

Quality Assurance
Procedure QAP 5940

Method of Test For

**Qualification of Liquid Penetrant
Inspection Procedures and Material
Sensitivity Tests**

1. SCOPE

1.1 This written procedure establishes the method by which the relative sensitivity of penetrant materials are checked.

1.2 This written procedure establishes the method for qualifying penetrant tests outside the temperature range of 60 - 125 degrees F.

2. PERSONNEL

2.1 Personnel performing this examination shall be qualified in accordance with the Written Practice of Personnel Qualification and Certification for Nondestructive Testing per ASNT SNT-TC-1A.

3. REFERENCE

3.1 AASHTO/AWS D1.5M/D1.5:2015, Section 6.7.7 and 6.26.

3.2 ASTM Volume 3.03 , E165

3.3 NDT Handbook, McMaster Vol. 1

3.4 ASME Pressure Boiler Code, Article VI.

4. MATERIALS

4.1 Solvent-Removable Penetrants that are visible (Method B, Type 3) or fluorescent (Method A, Type 3) shall be used. A compatible (same manufacturer and family) solvent cleaner and dry or non-aqueous developer shall be used for the selected liquid penetrant.

4.1.1 The chlorine or sulfur content of the penetrant materials shall not exceed 1% when testing austenitic stainless steel.

4.1.2 Only materials from the same manufacturer and family may be used together. The following materials shall be considered the reference :

- A. Sherwin Williams Dubl-Chek DP-40, lot # 819J1 visible penetrant
- B. Sherwin Williams Dubl-Chek RC-65, lot # 82 C89 fluorescent penetrant
- C. Sherwin Williams Dubl-Chek D-100, lot# 814 L6 28

4.1.3 The materials to be compared to the reference material are: any penetrant or developer which is used 6 months after the date of purchase, newly purchased materials, or Quality Control's materials. Quality Control's materials may also be compared to tested CDOT materials (compared to the reference materials). Only tested materials shall be used to qualify penetrant procedures not within the 60 - 125 degree F. temperature range.

4.2 3/8" x 2 1/2 " x 5" (full size specimen) or two halves of one test control specimen.

4.3 Lint-free rags.

4.4 Light Meter (footcandles).

4.5 Camera

5. PROCEDURE

5.1 Material sensitivity check - Each newly purchased lot of penetrant and developer used to perform liquid penetrant tests shall be verified for sensitivity by a direct visual comparison to the reference materials. The reference materials and all materials to be compared to the reference shall be applied to test control specimen # F-1 face, both "A" and "B" ("Procedure for Fabrication of Liquid Penetrant Control Specimen") as follows:

5.1.1 The temperature of the penetrant materials and the surface of the part to be tested shall remain at 70, \pm 5 degrees Fahrenheit throughout the test.

5.1.2 Apply the penetrant using the same method that will be used during quality assurance testing (brush or aerosol can spray). In the case of brush application, use light even strokes applying enough penetrant to produce an even film on the entire surface of the specimen.

5.1.2.1 For spray application, hold the nozzle 12 inches from the specimen surface. Rapidly move, while spraying across the surface three times or until an even film of penetrant is present on the surface. Beading of penetrant on an evenly coated surface does not require further penetrant application. After the surface is evenly coated, the penetrant dwell time shall be started.

5.1.3 Allow a penetrant dwell time of 7 minutes
 \pm 30 seconds.

5.1.4 After the dwell time has elapsed, wipe as much of the penetrant from the surface as possible with a dry lintless cloth.

5.1.5 After the penetrant has been removed from the surface with the dry cloth, lightly apply a family compatible cleaner to the cloth and remove penetrant from the surface until very little is observed on the cloth.

5.1.6 Immediately after cleaning the surface, hold the developer 12 inches from the surface while spraying. Make one pass across the surface of the specimen. Wait 10 seconds and make a second pass directing the developer onto any uncoated areas. Repeat if necessary so that a minimum but uniform film is present on the surface. Start the developer dwell time.

5.1.7 Allow a developer dwell time of 7 minutes
∇ 30 seconds prior to interpretation of the indications.

5.1.8 Photograph the surface that has been tested with the reference materials as follows:

5.1.8.1 The ambient light at the surface of the specimen shall be 50 fc.
The lens shall be 6 inches away from the surface of the specimen.

5.1.8.2 The intensity of the black light shall be 800 mWatts/square centimeter when photographing the fluorescent penetrant process.

5.2 The procedure for checking relative sensitivity of an untested lot of penetrant materials, e.g. Q C materials, to a tested lot of materials shall be as described in Section 5.3.

5.3 Liquid penetrant testing at temperatures outside of the 60-125 degree range may be used provided the following qualification is performed:

5.3.1 The temperature of the materials and the base metal shall be the same and shall determine the following range allowable to perform penetrant tests:

minimum temperature - 125 degrees F.

5.3.2 The temperature of the base metal shall be at the highest temperature to qualify the following range:

60 - maximum degrees F. (within 125 degrees F)

Caution* The temperature of the aerosol can shall not exceed the manufacturers recommendation, but for the purpose of qualifying the higher range, shall be at the temperature anticipated at the time of test.

5.3.3 Perform the procedure detailed in 5.2, except the same face side both halves of the same control specimen shall be used, e.g. Face "A" of test control specimen A-1. One half shall be processed at the temperature being qualified. The other half shall be processed at 60 - 70 degrees F. for the minimum temperature or 80 - 125 degrees F. for the upper temperature being qualified.

5.3.3.1 The dwell time of the penetrant and developer may be adjusted from the values shown in the "Liquid Penetrant Inspection Procedure", sections 5.1.3, 5.1.7. These required values needed to achieve acceptable penetrant sensitivity shall become the specified procedure values. For temperatures less than 60 degrees F., the longer dwell times to achieve comparable sensitivity to the procedural temperature range of 60 - 125 degrees F. shall become the minimum dwell time. This dwell time shall be entered on the form "Procedure Values for Penetrant Testing Qualification".

5.3.3.2 For temperatures greater than 125 degrees (base metal only; the materials shall never be greater than 120 degrees or the manufacturer's recommended maximum temperature) the minimum and maximum dwell times shall be established in accordance with 5.2. These values shall be the limits of the dwell time and shall be recorded on the form "Procedure Values for Penetrant Testing Qualification".

6. EVALUATION

6.1 The same face shall be evaluated for all tests.

6.2 Comparisons for the procedure detailed in

5.1 shall be made between the materials being verified and the photograph of the reference materials on the same face of test control specimen F-1. Visual comparison shall be made in approximately the same ambient light as that which the photograph was taken.

6.3 Comparisons of procedure 5.2 and 5.3 shall be made on the same face of each half of the same specimen number.

6.4 Direct visual comparison between each test parameter shall be made by evaluating indications in the same area of the photograph or each half of the control test specimen. Essentially the same sensitivity shall be present as the photograph. Essentially the same sensitivity shall be present, particularly for the same bisected indications on the two halves.

7. RECORDS

7.1 Each can of the tested lot # shall be marked with the date the material was verified. Any material that does not exhibit comparable sensitivity shall be reported to CDOT Staff Bridge. Unsatisfactory material shall be discarded, or, in the case of newly purchased material, not accepted and returned to the manufacturer.

7.1.1 Each can of the lot number tested to qualify testing outside 60 - 125 degrees F., shall have the temperature range and date the qualification was performed written in ink on the can. The developer and penetrant dwell times shall also be listed on the container. A list of the lot numbers and qualification tests shall be on file with CDOT Staff Bridge. These qualifications and tests shall remain in effect for 6 months from the date of the test prior to requiring retesting.