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MILITARY SPECIFICATION

INSPECTION MATERIALS, PENETRANTS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers materials used in the liquid penetrant inspection of metal and nonporous, nonmetal parts for material discontinuities open to the surface. This specification provides the penetrant systems required by MIL-I-6866. This specification does not provide the special application materials that are designed for use outside the processing requirements of MIL-I-6866. Such special application materials include liquid oxygen compatible, high/low temperature, thixotropic, reverse fluorescence, and dye precipitation penetrant systems.

1.2 Classification. The penetrant inspection materials are classified as follows:

1.2.1 Penetrant systems. Penetrant systems covered by this specification shall be of the following types, methods and sensitivity levels.

Type I - Fluorescent dye
Type II - Visible dye
Type III - Visible and fluorescent dye (dual mode)

Method A - Water washable
Method B - Post emulsifiable, lipophilic
Method C - Solvent removable
Method D - Post emulsifiable, hydrophilic

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: AFWAL/MLSE, Materials Laboratory, WPAFB, OH 45433 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 6850

Sensitivity Level 1 - Low
Sensitivity Level 2 - Medium
Sensitivity Level 3 - High
Sensitivity Level 4 - Ultrahigh

1.2.2 Developers. Developers covered by this specification shall be of the following forms:

Form a - Dry powder
Form b - Water soluble
Form c - Water suspendable
Form d - Nonaqueous
Form e - Specific application

1.2.3 Solvent removers. Solvent removers covered by this specification shall be of the following classes:

Class (1) - Halogenated
Class (2) - Non-halogenated
Class (3) - Specific application

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-A-250/4	Aluminum Alloy, 2024, Plate and Sheet
QQ-A-250/12	Aluminum Alloy, 7075, Plate and Sheet
QQ-M-44	Magnesium Alloy, Plate and Sheet, AZ31B
PPP-B-636	Box Shipping, Fiberboard
PPP-B-640	Box Fiberboard, Corrugated, Triple-wall
PPP-C-96	Cans Metal, 28 Gage and Lighter
PPP-D-723	Drums Fiber
PPP-D-729	Drums Shipping or Storage, Steel, 55 Gallon (208 liters)
PPP-P-704	Pails Shipping, Steel (1 through 12 gallons)

STANDARDS

Federal

FED-STD-313	Material Safety Data Sheets Preparation and the Submission of

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-147	Palletized Unit Loads
MIL-STD-290	Packaging of Petroleum and Related Products
MIL-I-6866	Inspection, Penetrant Method of

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 173.300	Department of Transportation *Hazardous Materials Regulations*

(The Code of Federal Regulations is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Orders for the above publications should cite "49 CFR 100 to 177.")

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DOD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

CHEMICAL SPECIALTIES MANUFACTURERS ASSOCIATION (CSMA)

CSMA Aerosol Guide

(Application for copies should be addressed to the Chemical Specialities Manufacturers Association, 1001 Conneticut Avenue NW, Washington, DC 20036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 93	Flash Point by Pensky-Martens Closed Tester, Tests for
ASTM D 95	Water in Petroleum Products and Bituminous Materials by Distillation, Test for
ASTM D 130	Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test, Detection of
ASTM D 445	Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity), Test for
ASTM D 3951	Commercial Packing, Practices for
ASTM G 41	Cracking Susceptibility of Titanium Alloys Exposed under Stress to a Hot Salt Environment, Recommended Practice for Determining

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

SOCIETY OF AUTOMOTIVE ENGINEERS AEROSPACE (AMS)

AMS 4911	Titanium Alloy Sheet, Strip, and Plate, 6Al - 4V, Annealed
AMS 5391	Castings, Alloy Investment, 73Ni-13Cr-4.5Mo-0.75Ti-6Al-2.3(Cb+Ta)-0.10Zr-0.010B, Vacuum Melted
AMS 6350	Sheet, Strip, and Plate, 0.95Cr-0.20Mo-(0.28-0.33C) (SAE 4130)

(Application for SAE publications may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

(Technical Society and technical association specifications are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Qualification. Penetrant materials furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for the opening of bids (see 6.4).

3.1.1 Qualification provisions. Penetrant materials shall be qualified in accordance with the following provisions.

3.1.1.1 Type I (fluorescent dye materials). Method A (water washable) penetrants and Methods B and D (post emulsifiable) penetrants/emulsifiers shall be qualified with the standard dry developer D-1. Method C (solvent removable) penetrants shall be qualified with the standard Class (1) remover R-1 and standard nonaqueous developer D-4.

3.1.1.2 Type II (visible dye) materials. Method A penetrants shall be qualified with the standard nonaqueous wet developer D-4. Methods B and D penetrants/emulsifiers shall be qualified with the standard aqueous suspendable developer D-3. Method C penetrants shall be qualified with the standard Class (1) remover R-1 and standard nonaqueous developer D-4.

3.1.1.3 Type III (visible and fluorescent, dual mode) materials. Type III materials shall be qualified in accordance with 3.1.1.1 for the fluorescent mode and 3.1.1.2 for the visible mode. If the Type III materials are included in a limited application system, the provisions of 3.1.1.6 shall apply.

3.1.1.4 Developers. All developers, except Form e (limited application), intended for use with Type I (fluorescent) penetrant materials, shall be qualified with the standard penetrant/emulsifier FP-3/FE-2. All developers, except Form e, intended for use with Type II (visible) penetrant materials shall be qualified with the standard penetrant/emulsifier VP-1/VE-1. Form e developers shall be qualified in accordance with 3.1.1.6.

3.1.1.5 Solvent removers. Classes (1) and (2) solvent removers shall be qualified with the standard penetrant FP-3 and nonaqueous developer D-4. Class (3) solvent removers shall be qualified in accordance with 3.1.1.6.

3.1.1.6 Limited application developers/removers. Form e developers and class (3) removers shall be qualified with materials as specified by the manufacturer and approval shall be limited to those materials.

3.1.2 Qualification testing samples. Minimum sizes of samples submitted for qualification testing of bulk packaged materials shall be 3.8 liters (1 gallon) for each liquid material and 0.9 Kg (2 lbs) for each solid (developer) material. The samples shall be accompanied by complete operating instructions. For aerosol container packaged materials, three containers of each material shall be submitted.

3.1.3 Reference materials. Reference materials shall serve to demonstrate minimum acceptable performance as indicated in this specification. The reference materials are identified in Table I and are available from the qualifying agency (see 6.3). Penetrant reference materials with a specific level of sensitivity shall be used to evaluate penetrants representing other methods with the same level of sensitivity.

3.1.4 Laboratory facilities for qualification testing. For qualification to the requirements of this specification, all tests except 4.5.17.2, 4.5.17.3.1, 4.5.17.4 and 4.5.17.5, as applicable, shall be conducted at an independent laboratory approved by the qualifying agency, AFWAL/MLSA. Tests 4.5.17.2, 4.5.17.3.1, 4.5.17.4, and 4.5.17.5, as applicable, shall be performed by the qualifying agency.

3.1.5 Requalification. Penetrant materials shall be requalified when changes to their formulation or method of manufacture are made outside of normal manufacturing tolerances.

TABLE I. Reference material designations.

Material	Designation
Penetrant, Type I, Level 1, Method A	FP-1
Penetrant, Type II, Level 1, Methods B and C	VP-1
Penetrant, Type I, Level 2, Methods B, C, and D	FP-2
Penetrant, Type I, Level 3, Methods B, C, and D	FP-3
Penetrant, Type I, Level 4, Methods B, C and D	FP-4
Emulsifier, Type I, Method B	FE-1
Emulsifier, Type II, Method B	VE-1
Emulsifier, Type I, Method D	FE-2
Remover, Class (1)	R-1
Remover, Class (2)	R-2
Developer, Form a	D-1
Developer, Form b	D-2
Developer, Form c	D-3
Developer, Form d	D-4

3.2 Physical properties.

3.2.1 Toxicity. The toxic characteristics of the materials shall be properly identified and defined on the material safety data sheets prepared in accordance with FED-STD-313 (see 4.5.1). Form a developers shall be certified to contain no asbestos.

3.2.2 Corrosive properties. All inspection materials, as supplied by the manufacturer, (or mixed with de-ionized water in the case of aqueous developers) shall be noncorrosive and nontarnishing. The test panels shall show no evidence of pitting, etching, cracking or tarnishing when visually examined using 10X magnification when tested in accordance with 4.5.2.1, and 4.5.2.2. Coated panels tested in accordance with 4.5.2.3 shall show no more evidence of corrosion/oxidation than the uncoated panels.

3.2.3 Flash point. For penetrants and Method B emulsifiers, intended for use in open tanks or containers, the minimum flash point shall be 93°C (200°F) when tested in accordance with 4.5.3. Materials packaged in aerosol containers shall be non-flammable in accordance with Department of Transportation Regulations (49 CFR 173.300) in lieu of reporting flash point.

3.2.4 Viscosity. The manufacturer shall state the nominal viscosity of each penetrant and emulsifier submitted for qualification. This viscosity ±10 percent shall be required for each material which successfully passes all other qualification tests. Viscosity tests shall be made as specified in 4.5.4.

3.2.5 Storage stability. The supplier shall certify that all penetrant materials submitted for qualification are capable of meeting the acceptance requirements of this specification when packaged in accordance with the requirements of this specification, after a 1-year period of storage in fully closed containers at a temperature of 16°C (60°F) to 38°C (100°F). Conformance to this requirement may be confirmed by testing samples submitted for qualification to the tests specified in 4.5.5.

3.3 Penetrants. Penetrants shall be as specified herein.

3.3.1 Condition. All penetrants shall be furnished in a ready-to-use condition requiring no mixing or stirring.

3.3.2 Surface wetting. All penetrants shall readily wet the surface and the penetrant film shall not retract or form beads when tested in accordance with 4.5.6.

3.3.3 Extended penetrant dwell time. The penetrant system shall pass the appropriate removability test (see 4.5.16) after a four-hour penetrant dwell time at 21°C (70°F).

3.3.4 Color (Types II and III penetrants). Types II and III penetrants shall be red, orange, or purple when viewed under white light.

3.3.5 Fluorescent properties (Types I and III penetrants).

3.3.5.1 Color. Type I penetrants shall fluoresce yellow-green or green when illuminated with near-ultraviolet light. Type III penetrants shall fluoresce when illuminated with near-ultraviolet light.

3.3.5.2 Brightness. The fluorescent brightness of Types I and III penetrants shall be not less than 85 percent of the appropriate reference penetrant when tested in accordance with 4.5.7.

3.3.5.3 Ultraviolet stability. The average fluorescent brightness of samples exposed to near ultraviolet light in accordance with 4.5.8 shall be compared to the average fluorescent brightness of the unexposed samples. The minimum acceptable values are:

Level 1 - 50 percent.
Level 2 - 50 percent.
Level 3 - 70 percent.
Level 4 - 70 percent.

3.3.5.4 Thermal stability. The average fluorescent brightness of samples exposed to elevated temperatures in accordance with 4.5.9 shall be compared to the average fluorescent brightness of the unexposed samples. The minimum acceptable values are:

Level 1 - 60 percent.
Level 2 - 60 percent.
Level 3 - 80 percent.
Level 4 - 80 percent.

3.3.6 Storage temperature stability. All penetrants shall show no separation when tested in accordance with 4.5.10. Also, Method A penetrants, subjected to this test and returned to room temperature, shall meet the requirements of 3.3.8.

3.3.7 Tank life. All penetrants shall show no separation, precipitation or scum formation when tested in accordance with 4.5.11.

3.3.8 Water tolerance. The addition of 5 percent by volume of water to Method A penetrants shall not produce gelling, separation, clouding, coagulation or formation of water layer on the penetrant surface when tested in accordance with 4.5.12.

3.4 Emulsifiers.

3.4.1 Color (Type II system emulsifiers). The color of Type II system emulsifiers shall be distinctly different from the color of Type II penetrants.

3.4.2 Type I system emulsifiers.

3.4.2.1 Color. The color of Type I system emulsifiers shall be distinctly different, when viewed under both white and near ultraviolet light, from the color of Type I penetrants.

3.4.3 Lipophilic emulsifiers (Type I System, Method B).

3.4.3.1 Penetrant contamination. A mixture of four parts emulsifier and one part penetrant (by volume) shall leave no more residual fluorescence than a comparable mixture of appropriate reference materials when tested in accordance with 4.5.16.

3.4.3.2 Water tolerance. The addition of 5 percent by volume of water to Method B emulsifiers shall produce no gelling, separation, coagulation or formation of a water layer when tested in accordance with 4.5.12. Emulsifiers with 5 percent by volume addition of water shall also meet the requirement of 3.7 when used with the appropriate penetrant.

3.4.3.3 Tank life. Emulsifiers shall show no separation, precipitate or scum formation when tested in accordance with 4.5.11.

3.4.4 Hydrophilic emulsifiers (Type I System, Method D).

3.4.4.1 Concentration. Hydrophilic emulsifiers shall be diluted in accordance with the manufacturer's recommendation for tests in this specification.

3.4.4.2 Water content. Maximum water content of the emulsifier concentrate shall be 5 percent when tested in accordance with 4.5.20.

3.4.5 Storage temperature stability. There shall be no separation of constituents of Method B emulsifiers and Method D emulsifier concentrate when tested in accordance with 4.5.10.

3.5 Developers.

3.5.1 General. Developers for Type II penetrants shall provide a good contrasting background. Developers for Type I penetrants shall exhibit no more fluorescence than the appropriate reference developer, when exposed to black light as specified in 4.5.14.

3.5.2 Nonaqueous developers. The nonaqueous developers shall be ready-mixed in pressurized or nonpressurized containers, as specified by the procuring activity. Each aerosol container shall have a pellet to aid in agitation of the materials and to indicate proper mixing.

3.5.2.1 Redispersibility. The precipitate formed shall be readily re-suspended with gentle stirring when tested in accordance with 4.5.13.1.

3.5.2.2 Application. The nonaqueous developer shall provide a smooth, even coating on the surface of the test specimen when tested for sensitivity in accordance with 4.5.17.3.

3.5.3 Water soluble and suspendable (aqueous) developers. The developers shall be supplied in wet or dry condition, as specified by the procuring activity. When supplied in the dry condition, instructions for mixing shall be marked on the container.

3.5.3.1 Redispersibility (suspendable developers). The precipitate shall be readily resuspended with gentle stirring when tested in accordance with 4.5.13.2.

3.5.3.2 Application. The water soluble and suspendable developers shall provide a smooth, even coating on the surface of the test specimen when tested for sensitivity in accordance with 4.5.17.3.

3.5.4 Developer removability. All developers shall be as easily and completely removed as the appropriate reference standard developer when tested in accordance with 4.5.15.

3.6 Solvent removers. Solvent removers may be suitable commercial or proprietary solvents, and shall be identified by the manufacturer as to which class they belong to (see 1.2.3). Solvent removers shall leave no more residual penetrant than the reference solvent remover when tested in accordance with 4.5.16.3. In addition, they shall leave no oily residue on the panels.

3.7 Penetrant removability.

3.7.1 Method A, (water washable systems). Method A systems shall leave no more residual penetrant than the same sensitivity reference penetrant system when tested as specified in 4.5.16.2.

3.7.2 Method B (post emulsifiable [lipophilic] systems). Method B systems shall leave no more residual penetrant than the same sensitivity reference penetrant system when tested as specified in 4.5.16.4.

3.7.3 Method C (solvent removable systems). Method C systems shall leave no more residual penetrant than the same sensitivity reference penetrant system when tested as specified in 4.5.16.3.

3.7.4 Method D (post emulsifiable [hydrophilic] systems). Method D systems shall leave no more residual penetrant than the same sensitivity reference penetrant system when tested as specified in 4.5.16.5.

3.8 Penetrant system/solvent remover/developer sensitivity. Penetrant systems/solvent removers/developers shall equal or exceed the appropriate reference materials in the brightness and number of indications when tested in accordance with 4.5.17 for sensitivity in accordance with 3.1.1.

3.9 Pressurized (aerosol) containers.

3.9.1 Net weight of contents. The net weight of usable contents of each aerosol container shall not be less than the amount indicated or required by contract when determined as specified in 4.5.18.

3.9.2 Valve leakage. The filled aerosol container shall be tested for valve leakage. The leakage shall not exceed 3 ml in 48 hours when determined as specified in 4.5.19.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance

of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the supplier shall use his own or any other facilities approved by the qualifying agency, AFWAL/MLSA. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests. The inspection and testing of the inspection materials shall be classified as follows:

a. Qualification tests (4.3).
b. Quality conformance tests (4.4).

4.3 Qualification tests. The qualification tests shall consist of all of the tests described under 4.5 Sample sizes are specified in 3.1.2.

4.4 Quality conformance tests. Quality conformance tests shall consist of sampling plan A and sampling plan B tests.

4.4.1 Sampling.

4.4.1.1 Lot. A lot shall consist of any penetrant, emulsifier, solvent remover or developer of the same composition and group designation, each manufactured as one batch and offered for delivery at one time.

4.4.1.1.1 Batch. A batch shall be that quantity of any of the above items mixed and manufactured at one time under the same conditions.

4.4.1.2 Sampling plan A. The Government reserves the right to witness the sampling. For all items except developer solids, a sample of not less than 1 liter (1 quart) nor more than 4 liters (1 gallon) shall be taken from each lot. From each lot of wet developers in the dry condition, a 4-kilogram (2-pound) sample shall be selected, and from each lot of dry developer solids a 2-kilogram (1-pound) sample shall be selected. The samples shall be subjected to tests as specified in Table II as applicable.

4.4.1.2.1 Rejection and retests. Failure of any item to meet the specified tests shall be cause for rejection of the lot represented. Before resubmitting the lot, the contractor shall fully explain to the Government inspector both the corrections made and the cause of previous rejections.

4.4.1.3 Sampling plan B. Unless otherwise specified, a second sample shall be selected in accordance with the provisions of 4.4.1.2 and shall be forwarded to the procuring activity, as designated in the contract or order. The sample shall be accompanied by a certified test report showing the results of the tests specified in 4.4.1.2. After review of the test report, the procuring activity may subject the sample to any of the tests in 4.5 that may be deemed advisable.

TABLE II. Quality conformance tests.

Test	Test method paragraph
Flash point	4.5.3
Viscosity	4.5.4
Developer fluorescence	4.5.14
Water content (hydrophilic emulsifier concentrate)	4.5.20
Penetrant removability	4.5.16
Water tolerance (Method A penetrants, Method B emulsifiers)	4.5.12
Fluorescent brightness	4.5.7
Surface wetting	4.5.6
Thermal stability	4.5.9
Redispersibility	4.5.13

4.4.1.3.1 Rejection. Should the results of any of the tests conducted by the procuring activity (4.4.1.3) be unsatisfactory, the material will be considered as not meeting the requirements of the specification, and the contracting officer will be so informed for appropriate action.

4.5 Test methods.

4.5.1 Toxicity. The vendor shall submit to the Government a certified list of the products' ingredients, identifying each ingredient by the following (as applicable):

a. Chemical name and formula (nomenclature of the International Union of Pure and Applied Chemistry).

b. NIOSH identification number (accession or identification number referenced in the Registry of Toxic Effects of Chemical Substances, if assigned).

c. Chemical Abstract Services number.

d. Name and address of manufacturer for each component.

In addition, the ranges of percentages of harmful or toxic components in the finished product and any toxicological data that could be useful in evaluating the safety of the formulation shall be furnished. All data shall be provided to the USAF Occupational and Environmental Health Laboratory, Consultant Division, Brooks AFB, TX 78235. The Government reserves the right to determine whether such data is adequate for the purposes of qualification under the provisions of this specification.

4.5.2 Corrosive properties. The following tests are required on all inspection materials:

4.5.2.1 Moderate temperature corrosiveness. This test shall be in accordance with ASTM D 130 except as specified herein. The corrosive properties of the material under test shall be evaluated on test panels of bare 7075-T6 aluminum alloy (QQ-A-250/12), AZ-31B magnesium alloy (QQ-M-44), and SAE 4130 steel (AMS 6350). Test panels shall be of sufficient length to extend above the surface of the materials being tested. Test panels shall be prepared in accordance with ASTM D 130 with the exception that the final rinse on the AZ-31B magnesium shall be with distilled water, with each panel being rinsed and dried individually. Water shall not be allowed to remain on the panels throughout the preparation stage.

4.5.2.2 Titanium hot salt stress corrosion. The test shall be in accordance with ASTM G 41 as adapted herein. The test panels shall be Ti 6Al-4V, annealed (AMS 4911).

4.5.2.2.1 Test panel preparation. The test panels shall be as in Figure 1 with the longitudinal grain direction parallel with the length dimension. The panel surfaces shall be prepared in accordance with ASTM D 130 to a surface finish of 20 RHR. The panels shall be brake formed over a 0.28 inch radius mandrel to produce an unrestrained angle of 65 ± 5° (See Figure 1B).

4.5.2.2.2 Procedure. Four test panels shall be used for each material to be tested. Prior to stressing, the panels shall be cleaned by solvent wipe or degreasing and lightly etched in a 40 percent HNO_3, 3.5 percent HF solution. The panels shall be then stressed with a 1/4 inch bolt as shown in Figure 1C. One panel shall be uncoated, one panel shall be coated with a 3.5 percent NaCl solution per ASTM G 41 and the remaining two panels shall be coated with the material under test. Coating shall be done by immersing the stressed panels into solution with the open end up. Drain the stressed panels overnight or until dry. The stressed panels shall then be placed in an oven and held at 538° ± 4°C (1000° ± 10°F) for 4.5 hours.

4.5.2.2.3 Interpretation of results. The panels shall be viewed while stressed for obvious cracks. When the panel coated with 3.5 percent salt solution does not show obvious cracks, remove the bolt and clean the coated surface by soaking in 50 percent NaOH at 138 ± 4°C (280 ± 10°F) for 30 minutes followed by a rinse. Etch in a 40 percent HNO_3, 3.5 percent HF solution for 3-4 minutes. Examine the etched surface under magnification to 10X. If no cracks can be observed on the remaining panels while they are still in the holders, they shall be cleaned, etched and examined in a similar manner for conformance to 3.2.2. If the salt coated panel has no pitting or cracks or if the uncoated panel has pitting or cracks, the test is invalid and must be repeated.

4.5.2.3 High temperature corrosion. Test panels for this test shall be IN713C (AMS 5391) cut to approximately 0.5 inch X 0.5 inch squares of thickness 0.1 inch or greater. The surfaces to be used for the test shall be sanded with 600 grit abrasive paper to produce a smooth and uniform finish. Two test panels shall be immersed or coated with the material under test and two additional panels shall remain bare. The panels shall be held in an oven maintained at 1010 ± 28°C (1850°F ± 50°F) for 100 hours ± 5 hours. Remove the panels from the oven and allow them to cool to room temperature. Section, mount, and polish each panel. Examine the cross section of each panel for evidence of surface and intergranular corrosion and oxidation using 200X magnification and compare the coated panels to the uncoated panels for conformance to 3.2.2.

4.5.3 Flash point. Flash points for all liquid materials shall be determined by ASTM D 93.

4.5.4 Viscosity. The viscosity of penetrants and emulsifiers shall be determined in accordance with ASTM D 445 at 38 ± 3°C (100 ± 5°F).

4.5.5 Storage stability. A closed, filled container of each item submitted for qualification shall be stored under warehouse conditions at a temperature of 16° to 38°C (60° to 100°F) for 1 year. Storage shall begin within 1 week after receipt of the material by the testing facility. At the end of the storage period, the materials shall be subjected to the quality conformance tests specified in 4.4.

4.5.6 Surface wetting. Penetrants shall be applied to the clean, shiny side of commercially available aluminum foil with a cotton swab. A small amount of penetrant is spread with the swab and observed after 10 minutes for conformance to 3.3.2.

4.5.7 Fluorescent brightness (Type I and Type III). This test shall be performed using an electronic filter fluorometer or equivalent instrumentation. Two procedures are given. One is for the Coleman 12C filter fluorometer and the other is for the Turner instruments, either Models 110, 111 or 112. Other instruments may be used with procedures adapted as required only with prior approval of the qualifying agency.

4.5.7.1 Preparation of specimens. Immediately prior to testing, a small amount of both the reference sample and the penetrant to be tested shall be diluted with an appropriate, nonfluorescent, highly volatile solvent, such as methylene chloride, in the ratio of 1 part sample to 24 parts solvent. Both penetrants shall be soluble in the same solvent. The solutions shall be agitated and then poured into separate, suitable, widemouthed containers. Immediately after the solutions have been poured into the test containers, test paper specimens, Whatmans No. 4 or equivalent, cut to fit the sample holder for the photofluorometer, shall be dipped into each solution, withdrawn, and clipped in a fixture to air dry vertically for 15 minutes.

Prior to dipping the test paper specimens into the solutions, the test paper specimens shall have been desiccated for at least 24 hours. The papers shall touch the fixture in as few places as possible. Six paper specimens shall be prepared for the reference sample and five paper specimens prepared for the test material.

4.5.7.2 Test procedure (Coleman 12C filter photofluorometer). The primary (light source) filter shall be the Coleman B1 or B1S (Corning CS7-39 glass) and the secondary or detector filters shall be the Kodak Wratten 2A, 86A, CC40Y, and Corning CS3-77. The test procedure shall be as follows:

4.5.7.2.1 Under black light compare the reference sample specimens with the test material specimens, then use one of the reference specimens as a master for setting the instrument. Place the master specimen under the leaf of the specimen holder, insert into the instrument and press the shutter button down. If, under the black light, the test specimen appears brighter than the reference specimen, adjust the aperture control on the instrument so that, by rotating the specimen holder, the peak reading on the meter will be near 50. Adjust the reading to near 100 if the reference specimens appears to be brighter than the test specimens. When a peak reading is obtained, the stop screw may be installed at a point which will engage the pin in the rotated specimen holder. Installation of stop screw is not essential if the specimen holder is rotated for each specimen and all readings are taken at peak of meter swing.

4.5.7.2.2 Remove the master specimen from the holder, place a clean blank piece of the same type of filter paper in the holder, and reinsert into the instrument. By means of the blanking controls, adjust the instrument so that the meter reads zero. Replace the blank filter paper with the master specimen and reinsert into the instrument. Using the standard control, set the instrument so that all readings will be taken in the upper 2/3 of the meter range and then remove the master specimen. Place the remaining specimens in the holder one at a time, read each specimen on one side only, and record the results. The five reference specimens and the five test specimens should be read alternately to compensate for instrument drift.

4.5.7.2.3 After all readings have been recorded, average the readings of the specimens. Using the average of the reference specimens as 100 percent, compare the average of the test specimens with this to determine conformance to the brightness requirements of 3.3.5.2.

4.5.7.3 Test procedure (Turner Model 110, 111, or 112). The test procedure shall be as follows:

4.5.7.3.1 Place a Corning CS7-37 primary filter in the filter holder in front of the light source and secondary filters (Corning CS 3-77, Kodak Wratten 2A, 86A, CC40Y, and neutral density filters, if known) in front of the detector

window. Turn the fluorometer on and allow the instrument to warm up for 15 minutes. Set the sensitivity of the light source at 1.

4.5.7.3.2 Place a standard penetrant prepared filter paper in the paper holder and position holder on the door of the fluorometer. Note the instrument's response. For the Model 111, a reading over 100 is off scale and this reading must be reduced to less that 100 by incorporating an appropriate number of secondary, neutral density filters. For the Model 112, a reading of 000, with no change when the treated papers are placed in the fluorometer, is off scale and this reading must be reduced with the appropriate number of neutral density filters.

4.5.7.3.3 Place a clean, untreated filter paper in the fluorometer and adjust (with zero adjust knob) the reading to zero. Replace the paper with a standard penetrant treated paper and record instrument reading. Replace the standard penetrant treated paper with a test penetrant treated paper and record instrument reading. Continue to alternate standard penetrant treated papers and test penetrant treated papers until all papers have been measured.

4.5.7.3.4 After all readings have been recorded, average the readings of the specimens. Using the average of the reference or standard specimens as 100 percent, compare the average of the test specimens to determine conformance to the brightness requirements for 3.3.5.2.

4.5.8 Ultraviolet stability of penetrants (Types I and III). The ultraviolet stability test will follow the fluorescent brightness test, using the same type of specimens and the same equipment (4.5.7). Dip ten filter paper specimens into the solution prepared for the test penetrant (4.5.7.1). After the samples have dried for five minutes, hang the fixture with five of the specimens in a location protected from strong light, heat and air currents. The other five specimens shall be exposed for one hour to a stable, uniform (over all specimens) near ultraviolet light intensity of 800 ± 40 microwatts per square centimeter. After the exposure, alternately measure the five exposed and five unexposed specimens per 4.5.7.2.2 or 4.5.7.3.3, as applicable. On the exposed specimens, make sure the measurements are taken on the side exposed to the ultraviolet light. The readings of the exposed specimens shall be averaged and compared to the average of the unexposed specimens for conformance to 3.3.5.3.

4.5.9 Thermal stability of penetrants (Type I and III). The thermal stability test for penetrants shall follow the fluorescent brightness test using the same type of specimens and same equipment (4.5.7). Dip ten filter paper specimens into the solution prepared for the test penetrant (4.5.7.1,. After the samples have dried for five minutes, hang a fixture with five samples in a location protected from strong light, heat and air current. (If the ultraviolet stability test is run concurrently, the same five unexposed specimens can serve for both tests.) The other five specimens shall be placed

for one hour on a clean metal plate in a dead air oven set at 121° ± 2°C (250° ± 5°F). After the exposure time has elapsed, alternately measure the brightness of the exposed and unexposed specimens, following the procedures in 4.5.7.2.2 or 4.5.7.3.3. For the exposed specimens, the brightness shall be measured on the side opposite the metal plate. The average of the exposed specimens shall be compared to the average of the unexposed specimens to determine conformance to 3.3.5.

4.5.10 Storage temperature stability. The storage temperature stability shall be tested by subjecting not less that 1 liter of the material in a closed glass bottle to 2 complete cycles of temperature variation. Each cycle shall consist of cooling the sample to -18°C (0°F) from room temperature, then increasing the temperature to 66°C (150°F), and then allowing to cool to room temperature again. Maintain the samples at each temperature extreme for at least 8 hours. After the temperature cycling has been completed, the material shall be allowed to return to room temperature. The sample shall then be visually examined for precipitation and separation of constituents.

4.5.11 Tank life (penetrants and emulsifiers). Fifty milliliters of material, in a one-hundred-fifty millimeters diameter petri dish, shall be placed in a convection oven maintained at 50°C ± 3°C (122 ± 5°F) for seven hours. At the end of this period, the material shall be removed from the oven and allowed to cool to room temperature. The material shall be examined for separation of constituents or the formation of surface scum.

4.5.12 Water tolerance. Twenty milliliters of the material to be tested shall be placed in a fifty milliliters beaker, containing a magnetic stirring bar 5/16 inch in diameter by 1 inch long and located on a magnetic stirrer. This test shall be conducted at 21°C ± 3°C (70° ± 5°F). Adjust stirring speed to get rapid mixing without entraining air bubbles (approximately 60 rpm). Add tap water drop wise from a Class A, ten milliliters burette placed above the beaker on the stirrer. The end point is reached when the test material turns cloudy or thickens as noted by slowing of the magnetic stirring bar. At the end point, close the burette and compute the percent water tolerance by the formula:

$$\text{Water tolerance} = \frac{B}{20 + B} \times 100$$

where B is the burette reading in milliliters

Some penetrants may be water-based and therefore do not reach an endpoint.

4.5.13 Redispersibility.

4.5.13.1 Nonaqueous developers. Prior to testing, the material shall be agitated until all solids are in suspension. For aerosol packaged products, the container shall be relieved of propellant and the entire contents be

transferred to a suitable container for agitation, in accordance with the suppliers instructions. After the solids are in suspension, the developer shall be allowed to stand for 24 hours. Then it shall be gently stirred and visually examined for conformance to 3.5.2.1.

4.5.13.2 Wet suspendable developers. The wet developer shall be mixed in accordance with the manufacturer's instructions and allowed to stand for 24 hours. Then it shall be gently stirred and visually examined for conformance to 3.5.3.1.

4.5.14 Developer fluorescence. Developers shall be exposed to black light and visually examined for any signs of fluorescence to determine conformance to 3.5.1.

4.5.15 Developer removability. The apparatus used to perform this test shall be in accordance with 4.5.16.1. Test panels shall be 1 1/2 inches X 2 inches (3.8 X 5.1 cm) in size and shall be cut from 16 gauge American Iron and Steel Institute (AISI) Type 301 or 302 stainless steel with an as-rolled surface. The panels shall be rinsed with methylene chloride and dried immediately before using.

4.5.15.1 Dry developers. Coat two panels, one panel for the candidate developer and one panel for the reference developer, by dusting and allow to stand 5 minutes. Place the panels in the wash fixture (Figure 2) and wash 1 minute in a cold tap water spray at 30 pounds per square inch (psi). Air dry the panels and examine under oblique white or natural light to determine conformance to 3.5.4.

4.5.15.2 Aqueous and non aqueous developers. The suspensions or solutions, as appropriate, mixed in accordance with the manufacturer's instructions, shall be applied to completely cover the test panel. Apply the reference developer to a second panel. The panels shall be then dried at a 45° angle in a circulating oven at 105° ± 3°C (220 ± 5°F) for 90 seconds. After drying, the panels shall be placed in the wash fixture and washed 1 minute with a cold tap water spray at 30 psi. The panels shall be air dried, and when dry, shall be examined under oblique white or natural light to determine conformance to 3.5.4.

4.5.16. Penetrant removability.

4.5.16.1 Apparatus. Test panels shall be 1 1/2 inches X 2 inches (3.8 X 5.1 cm) cut from 16 gauge annealed AISI Type 301 or 302 stainless steel sheet. The panels shall be vapor degreased and then blasted on both sides with 100 mesh Al_2O_3, using 60 pounds per square inch gauge (psig) air pressure and with the gun held normal to the surface and approximately 18 inches from the panels. After blasting, the panel surfaces must be free of scratches or other blemishes and should be handled by their edges only. Panels must be wrapped in tissue paper prior to use. After use, the panels shall be cleaned ultra-

sonically in a solvent or reprocessed as described above. The wash apparatus shall be as described in Figure 2. The spray nozzles and wash parameters shall be specified for each removal process.

4.5.16.2 Water-washable penetrant system removability. Immerse the test panel in the test penetrant and then allow to drain for 10 minutes at about a 60 degree angle. Equip the wash apparatus with two Type 1/8 GGI spray nozzles (Spraying Systems Company of Wheaton, Illinois) or equivalent. Water spray pressure shall be 30 psig and temperature shall be 21° ± 3°C (70 ± 5°F). At the end of drain period, place panel in wash apparatus and wash for 20 seconds. Dry panel in 66° ± 3°C (150 ± 5°F) oven for 90 seconds. Compare to panel processed with same sensitivity reference penetrant system and processed as specified in 4.5.16.2 or 4.5.16.5 as applicable. Examine under appropriate light for conformance to 3.7.1. Repeat test using rinse water at 38° ± 5°C (100 ± 5°F).

4.5.16.3 Solvent removable penetrant system removability. Apply penetrant to the panel and allow panel to drain for 10 minutes at about a 60 degree angle. Wipe panel with a clean, dry, lint-free cloth or towel to remove the excess penetrant. Place an absorbent paper towel on a flat horizontal surface and moisten the towel with the test remover. The towel should be moist but not saturated. Place the panel on the towel and wipe panel across towel. Remove panel. Compare to panel processed with the appropriate reference penetrant and remover for conformance to 3.7.3.

4.5.16.4 Post emulsifiable (lipophilic) penetrant system removability. Immerse panel in penetrant and then allow to drain for 10 minutes at about a 60 degree angle. Immerse panel in emulsifier and allow to drain for two minutes at about a 60 degree angle. With the wash station equipped with two Type 1/8 GGI spray nozzles (Spraying Systems Company, Wheaton, Illinois), or equivalent, water at 10 psig and 21° ± 3°C (70 ± 5°F), wash panel for 60 seconds. Dry panel in 66° ± 3°C (150 ± 5°F) oven for 90 seconds. Compare to panel processed in the same manner with the same sensitivity reference penetrant system. Examine for conformance to 3.7.2 under appropriate light. Repeat test with 38° ± 3°C (100° ± 5°F) rinse water.

4.5.16.5 Post emulsifiable (hydrophilic) penetrant system removability. Immerse panel in penetrant and then allow to drain for 10 minutes at about a 60 degree angle. With two Type 1/8 GGI spray nozzles (Spraying Systems Company, Wheaton, Illinois), or equivalent, water at 30 psig and 21° ± 3°C (70 ± 5°F) pre-rinse panel for 15 seconds. Immerse panel in the solution of hydrophilic emulsifier (at the manufacturer's recommended concentration) for 2 minutes. Wash panel, same apparatus, for 30 seconds. Dry panel in 66° ± 3°C (150° ± 5°F) oven for 90 seconds. Compare panel to panel processed in same manner with reference penetrant system of the same sensitivity. View panels under appropriate light for conformance to 3.7.4.

4.5.17 Sensitivity.

4.5.17.1 Level 1 penetrant system.

4.5.17.1.1 Preparation of test panels. Aluminum panels 3 inches X 2 inches (76 mm X 51 mm) shall be cut from 5/16 inch (8 mm) thick 2024 aluminum alloy conforming to QQ-A-250/4 in the T3 condition. The 3 inch (76 mm) dimension shall be parallel with the direction of rolling of the sheet. The panels shall be heated nonuniformly and water quenched so as to produce thermal cracks. This shall be accomplished by supporting the panel in a frame and impinging the flame of a gas burner or torch in the center on the lower side of the panel without movement in any direction. A 510 to 527°C (950 to 980°F) Tempilstik or Tempilac, or equal, shall be applied to an area the size of a penny on the top side and directly in the center of the panel. The heat of the burner shall be so adjusted that the panel is heated approximately 4 minutes before the Tempilstik or Tempilac melts after which the panel shall be immediately quenched in cold tap water. The above operation may then be repeated on the opposite side of the panel, if desired. A groove approximately 1/16 inch X 1/16 inch (2 mm X 2 mm) shall be cut in the 2 inch (51 mm) direction across the center of the heat-affected zone on both sides of the panel, to form 2 similar specimens and to eliminate cross-contamination. Before using, the panel shall be cleaned by a vigorous scrubbing with bristle brush and liquid solvent followed by a vapor degrease. These panels shall not be re-used.

4.5.17.1.2 Test procedure. The test penetrant system shall be applied to the surface bounded by the edges and the 1/16 inch (2 mm) groove. The reference penetrant system shall be applied to the remaining half of the panel's surface. Dwell times shall be as specified in Table III. When required, panel drying shall be done in an oven at 60° ± 3°C (140 ± 5°F) until panel surface is dry. Three such panels shall be processed and conformance to 3.8 shall be made by comparing indications produced by the test penetrant system to indications produced by the reference penetrant system.

Table III. Level 1 sensitivity parameters.

Method	Penetrant	Emulsifier	Developer
A	10 min	N/A	5 min
B	10 min	1/	5 min
C	10 min	N/A	5 min

1/ Type I -- 2 minutes, Type II -- 30 seconds

4.5.17.2 Levels 2, 3 and 4 penetrant systems.

4.5.17.2.1 Test panels. Test panels are 1 inch X 6 inches X 1/4 inch thick bars, some of which are Ti 6 Al-4V alloy and the remainder are IN 718 alloy. All bars contain laboratory generated low cycle fatigue cracks and have been processed to produce a range of lengths and surface openings. These test panels are available only at the qualifying agency.

4.5.17.2.2 Test procedure. Panels are first processed twice with the appropriate reference penetrant system and developer to the following reference process parameters:

Penetrant Dwell/Mode:	5 minutes/dip and drain
Prewash:	1 minute, 30 psig water at 21° ± 3°C (70 ± 5°F)
Emulsification:	5 minute dip/20 percent solution (with no agitation)
Wash:	2 minutes, 30 psig water at 21° ± 3°C (70 ± 5°F)
Dry:	Wipe, then air dry
Developer:	Dust, 1 to 2 minutes. Dwell for 30 minutes maximum.

Indication presence and qualitative brightness are then recorded. The panels are then cleaned by detergent rinse, dried, ultrasonically cleaned for 10 minutes minimum in 1,1,1, trichloroethane, rinsed in methanol or acetone, and then dried for 10 minutes in 67° ± 3°C (150° ± 5°F) oven. After cooling the panels to room temperature, the test penetrant system (with the reference developer) is then applied and processed with Table IV changes to the above noted parameters as required.

TABLE IV. Levels 2, 3 and 4 test parameters.

Method	A	B	C	D
Prewash	N/A 2/	N/A 2/	N/A 2/	1/
Emulsification	N/A 2/	2 min	N/A 2/	1/, 3/
Wash	5 min 30 psig/70°F	A/R 4/	N/A 2/	1/
Solvent wipe	N/A 2/	N/A 2/	A/R 4/	N/A 2/
Dry	(all methods) light air brush, 30 minutes at 21° ± 3°C (70 ± 5°F) (Run 1) 66° ± 3°C (150 ± 5°F) (Run 2)			
Developer dwell	(all methods) 15 minutes.			

1/ Same as reference process
2/ N/A - Not applicable
3/ Concentration recommended by manufacturer
4/ A/R - As required

The results obtained with the test penetrant system are then compared to the appropriate reference penetrant system for conformance to 3.8.

4.5.17.3 Developer sensitivity. Developers shall be tested for sensitivity in accordance with the following:

4.5.17.3.1 Developers intended for use with Type I penetrant materials shall be tested for sensitivity by processing the test panels of 4.5.17.2 with the FP-3/FE-2 reference materials using the process parameters in 4.5.17.2 for Method D. Form a developers are applied as indicated in 4.5.17.2. Forms b and c developers are mixed in accordance with the manufacturer's instructions to the maximum concentration recommended for use and are applied by immersing the panels of 4.5.17.2.1. These panels are then air dried at 21 ± 3°C (70 ± 5°F) for 30 minutes. Form d developers are applied in accordance with manufacturer's instructions. The developers are then compared to the appropriate reference developer for conformance to 3.8. The developers are also evaluated for conformance to 3.5.2.2 or 3.5.3.2 as appropriate.

4.5.17.3.2 Developers intended for use with Type II penetrant materials shall be tested for sensitivity by processing the test panels of 4.5.17.1.1 with the VP-1/VE-1 reference materials using the process parameters in 4.5.17.1.2 for Method B. The application and evaluation of the developers is as specified in 4.5.17.3.1.

4.5.17.4 Solvent remover sensitivity. Solvent removers shall be tested for sensitivity by processing the test panels of 4.5.17.2.1 with the FP-3/D-4 reference materials using the process parameters in 4.5.17.2.2 for Method C.

4.5.17.5 Special application developers and solvents. These materials are tested with the material specified by the manufacturer in accordance with the appropriate process in 4.5.17.1 or 4.5.17.2. The results are compared to the appropriate reference materials for conformance to 3.8.

4.5.18 Net content of aerosol containers. Net contents of the aerosol containers shall be determined as follows:

4.5.18.1 Remove valve protective caps and check the gross weight to the nearest 0.1 ounce (2.8 gm) of each of the 10 containers selected at random from each product in the family to determine the lightest and heaviest package in the sample lot. Record the gross weight of the lightest and heaviest container.

4.5.18.2 Choose the lightest container and shake (the container) in a wrist twisting motion for 15 seconds at the approximate rate of one complete cycle per second.

4.5.18.3 Empty the lightest container in an upright position by holding the valve actuator depressed until no additional product or gas is expelled. If any product remains, it should be expelled as completely as possible by holding the container in the hand with the valve actuator depressed and alternately inverting the container, restoring it to an upright position at approximately two second intervals until no additional product is delivered.

Prior to the final exhausting period, the container should be permitted to warm up to between 21-27°C (70-80°F).

4.5.18.4 *Rinse with tap water and dry the exterior of the container.* If valve actuator is removable, remove, clean and dry. Then replace the actuator.

4.5.18.5 Weigh the empty container to determine the wet tare (weight of container plus any product not expelled).

4.5.18.6 Subtract a test allowance of 1/8 ounce (3.5 gm) from the wet tare to obtain the corrected wet tare weight. (The test allowance is provided to represent the difference between the amount delivered in normal usage and the amount delivered under the expelling procedure specified above.)

4.5.18.7 Subtract the corrected wet tare weight from the gross weight to obtain the adjusted net weight of the lightest package.

4.5.18.8 If the adjusted net weight of the lightest package equals or exceeds the declared net weight, the lot shall be considered satisfactory for net weight content. If the adjusted net weight of the lightest package is less than the declared net weight, the foregoing procedures (4.5.18.2 through 4.5.18.7) will be repeated with the heaviest container. If the adjusted net weight of the heaviest package is not equal to the declared net weight plus two percent, the entire lot shall be rejected. If the adjusted net weight is more than two percent greater than the declared net weight, the following additional steps shall be taken:

4.5.18.9 The average of the two corrected wet tare weights shall be the standard tare weight for each of the remaining eight samples. Add the standard tare weight to the required net weight and compare the total with the gross weights recorded for each of the remaining eight samples. If the gross weights of all of the eight remaining samples exceeds the standard gross weight, the lot shall be considered satisfactory for net weight content. If one or more of the samples is less than standard gross weight, the lot shall be rejected for underfill. (The inspector is cautioned not to accept the tare weight of a single container as an average corrected wet tare, nor to accept permanent or reference record of tares as reliable.)

4.5.19 Valve leakage. A filled aerosol container for each product shall be tested for valve leakage in accordance with the procedure described in the Chemical Specialties Manufacturers Association Aerosol Guide and 4.5.19.1 through 4.5.19.3.

4.5.19.1 The valve shall be operated in several short bursts, wiped dry and the container inverted and valve immersed in one inch of water at 21 ± 3°C (70 ± 5°F) and held in this position by a clamping device for a period of one hour. The container shall be rejected if a gas bubble appears after the first

five minutes (1 gas bubble during the first 5 minutes is acceptable) and five more containers of the same family randomly selected from the lot shall be tested in a similar manner. If anyone of the group of five shows evidence of leakage the lot shall be rejected.

4.5.19.2 If the six containers show no leakage from the test of 4.5.19.1, one container shall be further tested for a volumetric measurement of gas leakage.

4.5.19.3 Remove the actuator from one container and submerge the container, in the upright position, in water. The top of the container shall be at least 4 inches below the water surface. An inverted funnel above the container will be used to direct any leaking gas into an inverted and water filled 10 ml centrifuge tube as shown in Figure 3. Any gas leaking from the valve will enter and rise into the tube. At the end of 48 hours the volume of gas is read and compared to the requirements of 3.9.2. The effects of height of water column, solubility of gas in water, ambient temperature change and water vapor pressure may be ignored as the combined effects are slight. However, if the propellant is known to be water soluble (CO_2 or N_2O) the water in the burette must be saturated initially with the propellant gas.

4.5.20 Water content. Water content of the hydrophilic emulsifier concentrate shall be measured in accordance with ASTM D 95 for conformance to requirements of 3.4.4.2.

4.5.21 Inspection of packaging. An inspection of packaging to determine conformance with specified requirements shall be performed. The lot shall consist of items, packages, or shipping containers as applicable. The unit of product shall be one item, one package, or one shipping container, as applicable. Sampling shall be performed in accordance with MIL-STD-105. The inspection level shall be S-2 and the acceptable quality level (AQL) shall be 4.0, as expressed in defects per hundred units.

5. PACKAGING

5.1 Packaging. Packaging shall be Level A or industrial practice as specified (see 6.2)

5.1.1 Packaging Level A.

5.1.1.1 Aerosol-type pressurized cans. Aerosol-type pressurized cans in the size specified shall conform to Type IX, Class 2 or 3 of PPP-C-96. The net contents of the can shall be indicated in ounces (avoirdupois). The valve and activator shall be designed for dispensing a fine uniform spray. Cans containing suspended solids which may settle out shall contain a ball which will facilitate agitating the solids into suspension. Twelve cans shall be packaged one layer in a fiberboard container conforming to PPP-B-636, Type CF, class weather resistant. Cartons shall be furnished with half-slotted, full height partitions and with top and bottom pads. Partitions and pads shall be

fabricated of the same material as the carton. Closure shall conform to the requirements specified in PPP-B-636.

5.1.1.2 1-pint (470 cc) and 1-gallon (3.8 l) size. One-pint (470 cc) or 1-gallon (3.8 l) cans shall conform to Type V, Class 4 of PPP-C-96. Inner seals shall be furnished with all screw cap closures. Exterior protective coating of cans shall be in accordance with Plan A para 3.2.2.1 of PPP-C-96. Filled cans shall be packaged as specified in PPP-C-96.

5.1.1.3 5-gallon (19 l) size. Five gallons (19 l) of material shall be packaged in a Type I, Class 4 pail in accordance with PPP-P-704. Exterior color of the pail may be olive drab or black at the option of the contractor.

5.1.1.4 55-gallon (209 l) size. Fifty-five gallons (209 l) of material shall be packaged in a Type I, Class A, DOT 5B, 18 gauge metal drum in accordance with PPP-D-729. Exterior color of the drum may be olive drab or black at the option of the contractor.

5.1.1.5 Developers, wet and dry. Wet or dry developers shall be packaged in a fiber drum in accordance with PPP-D-723. For wet developers, material shall be packaged in a Type II, Grade E, Class 3 drum. For dry developers, material shall be packaged in a Type II, Grade A drum. The fiber drum shall be the telescope type and drum closure shall be made by applying 2 inch (50 mm) wide tape around the diameter of the drum to seal all mating surfaces. Inner plastic bags shall be used for all dry developers. Closure shall be by heat sealing or wire tie.

5.1.1.6 Kits. Materials in aerosol-type pressurized cans, consisting of the size, type and quantity as specified for each kit, shall be packaged in one layer in a class weather resistant fiberboard carton conforming to PPP-B-636. Cartons shall be furnished with half-slotted, full height partitions and with a top and bottom pad. Partition and pads shall be of the same grade and class as the carton. Closure shall be as specified for weather resistant boxes in accordance with the requirements of PPP-B-636.

5.1.1.7 Manufacturers industrial practice. Material shall be packaged in accordance with ASTM D 3951.

5.2 Packing. Packing shall be Level A or commercial as specified (see 6.2).

5.2.1 Packing Level A. Filled aerosol cans, (except kits), packaged as specified in para. 5.1.1.1 shall require no additional packing. One pint (470 cc) and 1 gallon (3.8 l) size container shall be packed in accordance with PPP-C-96.

5.2.2 Five gallon (19 l) pails, 55 gallon (209 l) metal drums, and fiber drums shall require no additional packing.

5.2.3 Kits. Kits packaged as specified in 5.1.1.6 shall be packed in an exterior container conforming to PPP-B-640. Gross weight of the exterior shipping container shall not exceed 70 pounds (31.5 kg).

5.2.4 Manufacturers industrial practice. Material shall be packaged in accordance with ASTM D 3951.

5.3 Marking. Marking shall be in accordance with MIL-STD-290 for Level B requirements and in accordance with ASTM D 3951 for industrial practice.

5.4 Palletization. When specified (see 6.2) container shall be palletized in accordance with MIL-STD-147.

6. NOTES

6.1 Intended use. Penetrant inspection materials covered by this specification are intended for use in penetrant inspection of parts and assemblies when the material defects or discontinuities are open to the surface. Penetrant inspection is particularly suited to materials which are not ferromagnetic and for spot inspection in areas where the use of bulky equipment requiring electricity for operation would be impractical.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification.

b. Classification and name of item or items desired.

c. Unit quantity of each item.

d. Whether wet developers are to be furnished in the wet or dry conditions (see 3.5.3).

e. How mixing instructions for wet developers in the dry condition are to be placed on the container (see 3.5.3).

f. Whether penetrants, emulsifiers, dye removers, and developers in liquid form are to be furnished in bulk or in pressurized cans.

g. Size and type of container desired.

h. Selection of applicable levels of packaging and packing desired (See Section 5).

i. Whether or not all items should be purchased from the same supplier.

6.3 Reference materials. Reference materials may be obtained by contacting AFWAL/MLSA, WPAFB, OH 45433.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government, tested for qualification, in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is AFWAL/MLSA, WPAFB, OH 45433, and information pertaining to qualification of products may be obtained from that activity.

6.4.1 Sample identification. Each item submitted for qualification should be identified by name and by the manufacturers part or designation. When an item in one system is identical to an item in one or more other systems, the identification should also be identical.

6.5 Definitions.

6.5.1 Emulsifier, hydrophilic. A water soluble liquid that when added or applied to an oil-like penetrant material makes the penetrant removable from surfaces with rinsing.

6.5.2 Emulsifier, lipophilic. An oil-soluble emulsifier.

6.5.3 Near ultraviolet light. Ultraviolet light in the energy range of 3300 to 3900 Angstrom units.

6.5.4 System. A penetrant-emulsifier combination, furnished by the same manufacturer and qualified together. For Method A (water-washable), the system consists of the penetrant only.

6.5.5 Specific application. Denotes Method C removers and developers that are qualified only for use with a specific penetrant.

6.5.6 Supplier. The organization that furnishes penetrant inspection materials under contract to the Government or other using organization.

6.6 Supersedure information. A comparison of the penetrant material classification of this specification with the classification contained in the superseded MIL-I-25135C is as follows:

Designation in MIL-I-25135C	Designation in this specification
Group I	Type II, Level 1, Method C
Group II	Type II, Level 1, Method B
Group III	Type II, Level 1, Method A
Group IV	Type I, Level 1, Method A
Group V	Type I, Level 2, Method B
Group VI	Type I, Level 3, Method B
Group VI A	Type I, Level 3, Method D
Group VI B	Type I, Level 4, Method D
Group VII	Type I, Level 3, Method C

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

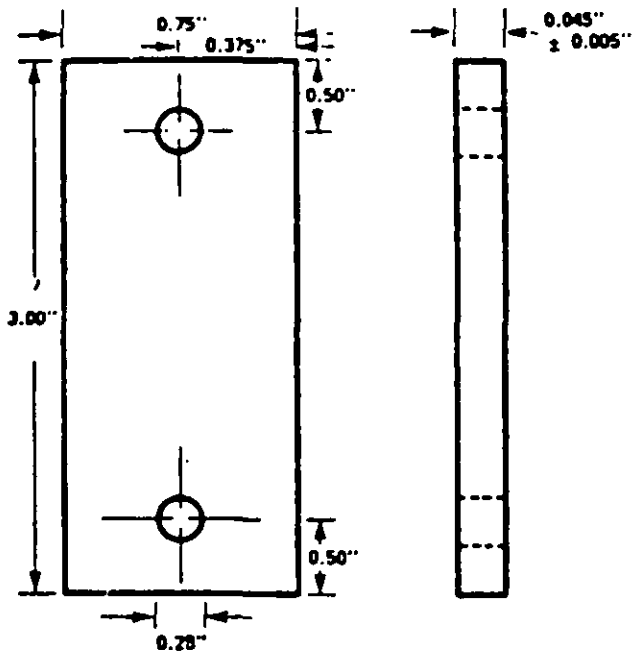
Custodians:
Air Force - 20
Navy - AS

Reviewers:
Air Force - 68, 99
Navy - SH
DLA - GS, DS

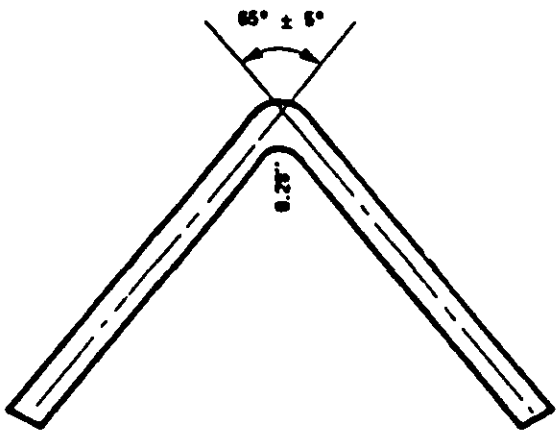
Users:
Navy - OS
Army - ME

Preparing activity:
Air Force - 20

(Project 6850-0688)

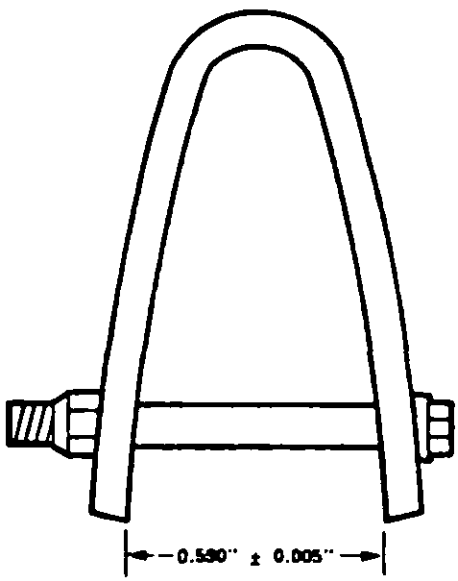


A. DIMENSION DETAILS
(± 0.01" TOLERANCE EXCEPT THICKNESS)



B. BEND DETAILS

Not to Scale



C. STRESSING DETAILS

FIGURE 1. Titanium hot salt stress corrosion panel.

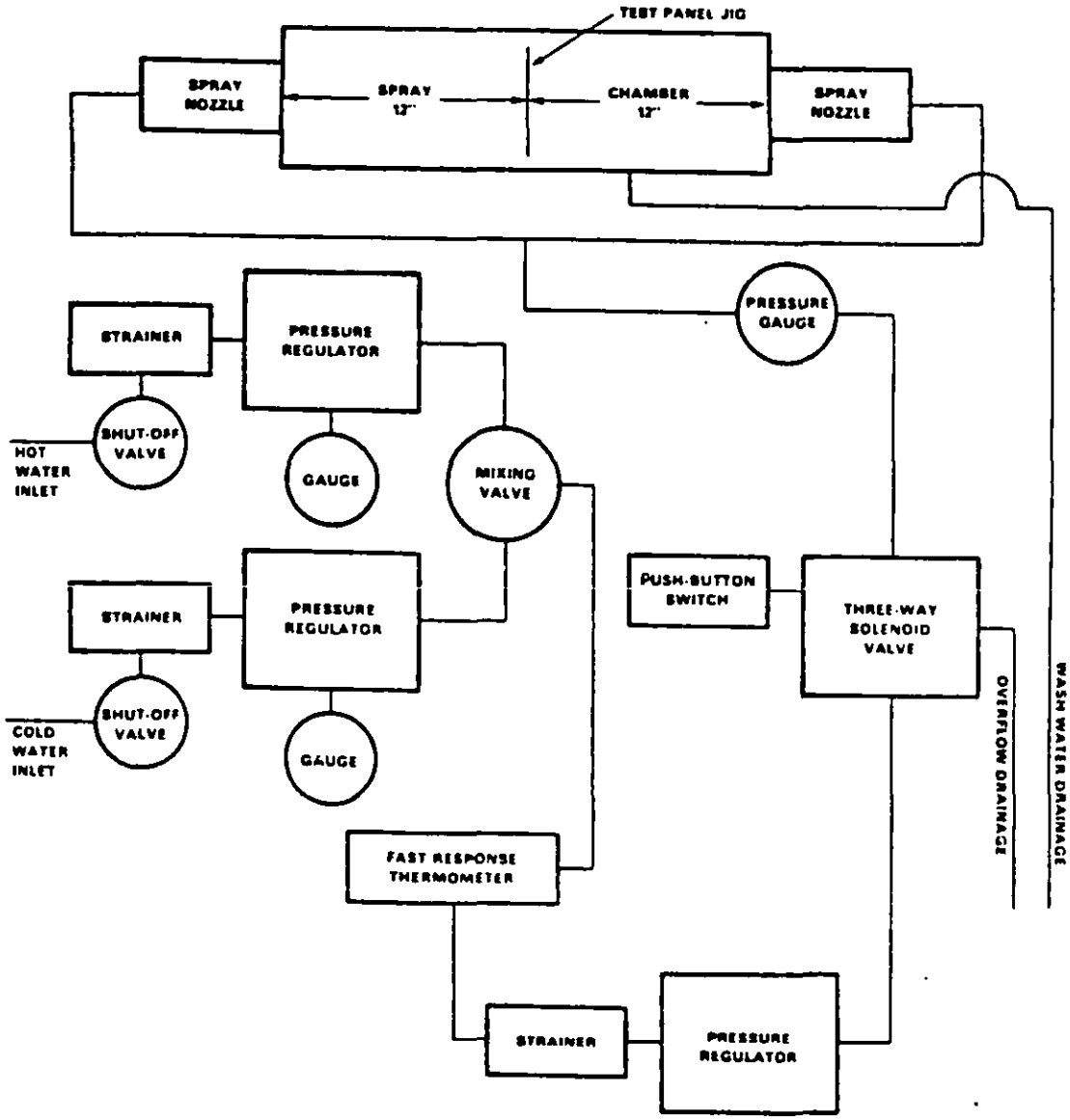


FIGURE 2. Penetrant removability test apparatus.

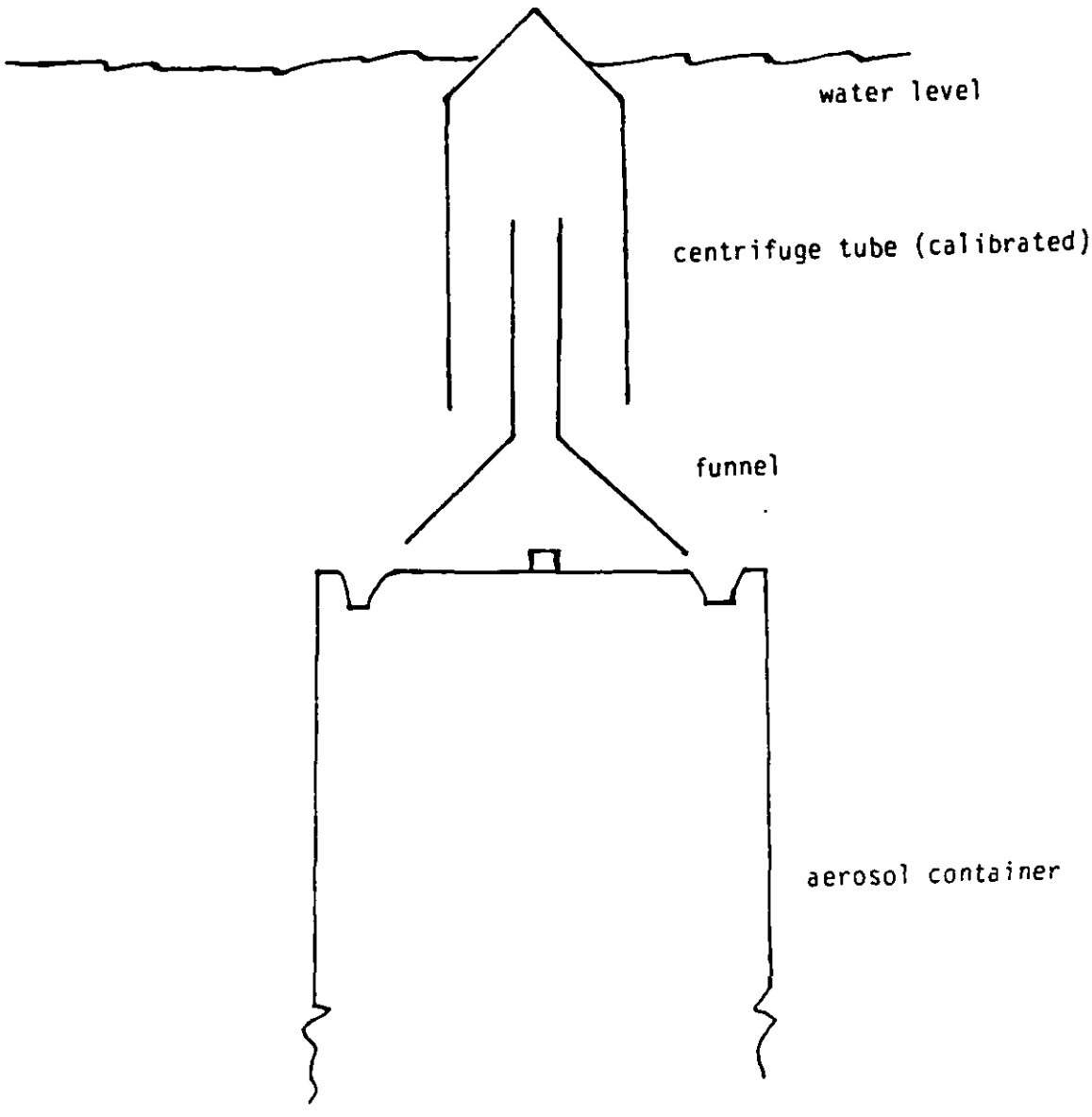


FIGURE 3. Apparatus for aerosol container volumetric leakage.

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