



OPERATING PROCEDURE

Procedure No.

SES 26-701

Title

LIQUID PENETRANT INSPECTION

Written By

Revised By

Revision Description

Release Date | Rev.



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1.0 PURPOSE

To provide a detailed procedure for the inspection of parts using Solvent Removable Visible Dye or water washable visible dye penetrant (PT) inspection.

2.0 APPLICABILITY

The requirements of this procedure are directive in nature to all personnel involved in:

- 2.1 Defining design requirements for Liquid Penetrant inspection.
- 2.2 The performance of Liquid Penetrant inspection for purposes of final product acceptance.

3.0 REFERENCE DOCUMENTS

- 3.1 SARA SAE Quality Assurance Manual
- 3.2 SOP 6.001, "Training"
- 3.3 SOP 7.003, "Workmanship Standard"
- 3.4 SOP 7.005, "Control of Non-Conforming Material"
- 3.5 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code
 - 3.5.1 Section V, Article 1 & 6, "Nondestructive Testing/Liquid Penetrant Examination"
 - 3.5.2 Section V, Article 24 SE-165, "Standard Practice for Liquid Penetrant Inspection"
- 3.6 American Petroleum Institute (API)
 - 3.6.1 Specification 6A, "Specification for Wellhead and Christmas Tree Equipment"
 - 3.6.2 Specification 16A, "Specification for Drill Thru Equipment"
 - 3.6.3 Specification 8A, "Specification for Drilling and Production Hoisting Equipment"



- 3.6.4 Specification 8C, "Specification for Drilling and Production Hoisting Equipment (PSL-1 and PSL-2)"
- 3.6.5 Specification 16D, "Control Systems for Drilling Well Control Equipment"
- 3.6.6 Specification 16C, "Specification for Choke and Kill Systems"
- 3.7 American Society for Testing and Materials (ASTM)
 - 3.7.1 ASTM E 433-71, "Standard Reference Photographs for Liquid Penetrant Examination"
 - 3.7.2 ASTM E 165-91, "Standard Practice for Liquid Penetrant Inspection"
- 3.8 American Society for Nondestructive Testing (ASNT)
 - 3.8.1 Recommended Practice SNT-TC-1A

4.0 GENERAL

Liquid Penetrant inspection is a nondestructive method for detecting discontinuities which are open to the surfaces of ferrous and non-ferrous materials. The intent of this procedure is to provide the required controls for the use of Liquid Penetrant Inspection.

5.0 RESPONSIBILITY

- 5.1 Design Engineering is responsible for including this procedure as a design requirement when Liquid Penetrant inspection is specified on product drawings. This requirement is effective with the original release of this procedure.
- 5.2 Manufacturing Engineering is responsible for including this procedure as a requirement on Process Routers in accordance with design requirements.
- 5.3 Quality Control is responsible for performing Liquid Penetrant Inspection for final product acceptance. The inspections shall be performed in accordance with this procedure.
- 5.4 The NDT Level III is responsible for approving Liquid Penetrant Inspection procedures.



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6.0 METHODS6.1 General

- 6.1.1 Liquid Penetrant inspection is performed where specified by the applicable Engineering drawing, Quality Assurance Plan, Manufacturing Routers or Nonconformance Report disposition.
- 6.1.2 SARA SAE personnel performing Liquid Penetrant inspection for final product acceptance shall be NDT Level II.
- 6.1.3 When NDT is subcontracted, the requirements of this procedure shall be followed:
 - 6.1.3.1 Technician qualifications shall be provided to SARA SAE and filed in the Quality Records Department.
 - 6.1.3.2 Technicians performing and/or interpreting PT inspections for final acceptance shall be NDT Level II - PT minimum and shall be qualified in accordance with the requirements specified in ASNT SNT-TC-1A.
 - 6.1.3.3 All subcontract PT inspection shall be accompanied by a report of Nondestructive Testing listing acceptance criteria and status
- 6.1.4 Material. The material tested is steel--wrought, cast, or welded. Surfaces tested are between 60°F and 125°F (15°C - 52°C).
- 6.1.5 Product Form. Configuration is the Design Engineering or process drawing. Surfaces may be in the as-cast, welded, rolled, or forged condition except where surface irregularities could mask indications of defects.
- 6.1.6 Test Materials. Liquid penetrant testing shall be conducted using only the materials listed in Exhibit A of this procedure.

6.2 Procedure

6.2.1 Position and Lighting.

- 6.2.1.1 Parts ready for testing are positioned for convenient access.



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6.2.1.2 Visible penetrant indications can be examined with either natural or artificial light. Adequate illumination is required to ensure no loss of sensitivity of the examination. A minimum light intensity at the examination site of 100 fc is recommended. If necessary, a flashlight or other auxiliary lighting may be used.

6.2.2 Part Preparation/Process Procedure

6.2.2.1 Visually examine surface for gross indications of discontinuities.

6.2.2.2 All surface irregularities that may mask the image of a discontinuity shall be removed by suitable means.

6.2.2.3 All surfaces to be examined and adjacent areas within 2" are to be clean, dry, and completely free of dirt, oil, grease, lint, weld spatter, or any other contaminant that could interfere with test results.

6.2.2.4 If necessary, the surfaces to be examined are to be cleaned with a residue free cleaner and wiper material prior to penetrant application. Clean wiper material used without cleaner may be used where it proves adequate to provide the necessary level of cleanliness.

6.2.2.5 Repeat cleaning process as necessary to insure the cleanliness of the part to be inspected. Dirt picked up by the wiper material is an indicator of the cleanliness of the area of interest.

USE EXTREME CAUTION! SOLVENT IS HIGHLY COMBUSTIBLE!

Extreme care should be taken when handling and applying solvent. Smoking shall not be permitted during the preparation and cleaning of the part to be inspected.

6.2.2.6 After final cleaning, allow two (2) minutes minimum or until completely dry before application of penetrant.



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6.2.2.7 After area to be inspected is dry, apply penetrant to the entire test surface by spraying from a pressurized can, or painting with a brush.

6.2.2.8 Penetrant Dwell time

<u>Surface</u>	<u>Minimum</u>	<u>Dwell Time Maximum</u>
Cast	5 minutes	30 minutes
Forged or wrought	10 minutes	30 minutes
Cad, plated, coated	5 minutes	30 minutes
Welded	5 minutes	30 minutes

6.2.2.9 Penetrant Removal

A. Remove excess penetrant by wiping with clean, dry, lint-free wiper material after dwell time. Penetrant remaining after this operation shall be removed as follows, dependent upon penetrant method used.

B. Solvent Removable Visible Dye Penetrant

Remove penetrant with a wiper material lightly dampened with remover.

CAUTION: DO NOT USE EXCESS REMOVER AS IT MAY REDUCE THE SENSITIVITY OF THE TEST.

C. Water Washable Dye Penetrant

Remove penetrant with a wiper material lightly dampened with water.

CAUTION: DO NOT USE EXCESS WATER AS IT MAY REDUCE THE SENSITIVITY OF THE TEST.

6.2.2.10 Developing

A. The time between excess penetrant removal and developer application shall not exceed 10 minutes.



- B. After the excess penetrant is removed, the developer shall be sprayed on the test area in a thin, even coat.
- C. The surface is closely observed during the application of the developer to monitor the behavior of indications which tend to bleed profusely.

6.3 EVALUATION

All indications shall be evaluated in terms of relevant or non-relevant to the acceptance standards defined in this procedure, or as otherwise specified in design documents or Quality Plans. An indication of an imperfection may be larger than the imperfection that causes it; however, the size of the indication is the basis for acceptance evaluation.

6.3.1 **Relevant Indications.** Only those indications with major dimensions equal to or greater than 1/16 inch shall be considered relevant unless otherwise specified in design documents, Quality Plans, or exhibits of this SOP.

6.3.2 **Nonrelevant Indications.** Any indication which is believed to be nonrelevant shall be regarded as an imperfection unless it can be explained by process methods, part geometry or test limitations. Nonrelevant indications may be caused by some design feature and not by an actual discontinuity.

Surface conditioning and/or inspections by other NDT methods may be used to demonstrate that no unacceptable discontinuities are present.

6.3.3 **Linear Indication.** An indication in which the length is equal to or greater than three times its width.

6.3.4 **Rounded Indication.** A circular or elliptical indication with its length less than three times the width.

6.3.5 Evaluation is made between 10 and 30 minutes after application of developer. Broad areas of pigmentation which could mask indications of discontinuities are unacceptable, and such areas shall be cleaned and reexamined.



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6.3.6 AREAS TO BE INSPECTED - ACCEPTANCE CRITERIA

6.3.6.1 LIQUID PENETRANT INSPECTION FOR FINAL ACCEPTANCE SHALL BE PERFORMED AFTER ALL HEAT TREATMENT/POST WELD HEAT TREATMENT AND MACHINING OPERATIONS ARE COMPLETED.

6.3.6.2 When required, all accessible areas of the following: (1) pressure containing weld areas and repair weld areas, (2) wellbore wetted areas, (3) sealing areas, (4) critical areas of finished parts, and (5) all other areas requiring PT inspection per design documents, Quality Plans or Manufacturing Routers.

A. Acceptance Criteria For Non-Sealing Areas

See Exhibit C

B. Acceptance Criteria For Sealing Areas

See Exhibit D

6.3.6.3 Welds that are not subsequently machined

See Exhibit J

6.3.6.4 Valve Seat and Gates Acceptance Criteria

See Exhibit E

6.5 API Ring Groove Acceptance Criteria

For sealing surfaces; see Exhibit D.

For non-sealing surfaces, see Exhibit C.

6.4 POST EXAMINATION CLEANING

6.4.1 Parts are cleaned as required for subsequent processing

6.5 DATA REPORTING

6.5.1 Acceptance of the Liquid Penetrant Inspection shall be documented by:



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- 6.5.1.1 Completing entries on the Router NDE form, and
- 6.5.1.2 Entering an inspection stamp impression or signature and date on the appropriate Router operation.
- (R) 6.5.2 Nonconforming parts shall be reported on an NCR in accordance with the SARA SAE. The report shall include an exact description and location of the nonconformance.



(R) – Indicates Revised Item

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EXHIBIT B

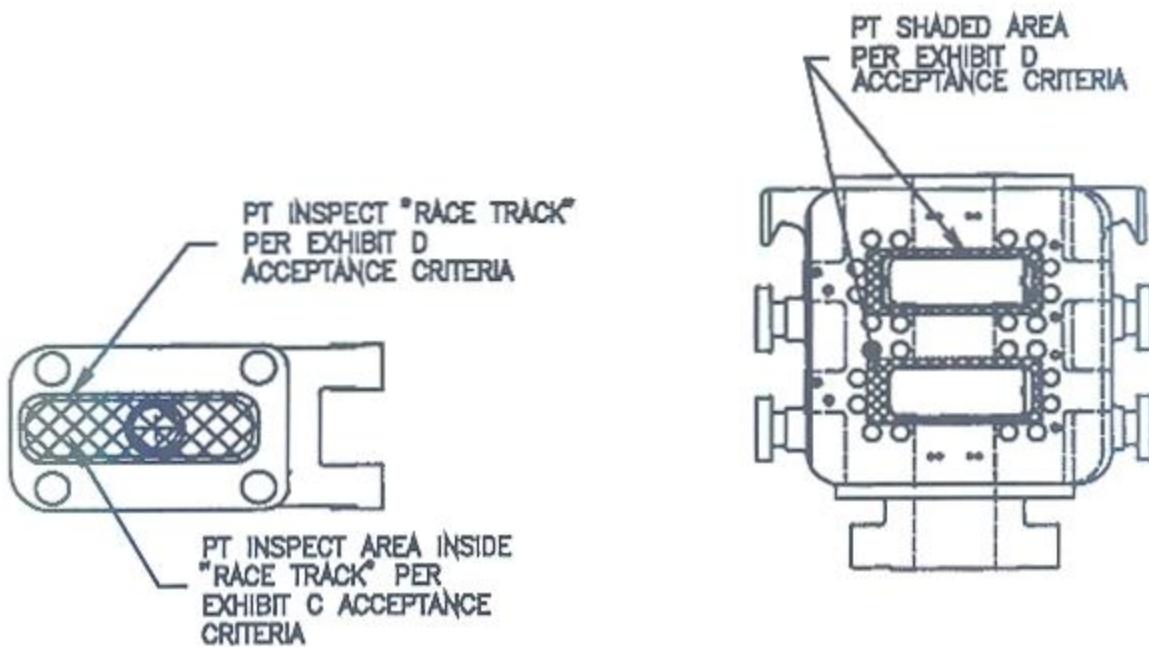
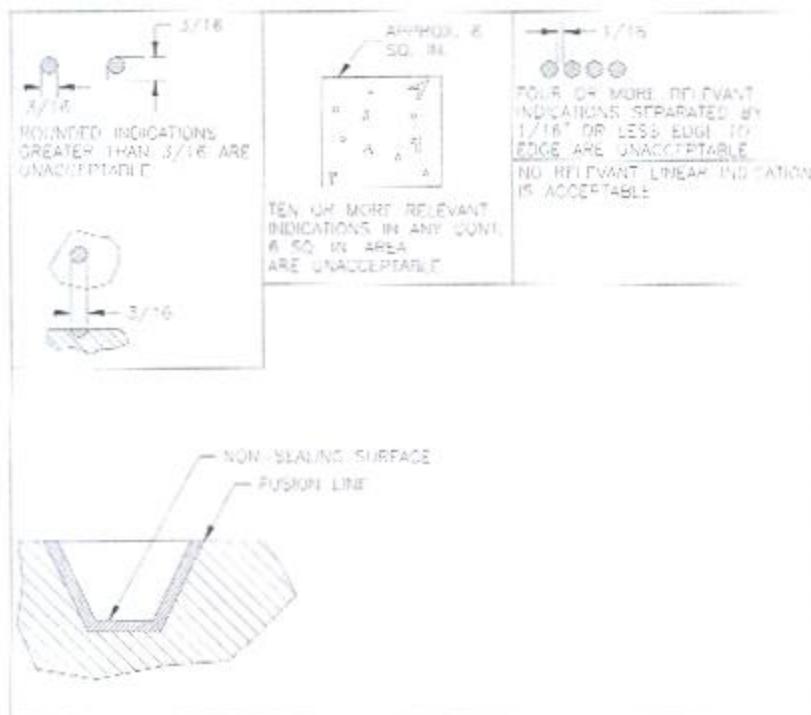


EXHIBIT C (R)
LIQUID PENETRANT INSPECTION FOR NON-SEALING SURFACES



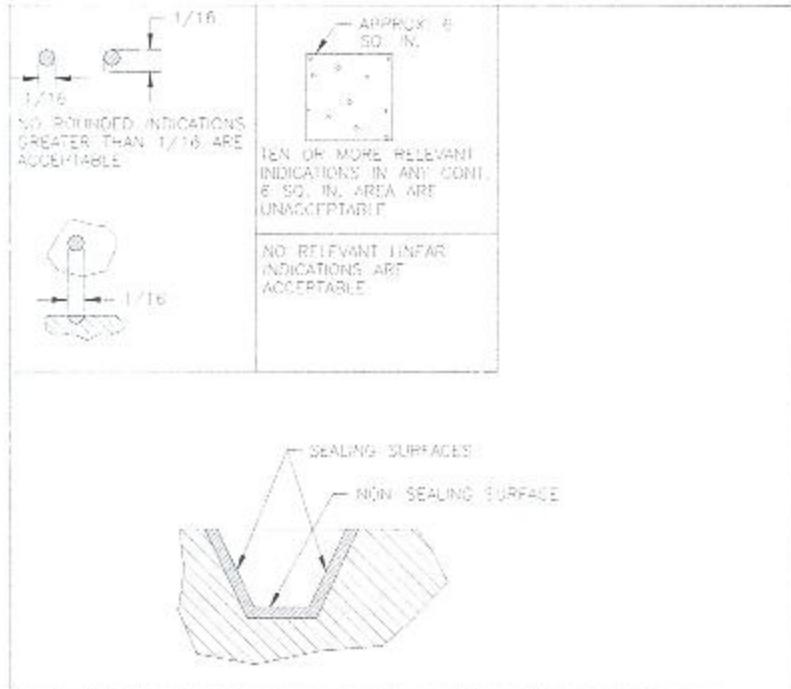
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EXHIBIT D (R)
LIQUID PENETRANT INSPECTION FOR RING GROOVES
AND OTHER CRITICAL SEALING SURFACES



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EXHIBIT E (R)
LIQUID PENETRANT INSPECTION FOR VALVE SEATS AND GATES

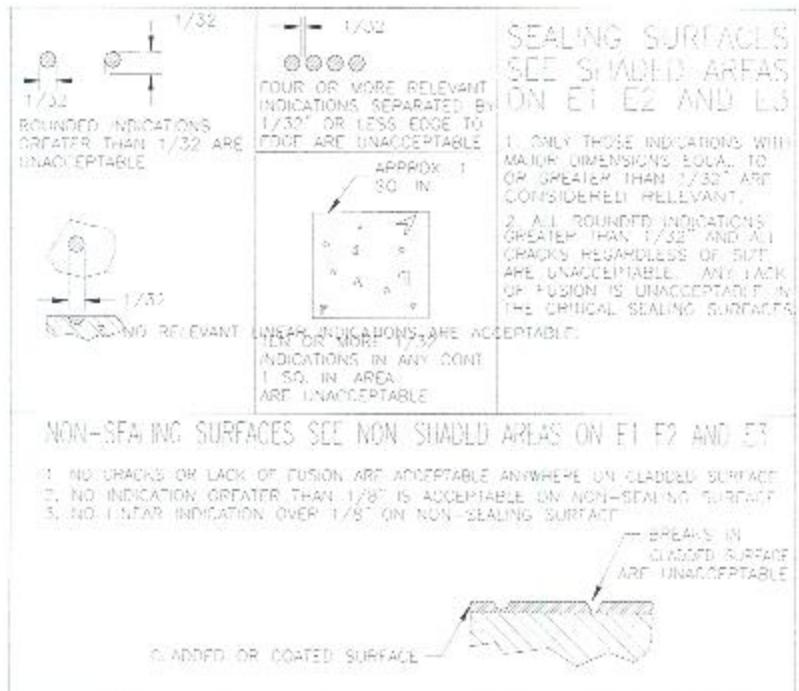
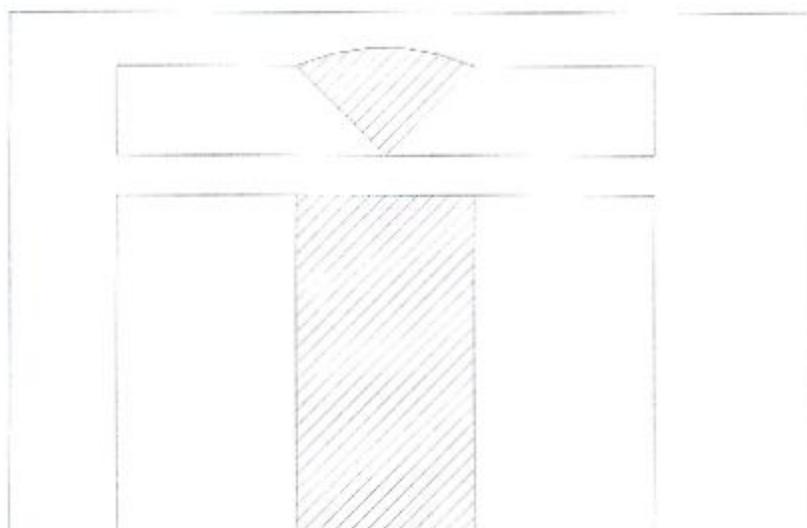
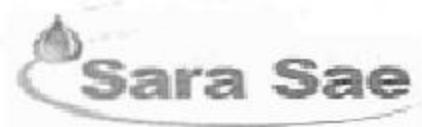


EXHIBIT J (R)**ACCEPTANCE CRITERIA FOR WELDS**

NO RELEVANT INFLAR INDICATIONS SHALL BE ALLOWED
NO HOLLOWED INDICATIONS GREATER THAN 1/8" DIAMETER FOR WELDS WHOSE
DEPTH IS 5/8" OR LESS OR 3/16" DIAMETER FOR WELDS WHOSE DEPTH IS
GREATER THAN 5/8" ARE PERMITTED





LIQUID PENETRANT INSPECTION REPORT

REPORT NO.:

DATE:

CLIENT / PROJECT :	INSPECTING AUTHORITY :
P.O. NO. / JOB NO. :	DRAWING NO.
PART NO. / WELD SEAM NO. :	PROCEDURE NO. / REV. NO. :
MATERIAL SPEC. :	THICKNESS OF MATERIAL ;
ACCEPTANCE STANDARD :	

Date of Examination	
Surface Preparation	
Surface Temperature	
Penetrant Expiry Date	
Penetrant Dwell Time	
Penetrant Remover (Cleaner)	
Developer Type / Expiry Date	
Method of applying Developer	
Developer Dwell Time	
Lighting Equipment	
Light Intensity	
Indications Observed (Type, Location & Extent)	
Result	
Post Cleaning	
Remarks	

PERFORMED BY	APPROVED BY	INSPECTION AUTHORITY
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