METHOD 504.3

CONTAMINATION BY FLUIDS

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METHOD 504.3

CONTAMINATION BY FLUIDS

NOTE: Tailoring is essential. Select methods, procedures, and parameter levels based on the tailoring process described in Part One, Paragraph 4.2.2, and Annex C. Apply the general guidelines for laboratory test methods described in Part One, paragraph 5 of this standard.

1. SCOPE.

1.1 Purpose.

Use contamination by fluids tests to determine if materiel (or material samples) is affected by temporary exposure to contaminating fluids (liquids) such as may be encountered and applied during its life cycle, either occasionally[1/], intermittently[2/], or over extended periods[3/].

1.2 Application.

The procedure described in this Method is used when there is a high probability of fluid contamination during the life cycle of the materiel. Contamination may arise from exposure to, but not limited to, fuels, hydraulic fluids, lubricating oils, solvents and cleaning fluids, de-icing and anti-freeze fluids, runway deicers, insecticides, disinfectants, coolant dielectric fluid, and fire extinguishants.

WARNING: THIS METHOD REQUIRES THE USE OF SUBSTANCES AND/OR TEST PROCEDURES THAT MAY HAVE AN ENVIRONMENTAL IMPACT OR BE INJURIOUS TO HEALTH, IF ADEQUATE PRECAUTIONS ARE NOT TAKEN. ADDITIONAL INFORMATION IS PROVIDED IN ANNEX A. REFER TO THE SUPPLIER'S SAFETY DATA SHEET (SDS) OR EQUIVALENT FOR CHEMICAL COMPATABILITY AND HEALTH HAZARD DATA ON THE VARIOUS CHEMICALS USED, AND COORDINATE WITH LOCAL ENVIRONMENTAL AUTHORITIES. ENSURE ALL POST-TEST MATERIALS ARE DISPOSED OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

1.3 Limitations.

This test is not intended to demonstrate the suitability of materiel to perform during continuous contact with a fluid; e.g., an immersed fuel pump, nor should it be used to demonstrate resistance to electrolytic corrosion or corrosion due to human perspiration.

2. TAILORING GUIDANCE.

2.1 Selecting the Contamination by Fluids Method.

After examining requirements documents and applying the tailoring process in Part One of this Standard to determine where exposure to contaminating fluids is foreseen in the life cycle of the test item, use the following to confirm the need for this Method and to place it in sequence with other methods.

2.1.1 Effects of the Contaminating Fluids Environment.

During its life cycle, materiel may be accidentally or intentionally exposed to one or more fluids that could have an adverse effect on the materiel. As a result, exposure of materiel to contaminating fluids may either temporarily or permanently impair the operation of the materiel by changing the physical properties of the material(s) composing it. Consider the following typical examples of problems to help determine if this Method is appropriate for the materiel being tested. The list is not intended to be all-inclusive and some of the examples may overlap.

a. Physical.
   (1) Shattering of glass vials and optical materiel.
   (2) Binding or slackening of moving parts.
   (3) Cracking of solid pellets or grains in explosives.
   (4) Differential contraction or expansion rates or induced strain rates of dissimilar materials.

[1/] Extraordinary/unusual circumstances occurring once or twice a year.
[2/] Regular basis under normal operation; possibly seasonally over the life of the materiel.
[3/] Long periods such that materiel is thoroughly exposed.

   - (5) Deformation or fracture of components. (Solder reflow is the worst case.)
   - (6) Cracking of surface coatings.
   - (7) Seal or gasket failures (leaking of sealed compartments).
   - (8) Failure of insulation protection.
   - (9) Condensation of water onto cold surfaces suddenly exposed to higher ambient temperatures at "high relative humidity" - can cause frosting on optical surfaces - can cause corrosion on vulnerable surfaces.
   - (10) Differential contraction or expansion rates or induced strain rates between surface and interior portions of thermally massive constructs.
   - (11) Packaging failure.
   - (12) Crazing or swelling of plastics and rubbers.
   - (13) Adhesion failures (delamination).
   - (14) Paint/legend removal.

b. Chemical.
   - (1) Separation of constituents.
   - (2) Failure of chemical agent protection.
   - (3) Leeching of antioxidants and other soluble materials.
   - (4) Corrosion.
   - (5) Melting or decomposition.

c. Electrical.
   - (1) Changes in electrical and electronic components.
   - (2) Electronic or mechanical failures due to rapid water or frost formation.
   - (3) Excessive static electricity.
   - (4) Interruption of electrical continuity (such as "grounding" fingers on EMI strips).
   - (5) Increase in electrical resistance due to thermo-mechanical "fretting corrosion."

2.1.2 Sequence Among Other Methods.

a. General. Use the anticipated life cycle sequence of events as a general sequence guide (see Part One, paragraph 5.5).

b. Unique to this Method. Do not perform these tests prior to other climatic environmental tests because of potential effect of the contaminants or their removal by decontaminants.

2.2 Difference Between Exposures.

This Method has one procedure, three exposures.

a. Occasional Contamination
b. Intermittent Contamination
c. Extended Contamination

2.2.1 Duration of Exposure.

There are three options provided in Procedure I; occasional, intermittent, and extended contamination (paragraph 1.1). From the requirements document, determine the option to be used based on the anticipated life cycle scenario, along with the order of application of the test fluids if more than one is required.

2.2.2 Contaminant Fluid Groups.

The groups of fluids are listed in Table 504.3-I (see paragraph 6.1, reference s), (see paragraph 6.1, reference t) and described in Annex B. These lists are not all inclusive and allow the addition of other fluids as called out in the test requirements.

Table 504.3-I. General test fluids.

CHEMICAL[1]	SOURCE DOCUMENT	POSSIBLE USES
1. Cleaning compound, solvent (Rifle bore cleaner)	MIL-PRF-372	Small arms, textiles, general
2. Degreasing Solvent Naphtha or Stoddard, dry cleaning, or D-Limonene solvent	MIL-PRF-680 (NATO #S-752, S-753, S-760)	Small arms, textiles, general, helicopters (parts)
3. Engine oil	MIL-PRF-2104, (NATO #O-1236/15W40), 40, 30 (NATO O-238), 10W, 10W (NATO O-237, SCPL (equipment specific)	Small arms, textiles, general
4. Lubricant, semi-fluid, automatic weapons	MIL-L-46000 (NATO #O-158)	Small arms, textiles, general
5. Lubricating oil, general purpose, preservative (water displacing, low temperature)	MIL-PRF-32033 (NATO #O-190)	Small arms, textiles, general
6. Lubricant, cleaner, and preservative	MIL-L-63460 (CLP), (NATO #S-758)	Small arms, textiles, general
7. Gasoline, commercial, or combat	ASTM D910, Aviation Gasoline; ASTM D4814, Automotive spark ignition engine (Commercial and MOGAS) and others as indicated by test requirements.	Small arms, textiles, general
8. Aviation Turbine fuels, kerosene types	Aviation turbine fuel JP-8 (NATO F-34); NATO Grade F-24, ASTM D1655; Commercial fuel, Jet A, Jet A-1 and others as indicated by test requirements.	Small arms, textiles, general, helicopters (parts)
9. Diesel Fuel, (DL-1, DL-2, other Grades)	A-A-52557, /ASTM D975, (NATO #F-54)	Small arms, textiles, general
10. Insect repellent, personal application	NSN 6840-01-284-3982, Crème, approx 32% Deet	Small arms, textiles, general
11. Dexron III ®	NSN 9150-00-698-2382, Automatic Transmission Fluid, Commercial	Small arms, textiles, general
12. Antifreeze, Multi Engine Type, ethylene (I) or propylene glycol (II)	A-A-52624, /ASTM D6210 Type I, ASTM D6211 Type II) (NATO #S-750)	Small arms, textiles, general
13. Water	Water (distilled). Used as baseline where applicable.	Small arms, textiles, general
14. Simulated sea water or 5% NaCl	ASTM D1141 or ASTM B117	Small arms, textiles, general
15. Decontaminating agent STB	MIL-DTL-12468	Small arms, textiles, general
16. Lubricating oil, weapons, low temperature	MIL-PRF-14107 (LAW), (NATO #O-157)	Small arms, textiles, general
17. Hydraulic fluid, synthetic hydrocarbon base, aircraft, missile, & ordnance (OHA), others as indicated by test requirements.	MIL-PRF-87257 (NATO #H-538) or MIL-PRF-83282 (NATO #H-537)	Small arms, textiles, general, helicopters (parts)
18. Hydraulic fluid, rust inhibited, phosphate based synthetic hydrocarbon, fire-resistant	MIL-PRF-46170 (FRH, (NATO #H-544)	Small arms, textiles, general
19. Hydraulic fluid, petroleum based for preservation and operation (OHT)	MIL-PRF-6083, (NATO # C635)	Small arms, textiles, general
20. DS-200 Decontaminating Agent	NSN 6850-01-501-1044, Peroxide based	Small arms, textiles, general
21. Lubricating Oils Synthetic, Aircraft turbine engines, transmissions	MIL-PRF-23699, NATO # O-156; MIL-PRF-7808 (NATO O-152, O-154, O-156, O-167)	Aircraft (parts)
22. De-icers, Anti-Icing	Deicers-Aircraft: Ethylene or propylene glycol mixtures; US antifreeze: AA-52624A (NATO S-750), and others as indicated by test requirements.	Aircraft
23. Silicone based damping fluid (various viscosities, cSts)	Dimethyl silicone (NATO S-1714)	

Table 504.3-I. General test fluids.

CHEMICAL[1]	SOURCE DOCUMENT	POSSIBLE USES
24. Aircraft Cleaners, Aerospace, Ground Equipment/Aircraft Interior/Exterior	MIL-PRF 87937, /MIL-PRF-85570, MIL-C-87936, MIL-PRF-85704 or others as indicated	Aircraft (parts)
25. Other Solvents	Denatured or Isopropyl alcohol (2-propanol), acetone, etc.	Small arms, textiles, general, Aircraft (parts)
26. Deicing & antifreeze fluids	Deicers-Aircraft: Ethylene or propylene glycol mixtures; US antifreeze: AA-52624 (NATO S-750), and others as indicated by test requirements.	Aircraft (parts)
27. Runway deicers	Potassium-acetate based solution (i.e., Cryotech E-36 or other as indicated by test requirements).	Aircraft (parts)
28. Insecticides	Insecticides (i.e., Malathion or pyrethrin) as indicated by test requirements).	Aircraft (parts)
29. Disinfectant (Heavy duty phenolics)	Clear, soluble phenolics, e.g., phenol or its derivatives dissolved in a surfactant and diluted with water to give a clear solution; Parachlorometaxylenol (i.e., EcoTru-1453, Aircraft Disinfectant or others as indicated by test requirements.	Aircraft (parts)
30. Coolant dielectric fluid	Polyalphaolefin (PAO) dielectric	Aircraft (parts)

[1] NOTE: The chemical list shows the more common chemicals used in Military applications and is not all inclusive. Some chemicals may not be readily available and therefore, substitutions may be made through agreement of Test Proponent and the laboratory performing the test. Also, new chemicals may be introduced after publication of this document or are specific to the test item. In this case, these can be added by the Test Proponent

2.2.3 Test Fluid(s).

Select the test fluid(s) from those listed in Tables 504.3-I, (as determined by tailoring procedures), that are representative of those commonly encountered during the life cycle. In the requirements document, list all other fluids identified during the tailoring process as possible contaminants (see 504.3-I, Note 1). Service grades of fluids may be changed or modified with development formulations and materiel demands. Some may subsequently be found undesirable because of environmental or health and safety problems.

2.2.4 Combination of Test Fluids[4/].

When more than one test fluid is to be applied, consider the following:

a. the need to assess the effect of the fluids individually, combined, or in succession.
b. the potential problem of identifying which fluid or combination of fluids affected the test item.
c. if the order of exposure to fluids in service is known, or if the order of exposure to fluids recognized as having synergistic effects is known and is realistic in service, specify this order.
d. if there is a requirement to clean the test item between or after tests, or if a new test item is to be used for each test fluid. Do not use a cleaning fluid that results in further contamination. Some of the specified test fluids may be used as cleaning fluids (e.g., aviation fuel, solvents, etc...), otherwise use a fluid known to be used in normal cleaning procedures.

2.2.5 Test Temperature.

Unless otherwise required by the customer, this test is performed with both the fluids and the test item at standard ambient conditions. Where appropriate, use temperatures representative of the actual conditions under which fluid contamination can occur, either intentionally or accidentally (see paragraphs 2.2.5.1 – 2.2.5.3). The application of

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[4/] When mixing two or more fluids, ensure they are compatible and will not produce hazardous reactions.

contaminating fluids could result in thermal shock as well as contamination effects. Ensure the temperatures used do not exceed the operation/storage temperatures of the test item, therefore incurring possible damage from over temperatures.

2.2.5.1 Test Item Temperature.

Unless otherwise required by the customer, the test fluids are stabilized at standard ambient conditions. Where appropriate, use a test item temperature representative of the materiel temperature when exposed to the contaminating fluid. For example, materiel to be de-iced will most likely be at or below freezing; materiel exposed to hydraulic leaks while on the tarmac may have surface temperatures higher than 50 °C (122 °F).

2.2.5.2 Test Fluid Temperature.

Unless otherwise required by the customer, the test items are stabilized at standard ambient conditions. Where appropriate, use the temperature of the test fluid equal to its temperature during its most extreme operating condition. Design assessment may prove that other temperatures provide a more severe environment, e.g., longer exposure at lower temperatures because of slower evaporation.

2.2.5.3 Soak Temperature.

If testing at other than standard ambient conditions and in order for contamination effects to mature, a temperature soak of the test item following contamination may be necessary. The temperature of both the contaminating fluid and the materiel will, most likely, change during actual contamination situations. The post-contamination temperature soak will not necessarily reflect the exposure scenario, but rather the worst-case effect(s) on the materiel. Accordingly, for the soak temperature, use the materiel's maximum life cycle temperature for the anticipated exposure situation.

2.2.6 Fluid Exposure Duration.

a. Occasional Exposure. Item is exposed to chemical for 5 to 10 minutes. If other than standard ambient temperature is used for the item temperature, maintain this temperature for 8 hours and then bring the item to standard ambient temperature.

b. Intermittent Exposure. Item is exposed to chemical for 8 hours continuous contact and then left to air dry for 16 +1 hr at standard ambient conditions.

c. Extended Contamination. Item is exposed to chemical for at least 24 hours (unless otherwise specified in test document) continuous contact. If other than standard ambient temperature is used for the item temperature, maintain this temperature for 8 hours and then bring the item to standard ambient temperature.

2.2.7 Methods of Application.

The solutions/chemicals can be applied by immersing, spraying, brushing, or as stated in the test requirements.

3. INFORMATION REQUIRED.

3.1 Pretest.

The following information is required to conduct contamination by fluid tests adequately.

a. General. Information listed in Part One, paragraphs 5.7 and 5.9, and Annex A, Task 405 of this Standard.

b. Specific to this Method.

   (1) List of the test fluid(s) to be used
   (2) The method of test fluid application. (See paragraph 4.1.)
   (3) The soak (post-wetting) temperature and duration.
   (4) The cleaning/decontaminating fluids.
   (5) The sequence of test fluid applications and post-test cleaning instructions.
   (6) The type of exposure, i.e., occasional, intermittent, or extended.
   (7) Any requirement for long term surveillance and inspections.
   (8) Material properties, e.g., tensile strength, hardness, weight, dimensions, protective finish, etc., of the material likely to be affected by the contaminating fluids.
   (9) Record of initial baseline information with digital photography.
   (10) Record of test item and test fluid temperature.

c. Tailoring. Necessary variations in the basic test procedures to accommodate environments identified in the LCEP.

3.2 During Test.

Collect the following information as appropriate during conduct of the test:

a. General. Information listed in Part One, paragraph 5.10, and in Annex A, Tasks 405 and 406 of this Standard.

b. Specific to this Method.
   (1) Record of chamber and test item temperature versus time conditions.
   (2) Test fluid(s) and the corresponding temperature.
   (3) Any deterioration noted during visual checks.

3.3 Post Test.

The following post test data shall be included in the test report.

a. General. Information listed in Part One, paragraph 5.13, and in Annex A, Task 406 of this Standard.

b. Specific to this Method.
   (1) Results of each functional check after each exposure to each of the specified fluids.
   (2) Any degradation of materials, protective finishes, etc. (see paragraph 3.1b(8)).
   (3) Exposure durations and types.
   (4) Any deviation from the original test plan.
   (5) Record degradation with digital photography.

4. TEST PROCESS.

4.1 Test Facility.

Use a test facility that includes an enclosure and a temperature control mechanism designed to maintain the test item at a specified temperature, as well as a means of monitoring the prescribed conditions (see Part One, paragraph 5.18). The contamination facility is a tank or other container within the test enclosure (non-reactive with the contaminant) in which the test item is exposed to the selected contaminant by immersion, spraying, or brushing. When the flash point of the test fluid is lower than the test temperature, design the test facility in accordance with fire and explosion standards.

4.2 Controls.

Record chamber and, if required, test item and test fluid temperatures in accordance with Part One, paragraphs 5.2 and 5.18, at a sufficient rate to satisfy the post-test analysis (see Part One, paragraph 5.18).

Ensure the test and cleaning (decontaminating) fluids are handled and disposed of as required by local environmental and safety requirements. Some test fluid specifications are referenced in Table 504.3-I.

4.3 Test Interruption.

Test interruptions can result from two or more situations, one being from malfunction of test chambers or associated test laboratory equipment. The second type of test interruption results from failure or malfunction of the test item itself during performance checks (required or optional).

4.3.1 Interruption Due to Chamber Malfunction.

a. General. See Part One, paragraph 5.11 of this Standard.

b. Specific to this Method.
   (1) Undertest interruption. If an unscheduled test interruption occurs that causes the test conditions to exceed allowable tolerances toward standard ambient conditions, give the test item a complete visual examination and develop a technical evaluation of the impact of the interruption on the test results. Restart the test at the point of interruption and re-stabilize the test item at the test conditions.
   (2) Overtest interruption. If an unscheduled test interruption occurs that causes the test conditions to exceed allowable tolerances away from standard ambient conditions, stabilize the test conditions to within tolerances and hold them at that level until a complete visual examination and technical evaluation can be made to determine the impact of the interruption on test results. If the visual examination or technical evaluation results in a conclusion that the test interruption did not adversely affect the final test results, or if the effects of the interruption can be nullified with confidence, re-

stabilize the pre-interruption conditions and continue the test from the point where the test tolerances were exceeded. Otherwise, see paragraph 4.3.2 for test item operational failure guidance.

4.3.2 Interruption Due to Test Item Operation Failure.

Failure of the test item(s) to function as required during required or optional performance checks during testing presents a situation with several possible options. See Part One, paragraph 5.11 of this Standard.

a. The preferable option is to replace the test item with a "new" one and restart from Step 1.

b. A second option is to replace / repair the failed or non-functioning component or assembly with one that functions as intended, and restart the entire test from Step 1.

> **NOTE**: When evaluating failure interruptions, consider prior testing on the same test item and consequences of such.

4.4 Test Setup.

a. General. See Part One, paragraph 5.8.

b. Unique to this Method. Ensure collection containers are available for each test fluid and waste fluids.

4.5 Test Execution.

The following test procedure may be used to determine the resistance or compatibility of the materiel to contaminating fluids. Conduct the functional checks after each exposure to each of the specified fluids.

4.5.1 Preliminary Steps.

Before starting any of the test procedures, determine the test details (e.g., procedure variations, test item configuration, contaminating fluids, durations, parameter levels, etc.) from the test plan. (See paragraph 3.1 above.)

4.5.2 Pretest Standard Ambient Checkout.

All test items require a pretest standard ambient checkout to provide baseline data. Examine munitions and other appropriate materiel by nondestructive examination methods. Conduct the checkout as follows:

Step 1. Stabilize the test item at standard ambient conditions (Part One, paragraph 5.1).

Step 2. Conduct a complete visual examination of the test item (evaluate against paragraph 2.1.1) with special attention to surface coatings and stress areas such as corners of molded areas and interfaces between different materials (e.g., component lead/ceramic interfaces of visible electronic parts), and document the results for comparison with post test data.

Step 3. Conduct an operational checkout, where applicable, in accordance with the approved test plan and record the results for comparison with post test data. If the test item operates satisfactorily, proceed to the next Step. If not, resolve the problems and restart at Step 1, above. Where only parts are available, cut the part into appropriate sizes to accommodate all of the test fluids. Record any weight, hardness, or other physical data for each piece where appropriate.

Step 4. Where applicable, prepare the test item in accordance with Part One, paragraph 5.8, and in the required test item configuration. Record initial baseline information with digital photography if available.

4.5.3 Cleaning.

If necessary and, unless otherwise specified, clean the test item to remove unrepresentative coatings or deposits of grease. Be careful to ensure the cleaning compound will not interfere with the test, i.e., by leaving a residue to interact with test chemicals.

4.5.4 Multiple Fluids.

If more than one contaminating fluid has been identified per test item, determine if each is to be evaluated simultaneously or sequentially. Where small items are used such as small arms ammunition, non-metallic materials, or pieces from a larger test item, use one test piece for each chemical. If sequential testing is required, specify in the requirements document any necessary cleaning method between tests for different contaminants. Check the supplier's material safety data sheet for chemical compatibility. Since contamination normally occurs with one fluid at a time, apply test fluids singly with appropriate cleaning of the specimen before applying subsequent fluids. If desired, clean the test item using a fluid listed as a 'contaminant' if its effect has been shown to be neutral, e.g., aviation fuel detergent.

Consider the possibility of simultaneous contamination by two or more fluids, especially if the result is expected to be synergistically more severe. Also consider the possibility of synergistic action resulting from consecutive contamination. In these cases, do not clean the test item between the applications of test fluids.

WARNING: READ ALL PERTINENT SDS INFORMATION ON ANY CHEMICAL PRIOR TO ITS USE. ADDITIONALLY, USE APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT.

4.5.5 Procedure

Step 1. Select the appropriate chemicals/solutions as per the test directive (chemicals may or may not be listed in Table 504.3. Prepare the test items.[5] If etching will not affect the test item, number the parts to help with identification. Record the test item nomenclature, serial or lot numbers, manufacturer, chemicals/solutions, and any other pertinent test data.

Step 2. Stabilize the test item at the appropriate temperature for the identified contamination scenario (see paragraph 2.2.5).

Step 3. Stabilize the temperature of the specified fluid(s) to that determined from paragraph 2.2.5.2. If simultaneous application of more than one fluid is required, apply the fluid with the highest application temperature first, then the next highest, and so on until all required fluids have been applied.[6]

a. Occasional Contamination.

(1) Apply the specified fluid(s) (e.g., immerse, dip, spray, etc.) to the entire surface of the test item that is likely to be exposed.

(2) Allow the test item to drain naturally for 5 to 10 minutes. Shaking or wiping is not permitted but, if representative of service conditions, it may be rotated about any axis to allow for drainage from different positions.

(3) Where applicable, maintain the test item at the temperature determined in paragraph 2.2.5.1 for eight hours (paragraph 2.2.6). Ramp the chamber to standard ambient temperature at a rate not to exceed 3°C/min (5°F/min) prior to removal of test item(s).

(4) Visually examine the test item for degradation of materials and surface finishes. Record any physical characteristics for comparison with previous results or if appropriate, conduct an operational check of the test item similar to that in paragraph 4.5.2, step 3, and document the results for comparison with the pretest data.

(5) Clean the test item with a known fluid that will not cause any changes to the test item (Annex C).

If testing sequentially, repeat steps a (1) through (4) for each specified fluid without cleaning between each chemical application.

b. Intermittent Contamination[7, 8].

(1) Apply the specified fluid(s) (e.g., immerse, dip, spray, etc.) to the entire surface of the test item that is likely to be exposed. After one hour, visually inspect the test item/s for deterioration including softening, color changes, cracking, or dissolving of the material into the solution. If deterioration is observed, remove that item from the fluid and report

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[5] Items can be cut to size. The integrity of the samples must be taken into account. If using one test item, use different sections of the test item for each chemical unless stated otherwise in the test requirements document.

[6] When mixing two or more fluids, ensure they are compatible and will not produce hazardous reactions.

[7] Intermittent contamination is tailorable to any test item. The exposure times can be shortened or lengthened according to the test plan. Also, if required, temperatures of the solution and/or test item can be changed to meet the requirements.

8/ Intermittent contamination, see TOP 03-2-609 for additional details.

the results after one hour. If no deterioration is observed, maintain surfaces in a wetted condition for a total of 8 hours followed by a drying period of 16 hours at the temperature specified in paragraph 2.2.5.1. If tested at other than standards ambient conditions, ramp the chamber to standard ambient temperature at a rate not to exceed 3C/min (5F/min) prior to removal of test item(s).

(2) After 8 hrs of exposure to fluids, blot excess chemicals from the item, and inspect again for any type of chemical degradation of materials, surface finishes, and physical changes. After the drying period, record final measurements and weights, if any, and record final visual observations. Where applicable, maintain the test item at the temperature determined in paragraph 2.2.5.1 for eight hours (paragraph 2.2.6). Ramp the chamber to standard ambient temperature at a rate not to exceed 3C/min (5F/min) prior to removal of test item(s).

(3) If appropriate, conduct an operational check of the test item similar to that in paragraph 4.5.2, step 3, and document the results for comparison with the pretest data.

(4) Clean the test item with a known fluid that will not cause any changes to the test item. If testing sequentially, repeat steps b(1) through (4) for each specified fluid.

c. Extended Contamination.

(1) Immerse the test item in the specified fluid and maintain for the period specified in the requirements document. If not specified, immerse the test item for at least 24 hours.

(2) Remove the test item from the chemical and allow it to drain naturally for 5 to 10 minutes.

(3) Where applicable, place the test item in a chamber set at the temperature determined in paragraph 2.2.5.1 for eight hours (paragraph 2.2.6). Ramp the chamber to standard ambient temperature at a rate not to exceed 3C/min (5F/min) prior to removal of test item(s). Steps c (1) through (3) can be repeated if long term analysis is needed as per the test plan (record number of cycles performed).

(4) After all cycles have been performed, visually examine the test item for degradation of materials, protective finishes, and physical changes and if appropriate, conduct an operational check of the test item similar to that in paragraph 4.5.2, step 3, and document the results for comparison with the pretest data record results.

(5) If testing sequentially, repeat steps c (1) through (4) for each specified fluid.

5. ANALYSIS OF RESULTS.

In addition to the guidance provided in Part One, paragraphs 5.14 and 5.17, any contamination effects must be analyzed for their immediate or potential (long-term) effects on the proper functioning of the test item or safety during its life cycle. Satisfactory functioning immediately following this test is not the sole criterion for pass/fail.

6. REFERENCE/RELATED DOCUMENTS.

6.1 Referenced Documents.

a. MIL-PRF-372, Cleaning Compound, Solvent (For Bore of Small Arms and Automatic Aircraft Weapons).
b. MIL-PRF-680, Degreasing Solvent.
c. MIL-PRF-2104, Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service.
d. MIL-L-46000-C, Lubricant, Semi-Fluid (Automatic Weapons).
e. MIL-PRF-32033, Notice 1, Lubricating Oil, General Purpose, Preservative (Water-Displacing, Low Temperature);.
f. MIL-PRF-63460E, Amendment 3, Lubricant, Cleaner and Preservative for Weapons and Weapons Systems (Metric).
g. ASTM D4814-13, Fuel, Automotive Spark-Ignition Engine.
h. MIL-DTL-83133, Turbine Fuels, Aviation, Kerosene Types, NATO F-34(JP-8), NATO F-35, and NATO F-37 (JP-8 + 100).

i. A-A-52557A, Notice 1, Fuel Oil, Diesel; For Posts, Camps and Stations.
j. ASTM D975, Oils, Diesel Fuel.
k. A-A-52624A, Notice 1, Antifreeze, Multi Engine Type.
l. ASTM D1141, Ocean Water, Substitute.
m. MIL-DTL-12468, Decontaminating Agent, STB.
n. MIL-PRF-14107, Lubricating Oil, Weapons, Low Temperature.
o. MIL-PRF-5606H, Notice 1, Hydraulic Fluid, Petroleum Base, Aircraft; Missile and Ordnance; remain inactive for new design; however, documents valid for use.
p. MIL-PRF-46170, Hydraulic Fluid, Rust Inhibited, Fire Resistant, Synthetic Hydrocarbon Base, NATO Code No. H-544.
q. MIL-PRF-6083, Hydraulic Fluid, Petroleum Base, for Preservation and Operation.
r. ASTM D910, Gasoline, Aviation.
s. NATO STANAG 4370, Allied Environmental Conditions and Test Publication (AECTP) 300, Climatic Environmental Tests Method 314.
t. Test Operations Procedure (TOP) 03-2-609, Chemical Compatibility of Non-metallic Materials Used in Small Arms Systems; USATEC, APG, MD 21005-5001. DTIC Acquisition No. A359425.
u. MIL-PRF-23699F, Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code No. O-156.
v. MIL-PRF-87937, Cleaning Compound, Aerospace Equipment.
w. MIL-PRF-85570, Cleaning Compounds, Aircraft, Exterior.
x. MIL-PRF-85704, Cleaning Compound, Turbine Engine Gas Path.

6.2 Related Documents.

a. NATO STANAG 4370, Environmental Testing.
b. Egbert, Herbert W. “The History and Rationale of MIL-STD-810 (Edition 2),” January 2010; Institute of Environmental Sciences and Technology, Arlington Place One, 2340 S. Arlington Heights Road, Suite 100, Arlington Heights, IL 60005-4516.
c. Defence Standard 42-40, Foam Liquids, Fire Extinguishing (Concentrates, Foam, Fire Extinguishing), (UK Ministry of Defence).
d. Defence Standard 68-161, Dispensers, Insecticide Aerosol Flying Insect Killer, (UK Ministry of Defence).
e. BS 6580: 1992, Specification for Corrosion Inhibiting, Engine Coolant Concentrate ('Antifreeze'), British Standards Institute.
f. Defence Standard 79-17, Compound, Cleaning, Foaming, for Aircraft Surfaces, (UK Ministry of Defence).

METHOD 504.3, ANNEX A

ENVIRONMENTAL AND TOXICOLOGICAL CONSIDERATIONS

1. GASOLINE FUELS AND MINERAL/SYNTHETIC OILS.

a. Open burning will produce environmental pollution.

b. Contact with the skin will promote de-fatting.

  (1) Ignition under certain circumstances will cause explosion.

  (2) Low flash point of gasoline (piston engine): -40 °C (-40 °F).

  (3) Spillage can cause contamination of waterways and underground water supplies. Three hundred liters of gasoline has the capacity to produce a surface film over one square kilometer of still water.

  (4) Carcinogenic chemicals such as benzene are present in fuels; oils often contain other toxic ingredients.

  (5) Tri alkyl phosphate is a typical synthetic hydraulic oil. Spillage can cause toxic pollution of waterways and underground water supplies.

2. SOLVENTS AND CLEANING FLUIDS.

a. Propan-2-ol is flammable.

  (1) 1.1.1 Trichloroethane has been withdrawn from use because of its environmental impact when reacting with ozone. It is also believed to have mutagenic properties.

  (2) Denatured alcohol is both toxic and flammable. It is a mixture containing approximately 95 percent ethyl alcohol, 5 percent methyl alcohol, and minor ingredients such as pyridine.

  (3) Detergent made from biodegradable phosphates sodium sulfate and sodium carboxy methyl cellulose is a conventional laundry substance. Untreated discharge into waterways must be avoided.

3. DEICING AND ANTIFREEZE FLUIDS.

50 percent inhibited aqueous potassium acetate solution is commercially marketed and reputed to be a completely safe new alternative to the ethylene glycols. However, its interaction with aluminum alloys is less than satisfactory.

4. DISINFECTANT.

Phenol based disinfectants can blister the skin; if toxic, they may cause poisoning by absorption through the skin or by inhalation of the vapors. Undiluted forms of certain disinfectants may be flammable. Use expert commercial disposal companies to manage disposal of detergents. Small quantities may be flushed down the drain with copious quantities of water.

5. COOLANT DIELECTRIC FLUID.

The most recent coolants are based on polymerised alpha olefins that are both non-toxic and generally inert.

WARNING: READ ALL PERTINENT SDS INFORMATION ON ANY CHEMICAL PRIOR TO ITS USE. ADDITIONALLY, USE APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT.

6. INSECTICIDES.

Most insecticides may be regarded as toxic to man. If the delivery vehicle for the insecticide is a kerosene-type (fuel/oil) spray or mist, many of the features identified under paragraph 1 above will also apply.

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METHOD 504.3, ANNEX B

GENERAL FLUID INFORMATION

CONTAMINANT FLUID GROUPS. (See paragraph 2.2.3)

The following groups of fluids are listed in Table 504.3-I for Procedure I, and Table 504.3-II for Procedure II. These lists are not all inclusive, and allow the addition of other fluids as called out in the test requirements.

a. Fuels. Fuels will, for the most part, be of the gasoline, diesel or kerosene type, and whereas the former may be expected to evaporate rapidly - possibly with few permanently harmful effects, the latter two - being more persistent - can be damaging to many elastomers, particularly at elevated temperatures. Paints and most plastics are normally not affected by fuels, but silicone resin bonded boards may tend to de-laminate after prolonged exposure. Some fuels may have additives to inhibit icing or to dissipate static charges. Where there is reason to believe that these additives may increase the severity of the test, include them in the test fluids.

b. Hydraulic Fluids. Commonly used hydraulic fluids may be of the mineral oil or ester-based synthetic type. The latter are damaging to most elastomers and to plastics; phosphate esters are especially damaging to these materials and to paint finishes.

c. Lubricating Oils. Mineral or synthetic-based lubricating oils may be at elevated temperatures in their working states. Mineral oil is damaging to natural rubber but less so to synthetics such as polychloroprene, chlorosulphonated polyethylene, and silicone rubber. Synthetic lubricants are extremely damaging to plastics such as PVC, as well as to many elastomers.

d. Solvents and Cleaning Fluids. Many areas of aircraft or vehicles may require dirt or grease removal before servicing can begin. The fluids given in Table 504.3-I are representative of those presently in use.

e. Deicing and Antifreeze Fluids. These fluids may be applied, often at elevated temperatures, to the leading edges, intakes, etc., of aircraft and may penetrate areas where they can contaminate components and materiel. These fluids are based, typically, on inhibited ethylene glycols.

f. Runaway Deicers. These fluids are used on runways and other areas to lower the freezing point of water. They may penetrate the undercarriage and equipment bays of aircraft as a fine mist.

g. Insecticides. Aircraft flying in and through the tropics may be treated with insecticide sprays as a routine precaution. While it is unlikely that these will have a direct adverse effect on materiel, it may be necessary to make exploratory tests using a proprietary insecticide.

h. Disinfectants. The primary contaminating agent is likely to be the disinfectant used, that will be a formaldehyde/phenol preparation, and its use on waste liquid in/from galleys and toilet compartments, where a leak may permit contamination of materiel below the leak.

i. Coolant Dielectric Fluids. These are used as thermal transfer liquids to assist cooling of certain equipment. They are usually based on silicate ester materials, and their effects on materials may be considered to be similar to the phosphate ester hydraulic fluids, although not quite as severe.

j. Fire Extinguishants. Many HALON extinguishing agents have been or are being banned in many countries. Although HALON 1301 is still in some legacy systems, the extinguishing agents replacing some older chemical compounds are FE25, FM200, CO_2 ABC extinguishers, and newer types such as FE13. Fire fighting aqueous foams such as FFFP (Protein/Flurorprotein foams) have been replaced with AFFF (Aqueous Film-Forming Foam). The necessity for testing with these products is based on the need to maintain equipment functioning after release of the extinguishant.

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METHOD 504.3, ANNEX C

HANDLING, DISPOSAL OF CHEMICALS, AND THE DECONTAMINATION OF TEST EQUIPMENT AND TEST ITEMS AFTER EXPOSURE TO CHEMICALS

Decontamination of test equipment, materials, and test items that have been subjected to a contamination by fluids (chemical compatibility) test is paramount when the test items are to be sent back to the users, manufacturer, or material management office for further evaluation or reuse. Many test items are too expensive to scrap and must be decontaminated.

a. Always read the related SDS information for each chemical before use and during disposal. Personal protective equipment (PPE) such as gloves and safety glasses should be worn during handling of the chemicals and be familiar with the information found in the test site Chemical Hygiene Plan where applicable.

b. Follow all Federal, State, and Local regulations for disposing of the chemicals after testing.

c. Removing excess chemicals is necessary for safety to the user. Any residual chemical can be wiped with paper towels, rags or other soft cloth. The rags should be rung free of excess chemicals before being placed in a plastic bag and disposed of in accordance with Federal, State, and Local regulations.

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