

**METALTEK INTERNATIONAL
THE CARONDELET DIVISION**

CARONDELET QUALITY PROCEDURE

TITLE: LIQUID PENETRANT EXAMINATION
SUBJECT: STANDARD PRACTICE FOR LIQUID PENETRANT EXAMINATION
(PT) ASME SECTION V, ARTICLE 6 & 24, ASTM E1417-99A, ASTM E165-02
AND MIL-STD-6866 (29 NOVEMBER 1985)
NUMBER: CQP-300

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Revisions and amendments to this procedure are recorded below. A master log of revisions and amendments shall be maintained by the Quality Assurance Department.

<u>REVISION</u>	<u>AMENDMENT</u>	<u>PAGE</u>	<u>DATE ISSUED</u>
1			
2	REWRITE		
3	REWRITE		4/23/97
4	REFORMAT	All	7/14/03
5	REWRITE		
6	REWRITE		5/14/02
7	REFORMATE	All	10/20/03
8	REWRITE	All	12/22/03
9	Added minimum drying time to 5.4	6,7,8	2/11/04
	Added statement about broad areas of pigmentation to 5.11		
	Reformat Process Flow Chart		
10	REWRITE		5/11/04

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1. SCOPE:

- 1.1 This practice covers procedures for liquid penetrant inspection of welds and raw or finished castings. Liquid penetrant processes are nondestructive techniques for detecting discontinuities that are open to the surface such as but not limited to cracks, cold shunts, seams, laminations or lack of fusion. These practices are applicable to in process, maintenance and final inspection.
- 1.2 This practice does not address interpretation of indications as to size, type, acceptance or rejection. It should be pointed out that once indications are produced, they must be interpreted and evaluated. For this purpose a separate code or specification agreeable to both purchaser and manufacturer must be stipulated.

2. METHOD

- 2.1 Only visible penetrant systems are covered in this practice. The penetrant is usually red in color so that the indications produce a definite contrast with the white background of the developer.
- 2.2 This practice meets the following specifications:
- A) ASTM E 165-92 Type II – Visible Penetrant Examination, Method A – Water – Washable (See Test Method E 1418)
 - B) ASTM E 1417-95A Standard Practice for Liquid Penetrant Examination Type II – Visible dye, Method A – Water washable
 - C) ASME Section V, Article 24, SE – 165 Standard Practice for liquid penetrant inspection method.
 - D) MIL-STD-6866 29 November 1985, Type II – Visible Dye, Method A – Water – Washable.
 - E) ASME Section V, Article 6, Liquid Penetrant Examination.
- 2.3 Water – Washable penetrants are designed to be directly water-washable from the surface of the part, after a suitable penetrant dwell time.

3. MATERIALS

- 3.1 The penetrants and developers used during examination shall be listed on the “Qualified products list of products qualified under military specification MIL-I-25135” Inspection materials, penetrants. Dispensing of Penetrant materials shall be recorded on the Penetrant Material Traceability Record. Completed (PMTR) forms shall be filed in the Quality Assurance Department for a period of three years.

- A) SKL-WP Water Washable Visible Red Dye Penetrant, Manufactured by Magnaflux Division of Illinois Tool Works Inc., Harwood Heights, Illinois – Qualified Reference Number – AFWALS/MLS 86-87.

FORM: 1) Aerosol Spray Can,
 2) Bulk – Various sizes.

SAFETY: No medical conditions are known to be aggravated by exposure to this product. Use appropriate protective and safety equipment (e.g. safety glasses and protective gloves). When prolonged or frequently repeated contact could occur, use protective clothing. Wash hands thoroughly after use. For detailed instructions see the material safety data sheet for this product.

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STORAGE: **DO NOT STORE** at temperatures above 110 F to avoid vapor pressure in closed containers. Keep containers closed when not in use. Keep away from heat, sparks and flames.

B) Spotcheck Developer SKD-S2, Manufactured by Magnaflux Division of Illinois Tool Works Inc., Harwood Heights, Illinois – Qualified Reference Number AFWALS/MLS 86-87.

FORM: 1) Aerosol Spray Can,
2) Bulk – Various Sizes.

SAFETY: Control airborne concentrations below exposure guidelines with mechanical ventilation. Use appropriate protective and safety equipment (e.g. safety glasses with side shields and protective gloves). When prolonged or frequently repeated contact could occur, use protective clothing. Wash hands thoroughly after use. For detailed instruction see the material safety data sheet for this product.

STORAGE: Keep containers cool, dry and away from sources of ignition. **DO NOT STORE** product in direct sunlight, high temperature above (120 F), or below freezing. Keep container tightly closed when not in use. Protect containers from physical damage and store with adequate ventilation.

C) Spotcheck SKC-S, Spotcheck SKC-HF Cleaner/Remover non-Chlorinated, Manufactured by Magnaflux Division of Illinois Tool Works Inc., Harwood, Illinois.

FORM: 1) Aerosol Spray Cans.

SAFETY: Use where ventilation will carry vapors away from occupied areas. Wear safety glasses to protect eyes. Wear nitrile rubber gloves if hand exposure is unavoidable. Wear a respirator with filter if sprayed in enclosed, unventilated space. If in contact with skin wash off with soap and water. For detailed instructions see the material safety data sheet for this product.

STORAGE: Store away from heat source. Do not spray around arcs or flame. Aerosol cans may burst in temperatures over 130 F (54 deg. C).

4. PERSONAL

4.1 Personnel performing the practices described in this procedure and presenting the affected parts for final acceptance/rejection to a particular code or standard shall be certified to at least level I according to MIL-STD-410 and/or American Society for non-destructive testing recommended practice SNT-TC-1A for liquid penetrant inspection.

4.2 Personnel making final accept/reject decisions on indications detected using the process in this standard shall be qualified to at least level II in liquid penetrant inspection according to MIL-STD-410 and/or American Society for non-destructive testing recommended practice SNT-TC-1A.

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5. PROCEDURE

- 5.1 Temperature Limits – The temperature of the penetrant materials. The surfaces of the component to be tested and the water used for penetrant rinsing should be between 50 F and 100 F. The ambient temperature shall be in the range from 60 F to 125 F.
- 5.2 Surface Preparation – All surfaces shall be clean, dry, and free of oil, grease, paint, foundry sand, welding flux or any material that will interfere with the effectiveness of the examination.
- 5.3 Precleaning – Shall be done by rinsing with water, solvent cleaning or mechanical methods. Solvent cleaning shall use SKC-S OR SKC-HF listed above. Mechanical cleaning shall be grinding, machining, sand, grit or shot blasting. Choice of mechanical cleaning must be matched to the material or component being inspected so imperfections are not masked or prevented from being detected. If only a section of the part is to be inspected, the adjacent area for a minimum of 1 inch shall be cleaned.
- 5.4 Drying After Cleaning – If a liquid is used to clean the component it must be dried before penetrant is applied. Forced cold air, infrared lamps, wiping with clean dry lint free cloth or exposure to ambient temperature can be used for drying. If infrared lights are used parts must not be warmed above 125 F. Minimum drying time shall be 5 minutes. Maximum drying time shall not exceed 15 minutes.
- 5.5 Penetrant Application – By spraying, brushing, dipping or flooding apply penetrant to the entire surface of the part, rotation or moving of the part is necessary to prevent pooling. If only a section of the part is to be examined apply penetrant to that area. Allow the excess penetrant to drain back into the reservoir. For spray applications allow for adequate ventilation. The ambient temperature shall be in the range of 60 F to 125 F.
- 5.6 Penetrant dwell Time – After application the dwell time shall be a minimum of 10 minutes but not longer than 60 minutes. If the penetrant has been allowed to dwell on the part longer than 60 minutes it must be rinsed off and reapplied. Dwell times other than those specified shall be agreed upon between purchaser and manufacturer.
- 5.7 Penetrant Removal – Rinse excess penetrant from the part by manual or semi-automatic water spray. The pressure of the water spray shall not exceed 40 PSI. The temperature of the water shall be between 50 F and 100 F. The degree and speed of washing shall be conducted under appropriate illumination to assure that over washing does not occur. A coarse spray shall be used at a minimum distance of 12 inches when possible between the spray nozzle and part. Washing times shall be held to a minimum. If over washing occurs the part must be dried and reexamined. After rinsing, drain water from the part by repositioning, blotting or filtered shop air at less than 25 psi to prevent pooling.

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- 5.8 Drying of Parts – After penetrant removal and prior to application of the non-aqueous developer the component must be dried. Drying may be done by cold air blast, or by exposer to ambient still air. Filtered shop air can be used for a cold air blast provided it is less than 25 PSI. Ambient temperature must be above 60 F or below 125 F. Drying shall be from 5 minutes minimum to 15 minutes maximum as necessary to dry the water from the part so that developer can be applied. Excessive drying shall be avoided.
- 5.9 Developer Application – Apply the non-aqueous developer by spraying from an aerosol can or by use of automatic spray equipment from bulk containers. The uniformity and thickness of the developer must be such that the metallic surface is not masked and only a thin white coating is left on the part. If the white coating is too thick the part must be cleaned and reexamined.
- 5.10 Developer Time – When a part is examined for final acceptance/rejection the minimum and maximum times for development shall be 10 minutes and 1 hour respectively. The inspection shall take place during this time span. Development time begins when the part is dry.
- 5.11 Examination / Evaluation – After the applicable development time the final inspection for acceptance/rejection shall take place in an area where any combination of natural or artificial illumination equals 100 foot candles. Interpretation of the indications shall be to a referencing code or specification as agreed upon between purchaser and manufacturer. If allowed by specification, indications may be re-evaluated by wiping the indication with a Solvent dampened swab or brush, allowing the area to dry and redeveloping. Redevelopment time shall be a minimum 3 minutes. If no indication reappears, the original indication is considered false. This procedure may be performed twice for any given original indication. No broad areas of pigmentation that could mask indications are acceptable. Any such areas shall be recleaned and reexamined.
- 5.12 Post Cleaning – Methods for removal of liquid penetrant materials shall be chosen in consideration of the components intended function. This will usually consist of manual washing, shot or grit blasting. Solvent removal can be substituted for manual washing.

6. QUALITY ASSURANCE PROVISIONS

- 6.1 Making and Recording – After components have been examined and a determination of accept/reject has been made to a referencing code or specification by a qualified Level II inspector the results of the inspection shall be entered into the inspection log for liquid penetrant inspection. In addition those parts which meet the specification requirements shall be stamped with the letter “P”. Those parts not meeting the requirements shall be set aside for rework or scrap. If prevented from impression stamping a component for any reason the parts may be vibro-etched or ink marked.

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6.2 Penetrant Materials Test and Test Frequency

<u>TESTS</u>	<u>FREQUENCY</u>
1) System Performance	1) Daily
2) Penetrant Contamination	2) Daily
3) Water Wash Pressure	3) Each Shift
4) Water Wash Temperature	4) Each Shift
5) Water Content	5) Monthly
6) Removeability	6) Monthly
7) Inspection Area Cleanliness	7) Daily
8) White Light	8) Weekly

All test results except inspection area cleanliness shall be recorded. All test results except for water content shall be recorded on the Penetrant Material Inspection checklists.

Monthly upon completion, the Penetrant Material Inspection checklists shall be filed in the Quality Assurance Department. Files shall be maintained for three years.

6.3 System Performance – This test will be performed on three aluminum panels with a 1/16” groove milled down the center. On one side the test (in use) penetrant is applied. On the opposite side the reference or unused penetrant is applied. The penetrants will be allowed to dwell for 5 minutes and rinsed. Developer is applied after drying. If the performance of the (in use) penetrant falls below the reference penetrant the test (in use) penetrant quality shall be checked with the appropriate tests and if found unacceptable shall be discarded. The panels are stored in a clean, dry location near the inspection area and are ultrasonically cleaned between usages.

6.4 Penetrant Contamination – The in use penetrant shall be looked at daily for evidence of precipitates, waxy deposits, white coloration, separation of constituents, surface scum or any evidence of contamination or breakdown.

6.5 Water Wash Pressure/Temperatures – Gauges and thermometers shall be checked at the start of each shift. If any settings are out of range they shall be adjusted to the proper settings. Gauges and thermometers shall be calibrated annually.

6.6 Water Content – This test shall be performed monthly. If the results returned exceed 5% by volume this shall cause for immediate replacement of the in-use penetrant and corrective action as deemed appropriate by the quality assurance.

6.7 Removeability – This test shall be performed monthly. If the test penetrant (in use) removeability is noticeable less than the reference (new) the in-use penetrant shall be replaced.

6.8 Inspection Area Cleanliness – The penetrant inspection area shall be cleaned at the end of each shift.

6.9 White Light – This weekly check shall be performed using a light meter capable of reading foot-candles directly. It shall be measured at working level (waste or bench top). The meter used shall be calibrated annually.

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Process Flow Chart

Parts to be inspected

