

NDE PROCEDURE

P & B TESTING, INC.
Destructive and Nondestructive Testing

Procedure#: PB-3000

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PB-3000

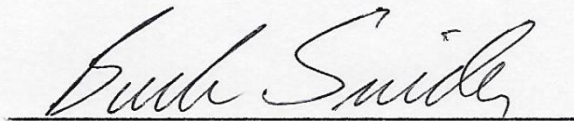
LIQUID PENETRANT TESTING

REVISION A04

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Reviewed By:

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Date: October 24, 2022



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REVISION HISTORY

Revision	Date	Description of Changes	Revised by
A0	01/01/96	Original Issue	N/A
A01	12/30/99	Minor revision in various paragraphs as noted	Scott Powers
A02	08/18/08	Major revision	Scott Powers
A03	09/12/18	Reformatted and updated procedure	Scott Powers
A04	10/21/22	Updated to incorporate ASTM E1417, corrected typo's	Scott Powers

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1.0 PURPOSE

- 1.1 This procedure describes the method to be used for testing of ferromagnetic and non-ferromagnetic materials for the detection of indications open to the surface by means of method A or method C Liquid Penetrant Examination. This includes Fluorescent (type I penetrants) and Color Contrast (type II penetrants).
- 1.2 This procedure shall be used unless the customer purchase order(s) require components to be examined by the specified customer's procedure. In which case, said procedure shall be reviewed and approved by the P&B Testing, Inc. Level III prior to testing.

2.0 APPLICATION

- 2.1 This procedure applies to all persons involved in the Liquid Penetrant Examination of materials by P&B Testing, Inc.

3.0 REFERENCES

The current revision (as of this writing) of each document listed below has been referenced in preparation of this procedure and shall be regarded as part of the procedure when referenced in the applicable purchase order or contract. The P&B Testing, Inc. Level III shall be responsible for verifying this procedure complies with the below referenced as new revisions are released by ASTM, API, ASME, or ASNT.

- 3.1 ASTM E165: Standard Test Method for Liquid Penetrant Examination.
- 3.2 RP-SNT-TC-1A: Personnel Qualification and Certification in Nondestructive testing.
- 3.3 PB 4000: P&B's Written Practice for Personnel Qualification and Certification in NDT.
- 3.4 API 6D: Specification for Pipeline Valves.
- 3.5 API 6A: Specification for Wellhead and Christmas Tree Equipment.
- 3.6 API 17D: Specification for Subsea Wellhead and Christmas Tree Equipment.
- 3.7 ASME B.16-34: Valves Flanged Threaded and Welded Ends.
- 3.8 ASME Section V: Nondestructive Examination, Article 6-Liquid Penetrant Examination.
- 3.9 ASTM E1417: Standard Practice for Liquid Penetrant Testing

4.0 PERSONNEL

- 4.1 All personnel conducting liquid penetrant examination shall be certified in accordance with P&B Testing, Inc. procedure PB-4000 and maintain a minimum of Level I status in the liquid penetrant method.
- 4.2 All personnel evaluating and interpreting liquid penetrant test results for acceptance shall be certified as a Level II or Level III in the liquid penetrant method.
- 4.3 P&B Testing, Inc. Quality Manager shall be responsible for maintaining personnel qualification and certification records on file.

5.0 MATERIAL

- 5.1 Penetrant
- 5.1.1 Penetrant may be type I (fluorescent) or type II (color contrast) depending on the size, shape, quantity and location of the objects of the penetrant materials shall be

in the area of medium to high sensitivity depending upon the type of material and surface condition of the material to be examined.

5.1.2 Unless otherwise specified by the customer, any proven brand name penetrant is acceptable for this procedure. Proven intended to mean by an approved penetrant manufacture and certified on certificate of compliance (C of C) for each penetrant batch. C of C to be maintained on file by the P&B Testing, Inc. Quality Manager. The Quality Manager is responsible for determining which penetrant manufactures shall be listed on P&B Testing, Inc. approved vendor list and materials supplied conform to the latest edition of ASTM E 165 as qualified per. AMS 2644.

5.1.3 Visible Dye Type II penetrants are not classified by their sensitivity levels but shall reveal at least 4 cracks when tested on 5 quench crack type tam panel. This test is not mandatory for aerosol spray can type penetrants when an acceptable C of C is accompany the penetrant, but may be used to qualify any type of visible penetrant. Results and essential variables shall be recorded.

5.1.4 Intermixing penetrant testing materials from different manufacturers is prohibited.

5.2 Developer

5.2.1 Can be of the aqueous or non-aqueous type, wet dip, spray or the dry powder type.

5.2.2 Unless otherwise specified by the customer any proven brand name developer is acceptable for this procedure.

5.3 Cleaner/Remover

5.3.1 Cleaning agents that may be used are detergents, organic solvents, descaling solutions and paint removers.

5.4 Acid Etching, pickling solutions, and chromates may be used at the discretion of the Quality Manager or NDE technician, but shall not have an adverse reaction with the penetrant, material or reduce sensitivity levels.

6.0 SURFACE PREPARATION

6.1 The surface(s) to be examined and all adjacent areas within at least one (1) inch shall be dry and free from rust, dirt, grease, dust, paint, welding slag or spatter or other foreign matter which could mask imperfections or interfere with the testing.

6.2 The surface to be tested should be "smooth" and free from coarse machining or grinding marks which could trap dye and/or hinder the cleaning operations.

6.3 Satisfactory results may be obtained when the surface is in the as-welded, as-rolled, as-cast, or as-forged condition. Surface preparation by grinding or machining may be necessary to prevent surface imperfections from masking possible unacceptable indications

6.4 Liquid Penetrant to be performed after all surface finish requirements are met. If a surface is ground, sanded, polished, or machined after the liquid penetrant test, the surface shall be reexamined.

- 6.5 To assist with contamination control of materials, grinding and sanding disk shall not be used interchangeably on various materials (e.g. grind carbon steel and then use the same wheel on stainless is prohibited). Grinding and sanding disk should be capable of surface conditioning most steels without metal smearing; however, in the event metal smearing is observed, subsequent acid etching shall occur.

7.0 TECHNIQUE

- 7.1 Method A (Water Washable), Method B & D (Post Emulsifiable) or Method C (Solvent Removable) may be used in the color contrast of fluorescent penetrant technique.

8.0 PENETRANT APPLICATION

- 8.1 Temperature of the parts surface as well as penetrant materials shall be between 50°F and 100° F during the entire inspection time. Temperature outside this range requires a re-qualification by means of producing 4 out of 5 quench cracks on a tam panel with temperatures equivalent to the part in question and results recorded. In this case dwell times may need to be adjusted. Re-qualified procedure and technique including tam panel types shall be approved by the P&B Testing, Inc. NDT Level III.
- 8.2 Penetrant may be applied by dipping, brushing or spraying. Care is to be taken to ensure no pools of penetrant forms on the part. The entire surface of the area to be examined and 2 inches of adjacent material shall be covered with penetrant, however, large parts may be examined in sections and steps shall be taken to ensure sufficient over-lap of two (2) inches minimum. Specific areas to be examined should be identified on the respective drawing, BOM, router or as defined by the customer.
- 8.3 After precleaning of parts with cleaning agents listed in section 5.3, parts shall be allowed to air dry for a minimum of 2 minutes, before the application of penetrant.
- 8.4 The penetrant dwell time shall be at least ten (10) minutes for forgings, plates, tubular products castings, welds, or fittings but not more than one (1) hour.
- 8.5 If the penetrant dwell time exceeds (1) hour or during an lengthy dwell time; the penetrant characteristics are affected as evidenced by difficulty in removing excess penetrant, the penetrant shall be reapplied for the original dwell time.
- 8.6 Penetrants shall be thoroughly agitated prior to applying to test surface.

9.0 PENETRANT REMOVAL

- 9.1 After the required penetration dwell time, excess penetrant remaining on the surface shall be immediately removed by the methods for each type penetrant as detailed below.
- 9.2 Care shall be taken not to wash penetrant from any wide, shallow discontinuities which may be present. With water washable method the spray rinse time should not exceed two (2) minutes.
- 9.3 A slight shading of penetrant in the developer background indicates that the part was not over- cleaned or over-washed. Indications with a light pink appearance may indicate excessive cleaning, while a heavy penetrant back ground may interfere with the interpretation when using red dye penetrant materials.

- 9.4 Excess water washable and post emulsifying penetrant shall be removed with a water spray not to exceed 40 psi and a temperature not higher than 100° F.

NOTE: Emulsification times are to be as recommended by the manufacturer.

- 9.5 Excess solvent removable penetrant shall be removed by wiping with an absorbent cloth or paper. Remaining penetrant will be removed by wiping with an absorbent cloth or paper which has been lightly moistened with cleaner when using method C.
- 9.6 Method A consist of using a coarse water spray rinse (40 psi max) at approximately 45° angle and shall be a minimum of 12” away from the examination area when possible. This shall be conducted under appropriate illumination and caution shall be used to prevent over-washing. After rinsing excess penetrant, use re-positioning, suction, blotting with clean absorbent material, or maximum shop air of 25 psi to dry the part.
- 9.7 Applying any liquid directly to the test surface following penetrant removal and prior to developing could risk washing penetrant from an indication, therefore, this would constitute an invalid inspection and a complete cleaning and re-examination shall be in order.

10.0 DEVELOPER

- 10.1 Surfaces which have been water-washed that require either a dry or non-aqueous developer shall be dried by blotting or maximum shop air of 25 psi to dry the part or by using circulating warm air provided the surface of the part is not raised above 100° F.
- 10.2 Aqueous developer may be applied to either a wet or dry surface and shall be dried by circulating warm air.
- 10.3 When using the solvent removable method the surface(s) may be dried by normal evaporation, blotting, wiping or forced air, with a maximum shop air of 25 psi.
- 10.4 Dry developer may be applied by soft brush, powder bulb or a powder gun. Other methods may be used provided the powder is dusted evenly over the entire surface.
- 10.5 With color contrast penetrant a wet developer only must be used. Fluorescent penetrants may be developed with either wet or dry developers.
- 10.6 Wet developer (water solutions or suspensions) shall be applied by dipping, brushing or spraying a thin coating on the surface of the part.
- 10.7 Solvent suspensions shall be applied by spraying whenever possible.
- 10.8 Developer shall be thoroughly agitated prior to applying to test surface.
- 10.9 Drying time may be decreased by using warm circulating air so long as the surface temperature of the part is not raised above 100°F.
- 10.10 Maximum time intervals for the developer application after penetrant removal shall be immediately after the excess penetrant has been removed from the part surface, prior to drying in the case of aqueous developers, and immediately after the part has been dried for all other developer forms.

- 10.11 Light, thin, single, even coats are to be applied over the entire area of interest as well as 2 inches of adjacent material when possible. Heavy coats of developer could mask an indication and care shall be taken to avoid this.

11.0 EXAMINATION

- 11.1 The surface of the part(s) shall be examined immediately after application of the developer so as to detect the nature of indications which may bleed out profusely.
- 11.2 Final interpretation shall be made after allowing the penetrant to bleed out at least ten (10) minutes and maximum time of sixty (60) minutes.
- 11.3 Larger parts which cannot be completely examined within the required time shall have increments examined at one time with sufficient overlap.
- 11.4 When using color contrast penetrant, discontinuities are indicated by bleed out of what is normally a deep red color which stains the uniform white coating of developer.
- 11.5 Excessive cleaning may cause indications to have a light pink color.
- 11.6 Inadequate cleaning may leave an excessive background which could mask indications.
- 11.7 Proper illumination of the part surface is required to insure detection of all discontinuities.
- 11.8 When fluorescent penetrant is used the examination shall be conducted in a darkened area using filtered "black light" the intensity of which shall be checked at least once every eight (8) hours or when the location is changed.
- 11.9 The black light shall be checked by using a meter which is sensitive to light in the ultraviolet spectrum, at the work surface. Centered on 3650 A, two (2) readings shall be taken, the first without the filter and the second with the filter covering the sensing element of the meter. The second reading is deducted from the first and the difference shall be a minimum of 1000 uW/cm².
- 11.10 Ambient light shall not exceed 2 foot candles max when using fluorescent penetrants.
- 11.11 Not less than ten (10) minutes shall be allowed for the bulb to warm up before taking these readings.
- 11.12 Natural or artificial minimum light shall be 100 fc (1076lx) at the test surface for color contrast penetrant inspections.
- 11.13 Personnel must wait at least 1 min. after entering a darkened area for their eyes to adjust to the low-level lighting before performing fluorescent magnetic particle examination.

12.0 EVALUATION OF INDICATIONS

- 12.1 Mechanical discontinuities at the surface shall be indicated by bleeding out of the penetrant however, localized imperfections may occur due to machining marks, surface conditions

or an incomplete bond between base metal and cladding may produce similar indications which are not relevant to the detection of unacceptable discontinuities.

- 12.2 Any indication in excess of the acceptance criteria, which is believed to be non-relevant, shall be regarded as an indication and shall be re-examined to verify whether or not actual indication(s) are present. Surface conditioning may precede the re-examination.
- 12.3 Relevant indications are those which result from discontinuities not intended by design or inherent in the material. Customers may provide a specific length that constitutes a relevant indication. 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 less than three times the width.
- 12.4 The size of indications shall be determined by measuring the size of the bleed-out within the specified time referenced in 11.2.
- 12.5 All relevant indications that cannot be removed by minor surface conditioning shall be recorded in the penetrant report and labeled on the part with a metal marker of the low impurity levels of sulfur and halogens that can cause contamination to titanium, nickel base alloys and some stainless materials.

13.0 REFERENCE ACCEPTANCE CRITERIA

- 13.1 The below is only for reference as applicable as it would be nearly impossible to list all of the codes applicable to every part inspected by P&B Testing, Inc. True acceptance criteria shall be determined by any one or more of the following; router, PO, ITP, QP, drawing, engineering specification or contract. When adherence to a specific code or standard is required, verification of the applicable revision level is mandatory. When the Level II is not certain which acceptance criteria to apply to a specific part, he/she shall consult their Quality Manager for clarification.
- 13.2 Reference Criteria for Materials for API 6A/API 17D, PSL 2, 3, and 4 materials:
- No relevant linear indications.
 - No relevant rounded indication with a major dimension equal to or greater than 3/16".
 - No more than 10 relevant rounded indications in any continuous 6-square inch area.
 - Four (4) or more relevant rounded indications in a line separated by less than 1/16" (edge to edge) are unacceptable.
 - No relevant indications in pressure contact sealing surfaces.
- 13.3 Reference Criteria for Weld for API 6A/API 17D, PSL 2,3, and 4 Parts
- No relevant linear indications.
 - No more than 10 relevant rounded indications in any continuous 6-square inch area.
 - Four (4) or more relevant rounded indications in a line separated by less than 1/16" (edge to edge) are unacceptable.
 - No relevant indications in pressure contact sealing surfaces.
 - No rounded indications greater than 1/8" for welds whose depth is 5/8" or less.
 - No rounded indications greater than 3/16" for welds whose depth is greater than 5/8".

14.0 NONCONFORMANCES

- 14.1 In the event an unacceptable indication is observed and it's obvious it cannot be removed by minor surface conditioning, a penetrant report shall be generated and forwarded to the

client. Reports shall contain as much information as practical to assist with the best disposition (e.g. size, shape, orientation, quantity, length, location, etc.).

14.2 Nonconforming parts shall be identified with an appropriate paint marker or attached with a paper tag protected by a plastic liner and segregated until disposition has been established by the client.

14.3 The NDT level II or III that rejected the part(s) shall circle all indications with an appropriate metal marker. Markers shall be of the low impurity levels of sulfur and halogens that can cause contamination to titanium, nickel base alloys and some stainless materials.

15.0 REPAIRS

15.1 P&B Testing, Inc. is not to conduct any repairs other than minor surface conditioning.

15.2 It is the customer's responsibility to conduct repairs however; P&B Testing, Inc may assist with the NDT involved, such as conducting a penetrant test on an area that was excavated prior to welding. In such case excavated area and re-welded area shall be examined in accordance with this procedure.

16.0 POST CLEANING

16.1 As soon as possible, after inspection of parts are completed; parts will be cleaned with solvents or detergents to ensure complete removal of penetrant material.

16.2 Cleaning materials shall not have an adverse effect on material or leave unwanted remnants behind.

17.0 SAFETY & ENVIRONMENT

17.1 All liquid penetrant material shall be properly disposed of as defined in P&B Testing, Inc Quality Manual.

17.2 Appropriate respirators must be worn in confined spaces as well as other personal protective gear as needed (e.g. rubber gloves, safety glasses and clothing).

17.3 Respective Material Safety Data Sheet (MSDS) to remain readily available for all personnel exposed to liquid penetrant materials.

17.4 Personnel working with penetrant materials shall thoroughly wash penetrant materials that may have been in contact with skin and report any abnormal skin irritations that may occur to their supervisor.

18.0 DOCUMENTATION

18.1 Documentation shall be maintained on file in accordance with the respective customer requirements, but not less than a period of 5 years.

18.2 After Liquid Penetrant examination all reports shall include the following information:
A. All Relevant Indications and their locations sketched out.
B. Technician's signature, date of examination and level of SNT-TC-1A certification.

- C. Part number, purchase order number, heat number, heat lot number, serial number, work order number and job number when applicable.
- D. Description of the material type and the area inspected.
- E. Names (preferably signatures) and employers of any witnesses to the examination.
- F. Contact information of the agency who conducted the examination including telephone numbers, name of company and physical address if any other than P&B Testing.
- G. Procedure number, with revision, acceptance criteria, applicable codes, standards and drawings when applicable.
 - Penetrant and developer method, type, batch number, manufacturer, method of application, method of cleaning, emulsifier and remover.
 - Status and quantity of parts inspected, accepted and rejected.
 - Lighting Equipment and light intensity at the surface of the part at the time of the examination.

18.3 As per ASTM E1417 Table 1 "Process Controls and Calibrations" P&B Testing shall maintain the daily "Liquid Penetrant Verification Log" QHSE form 020 (exhibit A) for normal day to day PT processes.

Note: Special PT process not listed on QHSE form 020 "Liquid Penetrant Verification Log" will be recorded on process WO, as customer requirements dictate.

