum of 10 minutes developing time. The minimum final interpretation developing time begins as soon as the wet developer coating is dry.

9.0 DRYING – AFTER APPLICATION OF DEVELOPER

9.1 Allow the developer to dry by normal evaporation.

10.0 INSPECTION

10.1 Begin inspection immediately after application of the developer and as the indications are forming.

10.2 Make final interpretation no sooner than 10 minutes and no later than a maximum of 60 minutes after the developer is dry.

11.0 EVALUATION OF INDICATIONS

11.1 Evaluate indications in accordance with the following:

- Mechanical discontinuities at the surface will be indicated by penetrant bleeding out onto the contrasting background (developer); however, localized surface imperfections may occur from machining marks or surface conditions may produce similar indications which are non-relevant to the detection of unacceptable discontinuities.
- Any indication which is believed to be non-relevant shall be regarded as a defect and shall be re-examined to verify whether or not actual defects are present. Surface conditioning may precede the re-inspection. Non-relevant indications and broad areas of pigmentation, which would mask indications of defects, are unacceptable.

- Relevant indications are those which result from mechanical discontinuities. Linear indications are those indications in which the length is more than three times the width. Rounded indications are indications which are circular or elliptical with the length equal to or less than three times the width.
- An indication of a discontinuity may be larger than the discontinuity that causes it; however, the size of the indication and not the size of the discontinuity is the basis of acceptance or rejection.

12.0 ACCEPTANCE STANDARDS

12.1 Determine acceptance (accept/reject) in accordance with the following:

- Acceptance criteria shall be as specified in the drawing, parent document, applicable specification, or code.
- When required by the engineering specification or other parent documentation, specific acceptance will be written as an addendum to this procedure (i.e., Quality Assurance Inspection Plan [QAIP]).

13.0 POST EXAM CLEANING

13.1 Perform post inspection cleaning as soon as possible upon completion of all inspection activities.

13.1.1 Conduct cleaning using a process that does not adversely affect the part.

13.1.2 Dispose of used wipes and rags resulting from the performance of this procedure in accordance with WP 02-RC3108.

14.0 RECORDS

14.1 Record results, i.e., manufacturer of penetrant materials, batch numbers, accept/reject, etc., of the liquid penetrant inspection on EA13QA1001-1-0.

15.0 DEFICIENT CONDITIONS

NOTE

Discrepant material identified during the initial receipt and/or receipt inspection processes at the warehouse will be documented and resolved through the use of a Receipt Discrepancy Report (RDR) in accordance with WP 15-PM3526. A Nonconformance Report (NCR) will be required only for discrepant items to be retained and dispositioned for use by WTS and subcontractors obligated to our program.

- 15.1 If deficiencies are identified during inspection/test, as applicable.
- 15.1.1 Issue ONE of the following:
- RDR in accordance with WP 15-PM3526
 - WIPP Form (EA04IM1000-1-0) in accordance with WP 04-IM1000
 - NCR (EA13QA3004-1-0) in accordance with WP 13-QA3004
- 15.1.2 Record the RDR, WIPP Form, or NCR number, as applicable, on EA13QA1001-1-0.
- 15.1.3 Initiate and hang hold tags in accordance with WP 13-QA3004.

16.0 M&TE USAGE LOG

- 16.1 Designated Quality Engineer, perform the following:
- 16.1.1 Maintain a Measuring and Test Equipment (M&TE) usage log on the QA database (Gallina/QRA/QAIS).
- 16.1.2 Compile M&TE data from the completed EA13QA1001-1-0 and/or EA13QA1006-1-0.
- 16.1.3 Enter complied data on the M&TE usage log.
- 16.1.4 Generate and complete and EA13QA1006-1-0 each month in accordance with WP 13-QA1006, documenting the M&TE usage.
- 16.1.5 Forward a copy of the monthly Quality Assurance M&TE Usage Log to the Metrology Office.