

# VISHAL ENTERPRISE & VRISHAL ENGINEERING PRIVATE LIMITED



## PROCEDURE FOR LIQUID PENETRANT EXAMINATION

**CLIENT: NAVIN FLUORINE ADVANCED SCIENCES LTD.**

**PROJECT: EPCM SERVICES FOR NEW HYDRO FLUORIC ACID PLANT**

**DOCUMENT NO: VEPL/NFASL/EPCM/QSI-001**

0	11.08.2024	ISSUED FOR REVIEW & APPROVAL	SURAJ SINGH	SHIVANG DIWAKAR	
REV	DATE	ISSUED FOR	PREP. BY / VEPL	REVIEW. BY / VEPL	APPR. BY / ASNT NDT LEVEL-III

# **TABLE OF CONTENTS**

- 1. SCOPE**
- 2. PURPOSE**
- 3. DISTRIBUTION & INTENDED AUDIENCE**
- 4. ABBREVIATIONS**
- 5. REFERENCE DOCUMENTS**
- 6. RESPOSIBILITIES**
- 7. PERSONNEL QUALIFICATION REQUIREMENTS**
- 8. TEST MATERIAL USED**
- 9. SURFACE PREPARATION**
- 10. PRE-TEST CLEANING**
- 11. EXAMINATION PROCEDURE**
- 12. EVALUATION OF INDICATION & ACCEPTANCE STANDARDS**
- 13. RE-EXAMINATION OF REPAIRED AREAS**
- 14. POST INSPECTION CLEANING**
- 15. SAFETY**
- 16. ATTACHMENTS**

## 1 SCOPE

- This procedure outlines visible Liquid Penetrant Examination by the solvent removable technique for the purpose of detecting surface discontinuities which are open to the surface on weldments and materials made of Carbon Steel and other materials in the form of Plate, weld, casts, Forged or Extruded items.
- Extent of NDT shall be as per approved ITP and project specification.
- This procedure shall cover the weld joints, base metal, heat affected zone for H-PLANT Plant Building Project where ever applicable

## 2 PURPOSE

- The purpose of this procedure is to guide the shop team to perform Liquid Penetrant and evaluation

## 3 DISTRIBUTION & INTENDED AUDIENCE

CLIENT: Navin Fluorine Advanced Sciences Ltd.

TPIA: Third Party Inspection Authority

VEPL: Vrishal Engineering Pvt Ltd (Manufacturer)

## 4 ABBREVIATIONS

Abbreviations	Definitions
ASTM	American Society for Testing and Materials
QA/QC	Quality Assurance/Quality Control
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ISO	International Organization for Standardization
PCN	Personnel Certification in Non-Destructive Testing
NDE	Non-Destructive Examination
BPV	Boiler Pressure Vessel
LUX	Luminous Intensity
LPT	Liquid Penetrant Testing

## 5 REFERENCE DOCUMENTS

SR. NO	DOCUMENT NAME	DOCUMENT NUMBER	LATEST REVISION
1	Structural Welding Code-Steel	AWS D1.1	2020
2	Inspection & Test Plan for Structural Fabrication & Erection	VEPL-NFASL-EPCM-ITP-001	REV.00

## 6 RESPONSIBILITY

### Shop In charge or his designee – is responsible for

- Making the weld joint and or surface ready for the Liquid Penetrant examination
- Coordinating with Head QA/QC or his designee for the successful the Liquid Penetrant examination
- In case of any repair, he is responsible for attending the repair

### QC Engineer / Inspector – is responsible for

- Organizing the liquid penetrant testing, interpretation, coordination with PT crew and client inspection agency
- Maintaining calibration record of the instruments

## 7 PERSONNEL QUALIFICATION REQUIREMENTS:

- The personnel employed for conducting the examination shall be trained, examined and qualified as per recommended practice of SNT-TC-1A. Personnel certified as per other certification methods like PCN, ISO 9712 are acceptable.
- All personnel conducting the examination shall be qualified as NDE level -I. However, personnel evaluating the result shall be qualified to level II as a minimum.
- Personnel conducting the Liquid Penetrant examination shall have vision with correction, if necessary, to read the Jaeger number J2 or equivalent at a distance not less than 300 mm and is capable of distinguishing and differentiating the contrast between colors used. This should be conducted upon initial certification and at one-year intervals thereafter.

- The personnel conducting the examination shall be aware of the safe practice requirements during examination.

## 8 TEST MATERIAL USED

SR. NO.	MANUFACTURER	PRECLEANER	PENETRANT	CLEANER	DEVELOPER
1	P-Met	PMC-PC-120B	PMC-PP-110B	PMC-PC-120B	PMC-PD-130B

- It shall be ensured that all the above chemicals do not contain excess presence of Chlorine and Sulphur as required by the code specification. Manufactures test certificate shall be treated sufficient documentary proof in regard.
- Intermixing of penetrate materials from different manufactures is prohibited.

## 9 SURFACE PREPARATION

- Liquid Penetrant Examination of welds shall include all accessible weld surfaces and a band of base metal at least 10 mm (3/8 in) wide on each side of the weld.
- Surface to be examined and adjacent areas within 25 mm shall be free from dirt, grease, lint, scale or any other extraneous matter that may obscure surface openings or interfere with the test.
- Grinding, Chiseling or wire brushing is permitted mechanical method for surface preparation. Sand blasting shall not be used. Loose sand or mud can be removed by water. Solvent cleaner, degreasing or commercial grade Acetone cleaning can be used for removal of oil & grease or any similar.
- Finally, the test area shall be thoroughly cleaned with the cleaner and then wiped with lint free cloth / paper / cotton waste.

## 10 PRE-TEST CLEANING

- The test area shall be thoroughly cleaned with the cleaner and wiped with cloth / paper.
- After cleaning, drying of the surfaces shall be accomplished by normal evaporation or with forced hot or cold air.

- A minimum period of time shall be established to ensure that the cleaning solution has evaporated prior to application of the penetrant. Minimum 2-minutes drying time shall be kept.
- Adequate care shall be taken to ensure proper surface condition prior to testing.

## 11 EXAMINATION PROCEDURE

### 11.1 Temperature

- The temperature and temperature-variation of test surface and penetrant shall not be below 40°F (5°C) and more than 125°F (52°C). If testing is to be done outside this range, both penetrant material manufacturers acceptance & procedure demonstration is required.

### 11.2 Application of Penetrant

- The penetrant shall be applied either by brushing or spraying from aerosol cans over the entire test surface or dipping in the penetrant.
- The minimum penetration time shall be as required in Table-1. Higher duration is permissible if the penetrant remains wet on the test surface. Decrease in dwell time shall be only after satisfactory demonstration. The maximum dwell time shall not exceed 30 minute or as qualified by demonstration for specific application.

**Table 1**

Materials	Product Form	Penetrant Dwell-Times Minutes
Steel, High Temperature Alloys, Aluminum, Magnesium, Bronze, Brass & Titanium	Welds & Castings	5
	Wrought Materials: - Plate, Forging, & Extrusions	10

### **11.3 Excess Penetrant Removal**

- The area with applied penetrant shall be removed by wiping with a cloth or absorbent paper, repeating the operation until most traces of penetrant have been removed.
- Cleaning is to be continued till all traces of visible penetrant are removed. Final cleaning is to be done using clean cloth dampened with cleaner.
- The drying time shall be 10-minute maximum.
- Care shall be taken to avoid the use of excess cleaner and the deposition of any contaminating material which may lead to the misinterpretation of test results. Flushing the area with solvent for the purpose of penetrant removal is prohibited.
- Surface dryness shall be ensured before the application of developer.

### **11.4 Application of Developer**

- The non-aqueous wet developer shall be applied after penetrant removal & the surface becoming dry. Prior to developer application, developer must be thoroughly agitated to ensure adequate dispersion of particles.
- The developer as mentioned above shall be applied as soon as possible after penetrant removal & surface is dry. The developer application time shall be 10-minutes maximum.
- Developer shall be applied by spraying to give a thin uniform coat.
- Insufficient coating thickness may not draw the penetrant out of discontinuities; conversely, excessive coating thickness may mask the indication.
- Drying of developer shall be by normal evaporation.

### **11.5 Developer Developing Times**

- Developing time for final interpretation begins immediately after the application of a wet developer and drying of wet developer.
- Developing time shall be 10-minute minimum to 60-minute maximum.

### **11.6 Interpretation**

- Final interpretation shall be made within 10 to 60 minutes after completion of minimum requirements of developing dwell time. Increase in interpretation time beyond limits specified in this procedure is not permitted. However, If the bleed out does not alter the examination results, increase in interpretation time can be permitted only after satisfactory demonstration.

## 11.7 Minimum Light Intensity

- The minimum light intensity on the inspection surface shall be 1000Lux at the time of evaluation of indications.
- The minimum light intensity on the inspection surface shall be 1000Lux at the time of evaluation of indications.
- In case light intensity is found to be insufficient, use 12W white LED bulb at 300mm maximum distance or 60W bulb at 225mm maximum distance or 100W bulb at 300 maximum distances whereas the area would be 4" radius from center.

## 12 EVALUATION OF INDICATION AND ACCEPTANCE STANDARDS

### 12.1 Evaluation of Indications:

- All indications shall be evaluated in terms of the acceptance standards of the referencing Code Section.
- Discontinuities at the surface will be indicated by bleed-out of penetrant which is normally a deep red color that stains the developer. Indications with a light pink color may indicate excessive cleaning.
- Inadequate Cleaning may leave an excessive background making interpretation difficult; however, localized surface irregularities due to machining marks or other surface conditions may produce false indications.
- 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. Only indications which have any dimension greater than 1/16 in. (1.5 mm) shall be considered as relevant.
  - A linear indication is one having a length greater than three times the width.
  - A rounded indication is one of circular or elliptical shape with a length equal to or less than three times its width.
  - Any questionable or doubtful indications shall be re-examined to determine whether or not they are relevant.

### 12.2 Acceptance Standards:

- Acceptance criteria for Structural Fabrication & Erection Activities as per the following table :



SR. NR.	ITEM	APPLICABLE CODE	EXTENT OF TEST / EXAMINATION	INSPECTION METHOD	ACCEPTANCE CRITERIA
1	Structural Weld Joint	AWS D1.1	10% of sub assembly of weld	DPT	AWS D1.1: Table 8.1 (Attachment – I)

### 13 RE-EXAMINATION OF REPAIRED AREAS

- After repair have been made, the repaired area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners and re-examined by the liquid penetrant method and by all other methods of examination that were originally required for the affected area.

### 14 POST INSPECTION CLEANING

- On completion of testing and interpretation, the part may be cleaned using a cloth / cotton waste / soft brush if required by customer specification.

### 15 SAFETY

- The Technician / Inspector shall be responsible for compliance with safety rules requirement applicable at Vishal Enterprise, Dahej location.
- All technicians involved with Liquid Penetrant examination shall be aware and fully understand the manufacturer's instruction.

### 16 ATTACHMENTS

- Acceptance Criteria as per AWS D1.1, Table 6.1: Attachment - I.
- A Liquid Penetrant examination report shall be prepared as per Attachment - II.

## Attachment-I

AWS D1.1/D1.1M:2020



CLAUSE 8. INSPECTION

**Table 8.1**  
**Visual Inspection Acceptance Criteria (see 8.9)**

Discontinuity Category and Inspection Criteria	Statically Loaded Nontubular Connections	Cyclically Loaded Nontubular Connections								
<b>(1) Crack Prohibition</b> Any crack shall be unacceptable, regardless of size or location.	X	X								
<b>(2) Weld/Base Metal Fusion</b> Complete fusion shall exist between adjacent layers of weld metal and between weld metal and base metal.	X	X								
<b>(3) Crater Cross Section</b> All craters shall be filled to provide the specified weld size, except for the ends of intermittent fillet welds outside of their effective length.	X	X								
<b>(4) Weld Profiles</b> Weld profiles shall be in conformance with 7.23.	X	X								
<b>(5) Time of Inspection</b> Visual inspection of welds in all steels may begin immediately after the completed welds have cooled to ambient temperature. Acceptance criteria for ASTM A514, A517, and A709 Grade HPS 100W [HPS 690W] steels shall be based on visual inspection performed not less than 48 hours after completion of the weld.	X	X								
<b>(6) Undersized Welds</b> The size of a fillet weld in any continuous weld may be less than the specified nominal size (L) without correction by the following amounts (U): <table><tr><td>L, specified nominal weld size, in [mm]</td><td>U, allowable decrease from L, in [mm]</td></tr><tr><td>≤ 3/16 [5]</td><td>≤ 1/16 [2]</td></tr><tr><td>1/4 [6]</td><td>≤ 3/32 [2.5]</td></tr><tr><td>≥ 5/16 [8]</td><td>≤ 1/8 [3]</td></tr></table> In all cases, the undersize portion of the weld shall not exceed 10% of the weld length. On web-to-flange welds on girders, underrun shall be prohibited at the ends for a length equal to twice the width of the flange.	L, specified nominal weld size, in [mm]	U, allowable decrease from L, in [mm]	≤ 3/16 [5]	≤ 1/16 [2]	1/4 [6]	≤ 3/32 [2.5]	≥ 5/16 [8]	≤ 1/8 [3]	X	X
L, specified nominal weld size, in [mm]	U, allowable decrease from L, in [mm]									
≤ 3/16 [5]	≤ 1/16 [2]									
1/4 [6]	≤ 3/32 [2.5]									
≥ 5/16 [8]	≤ 1/8 [3]									
<b>(7) Undercut</b> (A) For material less than 1 in [25 mm] thick, undercut shall not exceed 1/32 in [1 mm], with the following exception: undercut shall not exceed 1/16 in [2 mm] for any accumulated length up to 2 in [50 mm] in any 12 in [300 mm]. For material equal to or greater than 1 in [25 mm] thick, undercut shall not exceed 1/16 in [2 mm] for any length of weld. (B) In primary members, undercut shall be no more than 0.01 in [0.25 mm] deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall be no more than 1/32 in [1 mm] deep for all other cases.	X									
<b>(8) Porosity</b> (A) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no visible piping porosity. For all other groove welds and for fillet welds, the sum of the visible piping porosity 1/32 in [1 mm] or greater in diameter shall not exceed 3/8 in [10 mm] in any linear inch of weld and shall not exceed 3/4 in [20 mm] in any 12 in [300 mm] length of weld. (B) The frequency of piping porosity in fillet welds shall not exceed one in each 4 in [100 mm] of weld length and the maximum diameter shall not exceed 3/32 in [2.5 mm]. Exception: for fillet welds connecting stiffeners to web, the sum of the diameters of piping porosity shall not exceed 3/8 in [10 mm] in any linear inch of weld and shall not exceed 3/4 in [20 mm] in any 12 in [300 mm] length of weld. (C) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the frequency of piping porosity shall not exceed one in 4 in [100 mm] of length and the maximum diameter shall not exceed 3/32 in [2.5 mm].	X									
		X								
		X								

Note: An "X" indicates applicability for the connection type; a shaded area indicates non-applicability.

## Attachment-II

 		<b>VISHAL ENTERPRISE &amp; VRISHAL ENGINEERING PRIVATE LIMITED</b> <b>GROUP OF COMPANIES</b> <b>LIQUID PENETRANT TESTING REPORT</b>								
<b>JOB DETAILS</b>										
CLIENT					REPORT NO.					
PROJECT					REPORT DATE					
PO/WO NO.					TEST DATE					
PROCEDURE NO.					ACCEPTANCE CODE					
<b>TEST DETAILS</b>										
SURFACE CONDITION					SURFACE TEMP.					
EXAMINATION STAGE					TECHNIQUE					
LIGHTING EQUIPMENT					LIGHTING INTENSITY					
EXTENT OF EXAMINATION %										
TYPE		MAKE	MODEL		BATCH NO.		VALIDITY	DWELL TIME		
PENETRANT : SOLVENT REMOVABLE										
CLEANER : SOLVENT REMOVABLE										
DEVELOPER : SOLVENT REMOVABLE										
<b>RESULT SUMMARY</b>										
SR. No.	LINE NO.	SPOOL NO.	JOINT NO.	Welder Number	WELD TYPE	MATERIAL	SIZE	THK. (MM)	TEST RESULT	REMARKS
REMARKS:										
		EXAMINED BY (LEVEL I / II)		VE-QC (LEVEL II / III)			WITNESSED/ APPROVED / REVIEWED BY			
							CLIENT-QC / TPI			
SIGN.										
NAME										
DATE										
VE/QA/FORMAT/08 REV.2										