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**LIQUID PENETRANT  
EXAMINATION PROCEDURE  
(VISIBLE - SOLVENT REMOVABLE)  
DOCUMENT NO: PNEC/PT/01.Rev 0**

NDE- Level III		
<b>PREPARED &amp; APPROVED BY</b>	<b>CERTIFIED BY</b>	<b>REVIEWED BY</b>

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## **1.0 SCOPE**

1.1 This document describes the procedure and acceptance standards for liquid penetrant examination of base materials and welds for detection of discontinuities open to the surface in non-porous metals using visible color contrast solvent removable penetrant and non aqueous wet developer.

1.2 The extent of examination shall be as required by approved drawings, QAP and Code.

## **2.0 REFERENCE DOCUMENTS**

2.1 ASME Boiler and Pressure Vessel Code Section V, 2010 Edition.

2.2 ASME Boiler and Pressure Vessel Code Section VIII Division-1, 2010 Edition.

2.3 ASME Boiler and Pressure Vessel Code Section VIII Division-2, 2010 Edition.

2.4 ASME Boiler and Pressure Vessel Code Section IX, 2010 Edition.

2.5 PNEC-WP-01. Written Practice for Training, Qualification and Certification of NDE Personnel.

2.6 ASNT-SNT-TC-1A-2006

## **3.0 WRITTEN PROCEDURE REQUIREMENTS**

This examination procedure shall be the demonstrated as per T-150 of ASME Section V, to the satisfaction of AI.

A change of a requirement in Table-621 of ASME Section V (refer PNEC/PT/01 Annexure-1) identified as essential variable shall require re-qualification of this procedure by demonstration. A change of a requirement identified as a non-essential variable shall not require re-qualification of the written procedure. All changes of essential or non-essential variables from those specified within this procedure shall require revision of this procedure.

## **4.0 QUALIFICATION OF PERSONNEL**

The personnel performing liquid Penetrant examination shall be certified as per ASNT-SNT-TC-1A and as per PNEC written practice.

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## 5.0 PENETRANT MATERIALS

- 5.1 The term penetrant material used in this procedure is intended to include the penetrant, solvent or cleaning agent and developer used in the examination. This procedure covers use of color contrast solvent removable penetrant material only.
- 5.2 Penetrant, cleaner and developer shall be of the same brand. Inter-mixing of penetrant materials from different families or different manufacturers is not permitted. Following penetrant materials are approved for use:
- a) Penetrant: Magnaflux SKL-SP-1
  - b) Cleaner: Magnaflux SKC-1
  - c) Developer: Magnaflux SKD-S2
- 5.3 For examination of nickel based alloys, the penetrant materials (penetrant, cleaner and developer) shall not contain sulphur above 1% by weight as per Mandatory Appendix II of ASME Section V, Article-6.
- 5.4 For examination of austenitic or duplex stainless steels and titanium alloys, the liquid penetrant materials (penetrant, cleaner and developer) shall not contain total chlorine and fluorine above 1% by weight as per Mandatory Appendix II of ASME Section V, Article-6.
- 5.5 The Senior Manger QA&MR shall obtain penetrant material manufacturer's certification of contamination content for all liquid penetrant materials. The certification shall include the manufacturers' batch numbers and the tests results obtained in accordance with clause no 5.3 and 5.4 above.

## 6.0 SURFACE PREPARATION AND CLEANING

- a) In general, satisfactory results may be obtained when the surface of the part is in as-welded or as-ground condition. Any suitable surface preparation method like hand grinding, wire-brushing may be used where surface irregularities could mask indications.
- b) Prior to the examination, the surface to be examined and adjacent areas within at least 25 mm (1 inch) shall be thoroughly cleaned and shall be dry and free of all dirt, grease, lint, scale, welding flux, weld spatter, paint, oil, and other extraneous matter that could obscure surface openings or otherwise interfere with the examination. Cleaning shall be accomplished using cleaner as mentioned in 5.2 above.

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## **7.0 DRYING AFTER PREPARATION**

After cleaning, drying of the surfaces to be examined shall be accomplished by normal evaporation. It shall be ensured that the cleaner has evaporated completely before application of penetrant. A minimum time period of 2 minutes and maximum 15 minutes shall be allowed for drying to ensure that the cleaner has evaporated prior to application of the penetrant.

### **SURFACE TEMPERATURE**

The temperature of the penetrant and the surface of the part to be processed shall not be below 10 °C or above 52 °C throughout the examination period. Where it is not practical to comply with these limitations, the procedure shall be qualified at the proposed temperature range within the temperature limits recommended by manufacturer, on liquid penetrant comparator blocks, as per Mandatory Appendix III of ASME Section V, Article-6.

## **8.0 CALIBRATION**

Light meters shall be calibrated at least once a year or whenever the meter has been repaired. If the light meter has not been used in for one year or more, calibration shall be done before being used.

## **9.0 EXAMINATION**

### **9.1 Penetrant Application**

The penetrant shall be applied by Spraying.

### **9.2 Penetrant Dwell Time**

Penetrant dwell time shall be 10 minutes minimum and shall not exceed 30 minutes.

### **9.3 Excess Penetrant Removal**

After the specified penetrant dwell time has elapsed, any penetrant remaining on the surface shall be removed by wiping with clean, dry, lint free cloth or absorbent paper, repeating the operation until most traces of penetrant have been removed. The remaining traces shall be removed by lightly wiping the surface with cloth or absorbent paper moistened with solvent. To minimize removal of penetrant from discontinuities, care shall be taken to avoid use of excess solvent. Flushing or

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flooding the surface with solvent, following application of penetrant and prior to developer application, is prohibited.

#### 9.4 Drying after excess penetrant removal

After removal of excess penetrant, the surface shall be dried by normal evaporation. Drying time shall not be less than 2 minutes and shall not be more than 10 minutes.

#### 9.5 Application of Developer

- a) The developer shall be applied as soon as possible after penetrant removal and drying of the surface. The time interval between drying after removal of excess penetrant and application of developer shall not exceed 10 minutes. The developer shall be applied in thin and uniform layer. Insufficient coating thickness may not draw the penetrant out of discontinuities while excessive coating thickness may mask indications.
- b) Wet non-aqueous developer shall be used and shall be applied by spraying only to a dry surface. Prior to applying suspension type wet developer to the surface, the developer must be thoroughly agitated to ensure adequate dispersion of suspended particles. Drying of the developer shall be done by natural evaporation.
- c) Developing time for final interpretation begins immediately as soon as the wet developer coating is dry.

### 10.0 INTERPRETATION

10.1 Final interpretation shall be made not less than 10 minutes nor more than 30 minutes after the wet developer coating is dry. If the surface to be examined is large enough to preclude complete examination within the above prescribed and established time, the examination shall be performed in increments.

10.2 The characterization of type of discontinuities is difficult to evaluate if the penetrant diffuses excessively into the developer. If this condition occurs, close observation of the formation of indication(s) during application of the developer may assist in characterizing and determining the extent of the indication(s).

10.3 With the developer forming a reasonable uniform white coating, surface discontinuities are indicated by bleed-out of the penetrant which is a deep red color that stains the developer. Indications with light pink color may indicate excessive cleaning. Inadequate cleaning may leave an excessive back ground making interpretation difficult.

### 11.0 LIGHT INTENSITY

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11.1 A minimum of 1000 Lux (100 fc) light intensity is required on the surface to be examined to ensure adequate sensitivity during examination and evaluation of indications. The light source, technique used, and light level verification shall be demonstrated one time, documented, and maintained on file.

11.2 It has been demonstrated that a hand lamp of 220V/100 Watt bulb without reflector, when held at a distance of 250mm (10 inches) will give a minimum 1000 Lux (100 fc) within a circle of diameter 250mm (10 inches) directly below the bulb centre.

11.3 Refer separate procedure for the same of above.

## **12.0 EVALUATION**

12.1 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.

12.2 Broad areas of pigmentation which could mask indications of discontinuities are unacceptable and such areas shall be cleaned and re-examined.

12.3 An indication of imperfection may be larger than the imperfection that causes it, however the size of the indication is the basis of acceptance evaluation. Only indications with major dimensions greater than 1.5mm shall be considered relevant.

a) A linear indication is one having a length greater than three times the width.

b) A rounded indication is one of circular or elliptical shape with the length equal to or less than three times the width.

c) Any questionable or doubtful indications shall be re-examined to confirm whether or not they are relevant.

12.4 Any indication, which is believed to be non-relevant, shall be regarded as an imperfection unless it is shown by re-examination by the same method or by the use of other non-destructive methods and/or by surface conditioning, that no unacceptable imperfection is present.

## **13.0 ACCEPTANCE STANDARD**

13.1 All surface to be examined shall be evaluated for acceptance as per requirement with referencing code as below:

13.1.1 ASME section VIII Division – 1 Appendix – 8

13.1.2 ASME section VIII Division – 2 Part 7.

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As per ASME SECTION VIII DIVISION – 1 APPENDIX –8, 2010 EDITION

All surfaces to be examined shall be free of:

- a. Relevant linear indications more than 1.5 mm
- b. Relevant rounded indication greater than 5 mm
- c. Four or more rounded relevant indications in a line separated by 1.5 mm or less (edge to edge).

As per ASME SECTION VIII DIVISION – 2 PART – 7 2010 EDITION

All surfaces to be examined shall be free of the criteria defined as above including,

- a. Crack like indications detected, irrespective of surface conditions, are Unacceptable

#### **14.0 DEFECT REMOVAL AND REPAIR**

14.1 Un-acceptable imperfections shall be repaired and re-examination made to assure removal or reduction to an acceptable size. When an imperfection is repaired by chipping or grinding and subsequent repair by welding is not required, the excavated area shall be merged with the surrounding surface so as to avoid sharp notches, crevices or corners. Where welding is required after removal of an imperfection, the area shall be cleaned and welding performed in accordance with qualified welding procedure.

14.2 After a defect is thought to have been removed, and prior to making weld repairs, the area shall be examined by suitable methods to ensure that defect has been removed or reduced to an acceptably sized imperfection.

14.3 After repairs, the repaired areas 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, except that, when the depth of repair is less than the radiographic sensitivity required, radiography may be omitted.

#### **15.0 POST EXAMINATION CLEANING**

Post examination cleaning shall be done by wiping with cloth moistened with solvent.

#### **16.0 REPORT OF EXAMINATION**



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16.1 The examination shall be reported on "Liquid Penetrant Examination Report" format, as per PNEC/PT/01 Annexure-2.

16.2 Rejectable indications shall be recorded. As a minimum, the type of indications (linear or rounded), location and extent (length or diameter or aligned) shall be recorded.

**17.0 SAFETY** Test shall be conducted in well ventilated area.