



The Engineering Society
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AEROSPACE STANDARD



AS7114/1

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Superseding AS71001/1A

NADCAP REQUIREMENTS FOR NONDESTRUCTIVE TESTING FACILITY PENETRANT SURVEY

1. SCOPE:

This Aerospace Standard (AS) is to be used to supplement AS7114. In addition to the requirements contained in AS7114, the requirements contained herein shall apply to suppliers seeking NADCAP accreditation for Penetrant Nondestructive Testing.

When customer requirements differ from those specified herein, the customer requirements shall take precedence.

2. REFERENCES:

2.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15086-0001.

AS7003 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Program Operation
AS7114 National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Nondestructive Testing

2.2 U.S. Government Publications

Available from DODSSP Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-410 Nondestructive Personnel Qualification and Certification
MIL-STD-6866 Inspection, Liquid Penetrant
MIL-STD-45662 Calibration Systems Requirements
MIL-I-25135 Inspection Materials, Penetrants
QPL-25135 Qualified Products List

2.3 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

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3. MATERIALS AND EQUIPMENT:

- 3.1 All penetrant materials/combinations used shall be in accordance with customer requirements. There shall be no additional procurement of materials that are not on the current revision of QPL-25135, or approved for listing on the next revision of QPL-25135, without customer approval.
- 3.2 The facility shall have traceability to manufacturer's certifications for each batch of penetrant, emulsifier, and developer in use.
- 3.3 Contents of all tanks/drums shall be labeled as to material and batch number.
- 3.4 All tanks in the system shall be arranged/covered to prevent mixing of materials.

4. PROCEDURES:

4.1 NDT Facility Written Procedures:

- 4.1.1 There shall be a statement in the procedure or quality manual requiring that as a minimum customer requirements shall be met.
- 4.1.2 There shall be written inspection procedures, general and/or specific, containing the following information as applicable:
 - a. The procedure I.D. number or applicable program, if program specific
 - b. Date of approval
 - c. Approval by Level III
 - d. Listing of deviations and approval by customer, when applicable
 - e. Requirement that all personnel are qualified and certified to appropriate level
 - f. The part number and/or material to be examined
 - g. Equipment to be used including any unique requirements for automated versus manual equipment
 - h. Requirements for precleaning and/or etching process including materials, processing times, metal removal, and drying parameters, part masking and other part preparations
 - i. Brand name and specific type of penetrant, sensitivity level, emulsifier, developer, and classifications in accordance with MIL-I-25135
 - j. Complete processing parameters for the penetrant inspection materials including dwell times, application methods, drying times, concentrations of emulsifiers, temperatures, and controls to prevent excessive drying or overheating, as appropriate
 - k. Methods of removing excess penetrant, drying, spray nozzle type, water pressure and water temperature, hydro-air nozzles, and air pressure
 - l. Method of developer applications
 - m. Evaluation procedure including black light intensity, white light intensity, inspection booth ambient white light intensity, dark adaptation time, prohibition of photochromic lenses, acceptance criteria, and controls for mechanical evaluation and solvent cleaning evaluation
 - n. Identification of the components or areas within a component to be inspected
 - o. Applicable acceptance class for component and/or zone in accordance with engineering drawing and/or specification
 - p. Any special equipment required including type and intensity of light, if different from standard processing
 - q. When required, complete post-cleaning procedures
 - r. Method and location of marking parts, if applicable

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4.1.2 Continued:

- s. Method for control of software or programming used for automated processing equipment as applicable
- t. Provisions for process control tests and checks to be performed

4.1.3 If applicable, there shall be procedures defining handling of special material and processing of parts as required by customer.

5. LABORATORY PROCESS CONTROLS:

5.1 Penetrant Brightness Test (Reused):

The fluorescent brightness of in-use penetrant shall be tested.

- a. This test shall be performed at least quarterly.
- b. The test procedure shall be in accordance with MIL-I-25135, Para. 4.5.7.
- c. The minimum acceptable limit shall be 90%.
- d. Records of this test shall be on file.
- e. The test records shall indicate acceptable results.
- f. The facility shall be capable of demonstrating this check or provide documentation of acceptable results from a testing laboratory.

5.2 Water Content of Water-Washable Penetrants (Reused):

- a. The water content of in-use Method A penetrants shall be tested.
- b. The test results shall be documented.
- c. This test shall be performed at least monthly.
- d. A standard test (e.g., ASTM D 95) method shall be used.
- e. The maximum acceptable limit used shall be 5% or the facility shall demonstrate that the acceptability limit is in accordance with customer requirements.
- f. The test records shall indicate acceptable results.
- g. The facility shall be capable of demonstrating this check or provide documentation of acceptable results from a testing laboratory.

5.3 Water Content of Lipophilic Emulsifiers (Reused):

- a. The water content of in-use Method B emulsifier shall be tested.
- b. The test results shall be documented.
- c. This check shall be performed at least monthly.
- d. A standard test (e.g., ASTM D 95) method shall be used.
- e. The maximum acceptable limit used shall be 5% or the facility shall demonstrate that the acceptability limit is in accordance with customer requirements.
- f. The test records shall indicate acceptable results.
- g. The facility shall be capable of demonstrating this check or provide documentation of acceptable results from a testing laboratory.

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5.4 Concentration of Hydrophilic Emulsifiers:

- a. The concentration of (Method D) hydrophilic emulsifiers shall be tested.
- b. The test results shall be documented.
- c. For in-use (re-used) materials this check shall be performed at least weekly.
- d. A refractometer shall be used to perform this test.
- e. A correction graph for conversion shall be used.
- f. Maximum concentrations shall comply with QPL-25135 and/or documented manufacturers recommended maximum concentration, or per customer requirements.
- g. The maximum variation allowed shall be $\pm 3\%$ or the facility shall demonstrate the variation allowed is in accordance with customer requirements.
- h. Concentrations for spray applications shall be at or below 5%.
- i. The check shall be performed upon initial mixing and when adjusted.
- j. The test records shall indicate acceptable results.
- k. The facility shall be able to properly demonstrate this check.

5.5 Dry Developer Characteristics:

- a. The in-use dry developer shall be checked.
- b. The test results shall be documented.
- c. This check shall be performed at least daily.
- d. This check shall ensure that the developer is not caked (recycled and closed systems)
- e. Recycled dry developer shall not have excessive fluorescent material in excess of 9 specs in accordance with MIL-STD-6866, Para. 5.8.4.3.1.
- f. Records of this check shall be kept on file.
- g. The test records shall indicate acceptable results.
- h. The facility shall be able to properly demonstrate this check.

5.6 Characteristics and Concentration of Aqueous Developer (Soluble & Suspended):

- a. The concentration of in-use Form b and c developer shall be checked.
- b. The test results shall be documented.
- c. This test shall be performed at least weekly.
- d. A hydrometer and specific gravity chart shall be used for this test. Acceptance limits shall be in accordance with the manufacturers recommendations.
- e. The aqueous developer shall uniformly wet the test panel.
- f. The aqueous developer shall be checked for fluorescence in accordance with MIL-STD-6866, 5.8.4.3.2.
- g. The aqueous developer shall not contain fluorescent material.
- h. The test records shall indicate acceptable results.
- i. The facility shall be able to properly demonstrate this check.
- j. The test results shall be documented.
- k. The test shall be performed at least daily.

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5.7 Penetrant System Performance:

- a. The penetrant system performance shall be checked.
- b. The test results shall be documented.
- c. This test shall be performed daily in accordance with MIL-STD-6866, Para. 5.8.3.
- d. The type of known defect standard and the acceptance criteria for each level or group shall be in accordance with customer requirements.
- e. The test records shall indicate acceptable results.
- f. The facility shall be able to properly demonstrate this check for each penetrant system in use.
- g. The known defect standard shall be properly cleaned and stored.
- h. There shall be maintenance procedures in place that assure that cleaning of the known defect standards between usages is adequate and that physical changes in the standard, that make it unstable for use, can be detected.

5.8 Sensitivity of In-Use Penetrant (Reused):

- a. The sensitivity of in-use penetrants shall be compared at least monthly against unused penetrants in accordance with MIL-STD-6866, Para. 5.8.4.1.4.
- b. The test results shall be documented.
- c. The type of known defect standard and the acceptance criteria for each level or group shall be in accordance with customer requirements.

5.9 Removability of Water-Washable Penetrants (Reused):

- a. The removability test for in-use water-washable penetrant shall be performed.
- b. The test results shall be documented.
- c. This test shall be performed at least monthly.
- d. The test procedure shall be in accordance with MIL-I-25135, Para. 4.5.17.2.
- e. Records of this test shall be on file.
- f. The test records shall indicate acceptable results.
- g. The facility shall be able to properly demonstrate this test or provide documentation of acceptable results from a testing laboratory.

5.10 Removability of Emulsifiers (Reused):

- a. The removability test for in-use emulsifier shall be performed.
- b. The test results shall be documented.
- c. This check shall be performed at least weekly.
- d. The test procedure shall be in accordance with MIL-I-25135, Para. 4.5.17.4 or Para. 4.5.17.5 as applicable.
- e. Records of this check shall be on file.
- f. The test results shall indicate acceptable results.
- g. The facility shall be able to properly demonstrate this check or shall provide documentation of acceptable results from a testing laboratory.

5.11 Dryer Controls:

If a dryer oven is in use at the facility:

- a. The dryer oven shall be thermostatically controlled.
- b. The calibration shall be current.
- c. The frequency of calibration shall be in accordance with customer requirements.
- d. There shall be a temperature indicator for the dryer.
 - 1) The calibration of the temperature indicator shall be current.
 - 2) The frequency of calibration shall be in accordance with customer requirements.

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5.12 Black Light Meters and Measurements:

- a. The type and model of black light meter(s) shall be in accordance with customer requirements.
- b. Calibration of the black light meters shall be performed at least semi-annually.
- c. Tolerances for black light meters shall be defined in a calibration procedure.
- d. There shall be evidence that the black light meter has been calibrated.
- e. The black light intensity of the inspection light(s) shall be checked at least daily, or when used.
- f. Minimum acceptable limits shall be $800 \mu\text{W}/\text{cm}^2$ at 15" or in accordance with customer requirements.
- g. Records of this check shall be on file.
- h. The test results shall indicate acceptable results.
- i. The facility shall be able to properly demonstrate this check.
- j. The black light reflectors and filters shall be checked daily for cleanliness and integrity. This check shall be recorded.

5.13 White Light Meters and Measurements:

- a. The type and model of white light meter(s) shall be in accordance with customer requirements.
- b. Calibration of the meter shall be performed at least semi-annually unless a stricter customer requirement is applicable.
- c. The tolerance for calibration shall be documented and shall be in accordance with customer requirements.
- d. Calibration of the white light meter shall be documented in a procedure.
- e. The white light meter shall have a current calibration sticker.
- f. There shall be a means documented to ensure that ambient white light is controlled a maximum 2 ft-candles for Type I penetrants unless a stricter customer requirement is applicable.
- g. This check of ambient white light shall be performed weekly unless a stricter customer requirement is applicable.
- h. Records of this check indicating acceptable results shall be maintained on file.
- i. The facility shall be able to demonstrate this check.
- j. A white light shall be available in the undarkened inspection area for visual verification.
- k. A minimum of 100 foot-candles shall be available at the part surface for visual verification of penetrant indications
- l. There shall be documentation indicating that available light at the part surface is checked weekly.
- m. The facility shall be able to demonstrate this check.

6. PENETRANT AREA PROCESS CONTROLS:

6.1 Precleaning:

- a. Equipment shall be in place to adequately clean parts to remove grease, oil, scale, rust, etc..
- b. Alloy groups and their precleaning methods shall be defined.
- c. If aqueous cleaning methods (including etch) are utilized, the facility shall have the capability to dry parts prior to penetrant application. The temperature used shall be in accordance with customer requirements.

6.2 Pre-Penetrant Etching:

6.2.1 Facilities that perform pre-penetrant etching in-house shall comply with the following:

- a. Process controls shall be in place to ensure consistent etch rates (i.e., temperature, solution, activity, etc).
- b. Operator instructions shall adequately address circumstances requiring pre-penetrant etching.
- c. Operator instructions shall adequately describe the etching process procedure.

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6.3 Penetrant Application:

- a. Components, penetrant, and ambient temperatures shall be maintained between 40 °F (4 °C) and 120°F (49 °C) unless a stricter customer requirement is applicable.
- b. There shall be means for controlling penetrant dwell time.
- c. Parts shall be dry prior to penetrant application.
- d. Penetrant application operations shall be controlled to ensure complete coverage of areas to be inspected.

6.4 Use of Emulsifier:

- a. A means shall exist for controlling emulsification time.
- b. Methods of application and removal of emulsifiers shall be properly controlled.

6.5 Penetrant Removal:

- a. The rinse water shall be controlled to provide a coarse spray. The nozzle type shall be in accordance with customer requirements.
- b. The rinse water temperature shall be controlled between 50°F (10°C) and 100 °F (38°C).
- c. The rinse water temperature shall be monitored.
- d. Calibration shall be performed on the temperature monitor at an established frequency.
- e. The rinse water pressure shall be controlled to 40 psi maximum.
- f. The water pressure shall be monitored.
- g. The water pressure monitor shall be calibrated at an established frequency.
- h. Penetrant removal shall be verified under a black light.

6.5.1 Hydro-Air Nozzles

- a. Hydro-air nozzles shall be used only for Level 1 and 2 sensitivity penetrants.
- b. The air pressure on the hydro-air nozzle shall be controlled to 25 psi maximum.
- c. Calibration shall be performed on the hydro-air nozzle air pressure monitor at an established frequency.
- d. If compressed air is used, it shall be filtered.

6.6 Developer Application:

- a. There shall be means for controlling developer dwell time. Minimum and maximum dwell times shall be established in accordance with customer requirements.
- b. Parts shall be dried in accordance with MIL-STD-6866.
- c. Methods for applying and removing excess developer shall be properly controlled.

6.7 Inspection Area:

- a. If required, a magnifying glass shall be available for evaluating indications.
- b. Magnifying power (i.e., 3X, 10X) shall be in accordance with customer requirements.
- c. Borescopes available for inspection/evaluating indications shall be in accordance with customer requirements.
- d. Measuring devices shall be available for sizing indications.
- e. Measuring devices shall be traceable to NIST.
- f. The area shall be free of fluorescent material or other contamination that may interfere with the inspection process. This shall be checked at least weekly unless a stricter customer requirement is applicable.