



**Blue Sheet
Engineering Division**

DCN:

<p>This Blue Sheet applies to: <input checked="" type="checkbox"/> Individual Policy/Procedure Listed Below</p>		
<p>LANL review date: 12/1/08</p>		
<p>Policy/Procedure No: # KSL – PT - Procedure- 16-30-007</p>	<p>Rev. No.: 3</p>	<p>Date: 7/11/2007</p>
<p>Manual, Policy or Procedure Title: Liquid Penetrant Examination</p>		
<p>Reason for Revision (if complete revision is checked above) Roll over of SSS contractor activities and work to LANL/LANS</p>		
<p>Documents listed above will be reviewed and conformed to by: All qualified personnel to perform Liquid Penetrant examination for acceptance of welding & related fabrications.</p>		
<p>Description of Change:</p> <p>1.0 Purpose - No Changes</p> <p>2.0 Scope – delete – “by QC Inspection Services Department” and “by KSL”</p> <p>3.0 Definitions – Delete “QC – Quality Control , which is a department under PA Division” Modify “Test Personnel” – to read – Test & Inspection personnel qualified in accordance with Engineering Standards Manual (ESM), Chapter 13 – Welding & Joining, Volume 1, GWS 1-11 Attachment 3, Qualification and Certification of NDE Personnel.</p> <p>4.0 Responsibilities – Delete “QC Manager responsibilities paragraph Add - Personnel performing inspections shall be qualified and certified in accordance with ESM, Chapter 13 – Welding & Joining, Volume 1, GWS 1-11 Attachment 3, Qualification and Certification of NDE Personnel.</p> <p>5.0 Methodology –</p> <p style="padding-left: 40px;">5.1.6 Delete - Acceptance criteria shall be established by the NDE requestor and shall be documented on the NDE Inspection Report 16-30-005.1</p> <p>6.0 Records – Modify to read Recordable indications shall be reported as to length, width and location and recorded on LANL NDE Inspection Report Form. GWS 1-11 Attachment Modify last paragraph to read - The original report shall be given to the customer with a copy placed in inspectors file for a period of 1 year unless instructed by the customer to retain copies longer.</p>		

KSL Procedures/Work Instructions

7.0 References – Delete –

16-00-012, Control of Special Processes <http://intranet.ksl.lanl.gov/crypt/ap/16-00-012.pdf>

- Add –

ESM, Chapter 13 – Welding & Joining, Volume 1, GWS 1-11 Attachment 3, Qualification and Certification of NDE Personnel.

Implementation Support Document ISD 330-5.0 – Special Processes

8.0 Attachments:

Delete – “Form 16-30-007.1 NDE Inspection Report”

Add – NDE Inspection Report Form – GWS 1-11 Attachment 4

Date Revision Required: 12/1/10

Changes as marked

Reviewed by:

Kelly Bingham
LANL Welding Program Administrator

Date: 12-2-08

Approved by:

____ Signature on File ____ Date: 3/31/09 ____ Signature on File ____ Date: 3/31/09 ____
ES - DE Group Leader ES - DE Division Leader

MSS Policy/Procedures Review Team please forward original Blue Sheet to Luci Chavez upon approval



LIQUID PENETRANT EXAMINATION

16-30-007

IMPLEMENTATION

Affected Personnel: QC PERSONNEL PERFORMING LIQUID PENETRANT EXAMINATION AT KSL

Training Determination: Access Briefing

Procedure Owner: Performance Assurance Division

Release Date: 07/11/2006

Next Revision Date: 07/11/2009

Procedure Type: Operational Procedure

Revision Number: 3

Procedure Level: Department

Effective Date: 7/28/06

DOCUMENT MODIFICATION HISTORY

Rev No.	Description of Modification
1	Format changes and transfer to KSL
2	Format changes and update
3	Minor changes, reformatted into new template. Quick changes.

DOCUMENT REVIEW AND APPROVAL

Function	Name	Position Title	Date	Signature
Prepared by	Craig Rich	QC Inspector		
	Morgan Dungan	PA Document Coordinator		
Reviewed and Approved by	Thomas Bentley	Quality Control Specialist III		
	Richard Bingham	ASNT Level III		
Final Approval by	Gerald Woodson	Q.C. Manager		
	Dan Gibson	Performance Assurance Division Director		

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1.0 PURPOSE

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 Method.

2.0 SCOPE

This procedure applies to Liquid Penetrant Examination activities performed by QC Inspection Services department on items examined by KSL unless specified differently under a specific code or procedure.

3.0 DEFINITIONS/ACRONYMS

ASME – American Society of Mechanical Engineers

ASTM – 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.

IWD – Integrated Work Document

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.

NDT – Nondestructive Testing

Penetrant Materials - As used herein is intended to include penetrants, solvents, cleaning agents, developers, etc. used in the examination process.

MSDS – material Safety Data Sheet

NDE - Non Destructive Examination

PT – Penetrant Testing

PA – Performance Assurance Division

QC – Quality Control, which is a department under the PA Division

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.

Test Personnel – Personnel qualified and certified per QAP 16-30-001, Qualification and Certification of NDE Personnel

4.0 RESPONSIBILITIES

QC Manager

It is the responsibility of the QC Manger to 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 KSL Administrative Procedure (AP) 16-00-011, Qualifications of Inspection, examination & testing personnel.

Test Personnel

It is the responsibility of test personnel certified to Level I, II, or III 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 protective equipment during field-testing as noted in the IWD and have the appropriate protective equipment as defined in the MSDS.

5.0 METHODOLOGY

5.1 PROCEDURAL STEPS

5.1.1 PENETRANT MATERIALS

- Penetrant materials may be purchased in bulk. However, in such cases the penetrant materials cleanliness and traceability shall be maintained when transferring material from one container to another.
- The residual amounts of sulfur and halogens of materials used for penetrant examinations shall be defined and certified. The residual amount of sulfur and halogens shall not exceed one percent by weight.
- Material Safety Data sheets (MSDS) shall be available for hazards and controls associated with the Liquid Penetrant materials.

5.1.2 SURFACE PREPARATION

- Surfaces to be examined shall be free of all contaminants such as oil, dirt, lint, scale, weld flux, paint and other constituents that may interfere with the examination, including residues from previous penetrant examinations.
- Cleaning of the area to be examined may be done by use of detergents, or organic solvents or vapor degreasing. Grit blasting or shot peening should be avoided for cleaning due to the possible obscuring of open to surface discontinuities.
- Drying of surface after cleaning may be accomplished by normal evaporation or with circulating air. A minimum of five (5) minutes drying time shall be allowed to ensure that all traces of cleaning agents have evaporated from the test surface.
- Surfaces in the as-welded condition, following the removal of slag, shall be considered suitable for Liquid Penetrant Examination without grinding, provided it does not interfere with interpretation of test results, and, if the weld edge contour blends smoothly into the base metal.
- Examination of surfaces that require a specific surface finish shall be finished prior to the final Liquid Penetrant Examination prescribed by the applicable specifications.

5.1.3 EXAMINATION TECHNIQUES METHOD "1" VISIBLE PENETRANT-SOLVENT REMOVABLE

- This method is classified as Type II Visible, Method C –Solvent-Removable. Intermixing of materials from various manufacturers' ID not recommended.

- The test surface and materials shall be maintained in the temperature range of 40 degrees to 120 degrees 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.
- After cleaning, drying of the surface to be examined shall be accomplished by normal evaporation or with forced hot air, as appropriate.
- Upon completion of all surface preparation, the penetrant shall be applied by spraying, dipping, or brushing. The test surface shall be kept wet for a minimum dwell time as recommended by the manufacturer or per ASTM E1220, Table 1, Recommended Minimum Dwell Times. Unless otherwise specified, the dwell time shall not exceed the maximum recommended by the manufacturer.
- 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. Flushing the test surface with solvent is not recommended, unless approved by the NDT Level III. Normal evaporation should be sufficient for drying after removal of excess penetrant using the solvent.
- Developer shall normally be applied by spraying (Non-aqueous Wet Developer).
- The true size and type of discontinuities are difficult to evaluate if the penetrant diffuses excessively into the developer. Consequently, the Inspector will monitor the behavior of indications which tend to bleed-out profusely. Final inspection of the test surface and evaluation of indications shall begin 10 to 60 minutes after applying the developer.
- Visible light level at the examination site of 100fc (1000 lux) is recommended.

5.1.4 EXAMINATION TECHNIQUES METHOD "2" FLUORESCENT PENETRANT-SOLVENT REMOVABLE

- This method is classified as Type I Fluorescent, Method C –Solvent-Removable. Intermixing of materials from various manufacturers' ID not recommended.
- The test surface and materials shall be maintained in the temperature range of 40 degrees to 120 degrees 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.
- After cleaning, drying of the surface to be examined shall be accomplished by normal evaporation or with forced hot air, as appropriate
- Upon completion of all surface preparation, the penetrant shall be applied by spraying, dipping, or brushing. The test surface shall be kept wet for a minimum dwell time as recommended by the manufacturer or per ASTM E1219, Table 1, Recommended Minimum Dwell Times. Unless otherwise specified, the dwell time shall not exceed the maximum recommended by the manufacturer.
- 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. Flushing the test surface with solvent is not recommended, unless approved by the NDT Level III.

- Developer shall normally be applied by spraying (Non-aqueous Wet Developer).
- The true size and type of discontinuities are difficult to evaluate if the penetrant diffuses excessively into the developer. Consequently, the Inspector will monitor the behavior of indications which tend to bleed-out profusely. Final inspection of the test surface and evaluation of indications shall begin 10 to 60 minutes after the application of the developer.
- Perform examination of parts after the applicable development times as specified in developer times to allow for bleed out of penetrant from discontinuities onto the developer coating. It is good practice to observe the surface while applying the developer as an aid in evaluating indications.

Visible Ambient light level

- Examine fluorescent penetrant indications under black light in a darkened area. Visible ambient light should not exceed 2 fc (20Lux). The measurement should be made with a suitable photographic-type visible-light meter on the surface being examined.

Black light level

- Black light intensity (recommended minimum of 1000 $\mu\text{W}/\text{cm}^2$) should be measured on the surface being examined with a suitable black light meter. The black light shall have wavelength in the range from 320 to 380 nm. The intensity should be checked daily to assure the required output.

Black light warm up

- Allow the black light to warm up for a minimum of 10 min prior to its use or measurement of the intensity of the ultraviolet light emitted.

Visual adaptation

- The examiner should be in the darkened area for at least 1 min before examining parts. Longer times may be necessary for a more complete adaptation under some circumstances.



Photochromic or darkened lenses shall not be worn during examination.

5.1.5 EXAMINATION TECHNIQUES METHOD "3" FLUORESCENT PENETRANT-WATER WASHABLE

- Upon completion of all surface preparation, the penetrant shall be applied by spraying, dipping, or brushing. The test surface shall be kept wet for a minimum dwell time as recommended by the manufacturer or per ASTM E1209, Table 1, and Recommended Minimum Dwell Times. Unless otherwise specified, the dwell time shall not exceed the maximum recommended by the manufacturer.
- After The required penetration dwell time, the excess on the surface being examined must be removed with water, usually a washing operation. It can be washed off manually, by the use automatic or semiautomatic water spray equipment or by immersion. Accumulation of water in pockets or recesses of the surface must be avoided. If over removal is suspected, dry the (see drying times) and reclean the part, then reapply the penetrant for the prescribed dwell time.

CAUTION

Avoid over washing. Excessive washing can cause penetrant to be washed out of discontinuities. Perform the rinsing operation under black light so that it can be determined when the surface penetrant has been adequately removed.

Immersion rinsing

- For immersion rinsing, parts are completely immersed in the water bath with air or mechanical agitation. Effective rinsing of the water-washable, fluorescent penetrants by spray application can be accomplished by either manual or automatic water spray rinsing of the parts.
 - a. Rinse time should not exceed 120 s unless otherwise specified by part of material specification.
 - b. The temperature of the water should be relatively constant and should be maintained within the range of 50 degree to 100 degree F.
 - c. Spray rinse water pressure should not be greater than 30 psi.

Removal by wiping

- In special applications, penetrant removal may be performed by wiping the surface with a clean, absorbent material dampened with water until the excess surface penetrant is removed, as determined by examination under black light.

Drying

- During the preparation of parts for examination, drying is necessary following the application of the non-aqueous developer. Drying time will vary with the size, nature, and number of parts under examination.

Modes of drying

- Parts can be dried using a hot-air recirculation oven, a hot or cold-aired blast, or by exposure to ambient temperature.

Drying time limits

- Do not allow parts to remain in the drying oven any longer than is necessary to dry the part. Excessive time in the dryer may impair the sensitivity of the examination.

Non-aqueous, Wet Developers

- Developer shall normally be applied by spraying (Non-aqueous Wet Developer).

No developer

- For certain applications, it is permissible, and may be appropriate, to conduct this examination without the use of developer.

Developer time

- The minimum and maximum penetrant bleed out time with no developer shall be 10 min and 1 hr. respectively.

Examination

- Examine fluorescent penetrant in a darkened area. Visible ambient light level should not exceed 2fc (20 lux).
- The black light intensity should be 1000 μ W/cm² at the surface to be examined. The black light shall have wavelength in the range from 320 to 380 nm. The intensity should be checked daily to assure the required output. The black light shall be allowed to warm-up for 10 minutes prior to its use and of measurement of intensity. The examiner should be in the darkened area for at least 1 minute before examining the parts.
- Perform examination of parts after the applicable development times as specified in developer times. To allow for bleed out of penetrant from discontinuities onto the developer coating. It is good practice to observe the surface while applying the developer as an aid in evaluating indications.

Visible Ambient light level

- Examine fluorescent penetrant indications under black light in a darkened area. Visible ambient light should not exceed 2 fc (20Lux). The measurement should be made with a suitable photographic-type visible-light meter on the surface being examined.

Black light level

- Black light intensity (recommended minimum of 1000 μ W/cm²) should be measured on the surface being examined with a suitable black light meter. The black light shall have wavelength in the range from 320 to 380 nm. The intensity should be checked daily to assure the required output.

Black light warm up

- Allow the black light to warm up for a minimum of 10 min. prior to its use or measurement of the intensity of the ultraviolet light emitted.

Visual adaptation

- The examiner should be in the darkened area for at least 1 min. before examining parts. Longer times may be necessary for a more complete adaptation under some circumstances.



Photochromic or darkened lenses shall not be worn during examination.

5.1.6 INTERPRETATION AND EVALUATION OF INDICATIONS

- All indications shall be evaluated in terms of the acceptance criteria. Discontinuities at the surface will be indicated by bleed-out of penetrant. However, localized surface irregularities due to machining marks or other surface conditions may produce false indications. Broad areas of staining which could mask indications of discontinuities are unacceptable, and such areas shall be cleaned and reexamined.
- Acceptance criteria shall be established by the NDE requestor and shall be documented on the NDE Inspection Report 16-30-005.1.

5.1.7 POST CLEANING

- Post cleaning is necessary in those cases where penetrant would interfere with subsequent processing or with service requirements.

6.0 RECORDS

A copy of this procedure and qualification records shall be made available upon request.

Recordable indications shall be reported as to length, width and location and recorded on the inspection report.

The original report shall be given to the customer with a copy retained by QC for a period of 1 year unless instructed by the customer to retain copies longer.

7.0 REFERENCES

1. American Society of Testing and Materials (ASTM) E270, Standard Definitions of Terms relating to Liquid Penetrant Inspection
2. ASTM E165-02, Standard Recommended Practice for Liquid Penetrant Inspection Method
3. ASTM E 1219-05, Standard Test Method for Fluorescent Liquid Penetrant Examination Using the Solvent-Removable Process
4. ASTM E1220-05, Standard Test Method for Visible Liquid Penetrant Examination Using the Solvent-Removable Process
5. ASSTM E1209-05, Standard Test Method for Fluorescent Liquid Penetrant Examination Using the Water –Washable Process
6. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section V, Nondestructive Examination
7. American Welding Society (AWS) D1.1, Structural Steel
8. KSL JV Procedure 16-00-012, Control of Special Processes - <http://intranet.ksl.lanl.gov/crypt/ap/16-00-012.pdf>

8.0 ATTACHMENTS

Form 16-30-007.1 NDE Inspection Report



NDE Inspection Report

Project	Work Order #	Date
Product Nomenclature	Procedure Specification	Type of Material

METHOD MT <input type="checkbox"/> UT <input type="checkbox"/> PT <input type="checkbox"/> RT <input type="checkbox"/>	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:10%;"><i>Welder Identification</i></td> <td style="width:10%;"><i>Surface Indications</i></td> <td style="width:10%;"><i>Porosity</i></td> <td style="width:10%;"><i>Slag Inclusions</i></td> <td style="width:10%;"><i>Cracks</i></td> <td style="width:10%;"><i>Incomplete Fusion</i></td> <td style="width:10%;"><i>Inadequate Penetration</i></td> <td style="width:10%;"><i>Tungsten Inclusions</i></td> <td style="width:10%;"><i>Undercut</i></td> <td style="width:10%;"><i>Burn Through</i></td> <td style="width:10%;"><i>Gas and Blow Holes</i></td> <td style="width:10%;"><i>Accept</i></td> <td style="width:10%;"><i>Reject</i></td> </tr> </table>	<i>Welder Identification</i>	<i>Surface Indications</i>	<i>Porosity</i>	<i>Slag Inclusions</i>	<i>Cracks</i>	<i>Incomplete Fusion</i>	<i>Inadequate Penetration</i>	<i>Tungsten Inclusions</i>	<i>Undercut</i>	<i>Burn Through</i>	<i>Gas and Blow Holes</i>	<i>Accept</i>	<i>Reject</i>	DATA Straight/Angle Beam Db Level Unit Serial # Ducer Serial # Calibration Block #
<i>Welder Identification</i>	<i>Surface Indications</i>	<i>Porosity</i>	<i>Slag Inclusions</i>	<i>Cracks</i>	<i>Incomplete Fusion</i>	<i>Inadequate Penetration</i>	<i>Tungsten Inclusions</i>	<i>Undercut</i>	<i>Burn Through</i>	<i>Gas and Blow Holes</i>	<i>Accept</i>	<i>Reject</i>			

		Casting
		Other
		Single wall
		Double Wall
		Material Thickness
		Film to Source
		Exposure time
		Source type
		Curie Strength
		Kilovolts
		Milli-amperes
		Screens
		Filters
		Pene. Type
		Shim Size
		Sensitivity
		Film Size
		Film Type
		Film Quantity
		Pene. (dye) Flour.
		Dwell Time
		Mag (AC) (DC)
		Coil
		Yokes
		Central Bar
		Head Shot
		Prod.
		Amps
		Unit Calibration Date:

Batch #(Ut, PT,MT)		
Remarks		
		Inspectors Signature Level
		This inspection was performed in accordance with the above named procedure/specification.
	Reviewed By	

Form 16-08-04.01