METHOD 506.6

RAIN

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METHOD 506.6

RAIN

> **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.

The purpose of this Method is to help determine the following with respect to rain, water spray, or dripping water:

a. The effectiveness of protective covers, cases, and seals in preventing the penetration of water into the materiel.

b. The capability of the materiel to satisfy its performance requirements during and after exposure to water.

c. Any physical deterioration of the materiel caused by the rain.

d. The effectiveness of any water removal system.

e. The effectiveness of protection offered to a packaged materiel.

1.2 Application.

Use this Method to evaluate materiel likely to be exposed to rain, water spray, or dripping water during storage, transit, or operation. If the materiel configuration is the same, the immersion (leakage) test (Method 512.6) is normally considered to be a more severe test for determining if water will penetrate materiel. There is generally no need to subject materiel to a rain test if it has previously passed the immersion test and the configuration does not change. However, there are documented situations in which rain tests revealed problems not observed during immersion tests due to differential pressure. Additionally, the immersion test may be more appropriate if the materiel is likely to be placed on surfaces with significant amounts of standing water. In most cases, perform both tests if appropriately identified in the life cycle profile.

1.3 Limitations.

a. When a requirement exists for weapon system components such as seeker windows/radomes, nose cones, airframes, leading edges, control surfaces, thermal protection systems, and fuzes to operate during weather encounter to include high speed flight through hydrometeors, a tailored test approach must be utilized based on the system configuration, trajectories, and system specific statistically based weather occurrence. Traceability must be addressed between realistic flight through weather and ground test methods to ensure adequate performance characterization is achieved. Ground test methods include the use of nylon bead impact, single water drop impact, whirling-arm impact, ballistic gun ranges, and sled track facilities with rain field simulation capability to induce high speed/hypersonic integrated rain impact/erosion effects on flight components. For hypersonic item testing consider utilizing the methods described in Technical Report AMR-PS-08-01.

b. Because of the finite size of the test facilities, it may be difficult to determine atmospheric rain effects such as on electromagnetic radiation and propagation.

c. This Method is not intended for use in evaluating the adequacy of aircraft windshield rain removal provisions.

d. This Method doesn’t address pressure washers or decontamination devices.

e. This Method may not be adequate for determining the effects of extended periods of exposure to rain, or for evaluating materiel exposed to only light condensation drip rates (lower than 140 L/m^2/hr) caused by an overhead surface. For this latter case, the aggravated humidity cycle of Method 507 will induce a significant amount of free water on both inside and outside surfaces.

2. TAILORING GUIDANCE.

2.1 Selecting the Rain Method.

After examining the requirements documents and applying the tailoring process in Part One of this Standard to determine where rain is foreseen in the life cycle of the materiel, use the following to aid in selecting this Method and placing it in sequence with other methods. The term "rain" encompasses the full range of "free water" (blowing, steady state, drip) tests included in this Method.

2.1.1 Effects of Rain Environments.

Rain (when falling, upon impact, and as deposited as pooled water) has a variety of effects on materiel. Consider the following typical problems to help determine if this Method is appropriate for the materiel being tested. This list is not intended to be all-inclusive, and some of the examples may overlap the categories.

2.1.1.1 In the Atmosphere.

In the atmosphere the effects resulting from exposure to these environments include:

a. Interference with or degradation of radio communication.

b. Limited radar effectiveness.

c. Limited aircraft operations due to restricted visibility and decreased lift from wing surfaces (excessive rain rates only).

d. Damage to aircraft in flight.

e. Affect on munitions launch and flight.

f. Degradation or negation of optical surveillance.

g. Decreased effectiveness of personnel in exposed activities.

h. Premature functioning of some fuses.

i. Inhibited visibility through optical devices.

2.1.1.2 On Impact.

On impact it erodes surfaces.

2.1.1.3 After Deposition and/or Penetration.

After deposition and/or penetration, the effects resulting from exposure to these environments include:

a. Degraded strength/swelling of some materials.

b. Increased corrosion potential, erosion, or even fungal growth.

c. Increased weight.

d. Electrical or electronic apparatus become inoperative or unsafe.

e. Malfunction of electrical materiel.

f. Freezing inside materiel that may cause delayed deterioration and malfunction by swelling or cracking of parts.

g. Modified thermal exchange.

h. Slower burning of propellants.

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. This Method is applicable at any stage in the test program, but its effectiveness in determining the integrity of an enclosure is maximized if it is performed after the dynamic tests.

2.2 Selecting Procedures.

This Method includes three rain-related test procedures: Procedure I (Rain and Blowing Rain), Procedure II (Exaggerated), and Procedure III (Drip). Before conducting the test, determine which test procedure(s) and test conditions are appropriate.

2.2.1 Procedure Selection Considerations.

Differences among rain test procedures are explained below. Select the procedure that represents the most severe exposure anticipated for the materiel commensurate with materiel size. When selecting a procedure, consider:

a. The materiel configuration.

b. The logistical and operational requirements (purpose) of the materiel.

c. The operational purpose of the materiel and data to verify it has been met.

d. The natural exposure circumstances.

e. Procedure sequence.

2.2.2 Difference Among Procedures.

a. Procedure I - Rain and Blowing Rain. Procedure I is applicable for materiel that will be deployed out-of-doors and that will be unprotected from rain or blowing rain. The accompanying wind velocity can vary from almost calm to extremely high. Consider using Procedure II for materiel that cannot be adequately tested with this procedure because of its (large) size.

b. Procedure II - Exaggerated. Consider Procedure II when large (shelter-size) materiel is to be tested and a blowing-rain facility is not available or practical. This procedure is not intended to simulate natural rainfall but will provide a high degree of confidence in the watertightness of materiel.

c. Procedure III - Drip. Procedure III is appropriate when materiel is normally protected from rain but may be exposed to falling water from condensation or leakage from upper surfaces. There are two variations to the drip test:

(1) for materiel that may experience falling water (generally from condensation), and

(2) for materiel that may be subjected to heavy condensation or leaks from above.

2.3 Determine Test Levels and Conditions.

Having selected this Method and relevant procedures (based on the materiel's requirements documents and the tailoring process), it is necessary to complete the tailoring process by selecting specific parameter levels and special test conditions/techniques for these procedures based on requirements documents or Life Cycle Environmental Profile (LCEP) (see Part One, Figure 1-1), and information provided with this procedure. From these sources of information, determine the functions to be performed by the materiel in rain environments or following storage in rain environments. Then determine the rainfall levels of the geographical areas and micro-environments in which the materiel is designed to be employed. Variables under each test procedure include the test item configuration, rainfall rate, wind velocity, test item exposure surfaces, water pressure, and any additional appropriate guidelines in accordance with the requirements document.

2.3.1 Test Item Configuration.

Perform the test using all the configurations in which the materiel may be placed during its life cycle. As a minimum, consider the following configurations:

a. In a shipping/storage container or transit case.

b. Protected or not protected.

c. In its operational configuration.

d. Modified with kits for special applications.

NOTE: Do not use any sealing, taping, caulking, etc., except as required by the design specification for the materiel. Unless otherwise specified, do not use test items that have surface contamination such as oil, grease, or dirt that could prevent wetting.

2.3.2 Rainfall / Drip Rate.

a. Procedure I – Rain and Blowing Rain: The rainfall rate used in Procedure I may be tailored to the anticipated deployment locale and duration. Although various rainfall intensities have been measured in areas of heavy rainfall, recommend a minimum rate of 1.7 mm/min (4 in/hr) since it is not an uncommon occurrence, and would provide a reasonable degree of confidence in the materiel. MIL-HDBK-310 (paragraph 6.1, reference a) contains further information. During the pretest set-up, rain fall measurements should be taken at a minimum of 5 random locations. The average of these rain rate measurements should be within 10% or +/- 0.1 mm/min (0.25 in/hr) of the specified value, whichever is less. To ensure a uniform distribution of simulated rain on the test item each measurement should be within 25% or +/- 0.2 mm/min (0.5 in/hr) of the specified rain rate whichever is less.

b. Procedure II - Exaggerated: This procedure uses (as a guideline) a 276 kPa (40 psig) nozzle pressure with a flow rate of 20.8 L/min (5.5 gal/min) that should produce water droplets traveling at approximately 64 km/h (40 mph) when using a nozzle such as specified in paragraph 4.1.2.

c. Procedure III - Drip: The drip test has a requirement for a volume of water greater than 280 L/m^2/hr (7 gal/ft^2/hr) dripping through a pre-determined hole pattern. An alternative requirement is for items exposed only to 140 L/m^2/hr (3.5 gal/ ft^2/hr): Appropriately reduce the drip rate as long as the duration of the test is extended to 30 minutes to ensure the equivalent volume of water falls on the test item.

2.3.3 Droplet Size.

Nominal drop-size spectra exist for instantaneous rainfall rates but for the long-term rainfall rates they are meaningless since rates are made up of many different instantaneous rates possessing different spectra (paragraph 6.1, reference a). For Procedures I and II, use droplet sizes predominantly in the range of approximately 500 µm in diameter[1/] (that is considered to be mist or drizzle rather than rain (paragraph 6.1, reference b), to 4500 µm in diameter (paragraph 6.1, reference c). For lower rain rates, it may be difficult to achieve specified droplet size. For drip tests using dispensing tubes (Figure 506.6-1), polyethylene tubing sleeves added to the dispensing tubes will increase the droplet size to its maximum. Procedure III is not meant to simulate rain but rather droplets of condensation or overhead leakage, and therefore droplets may be larger than 4500 µm in diameter. Since the drip test is not to simulate rain, the droplets do not need to reach terminal velocity. It is possible to achieve larger droplet sizes, since the air resistance may not be sufficient to cause them to break up. The largest drop size that can be achieved without coalescence is recommended.

NOTE: Observations have shown that water droplets introduced into a high velocity air stream tend to break up over distance (paragraph 6.1, references d and e). Accordingly, recommend introducing the droplets as close as possible to the test item while assuring the droplets achieve the required velocity prior to impact with the test item.

2.3.4 Wind Velocity.

High rainfall intensities accompanied by winds of 18 m/s (40 mph) are not uncommon during storms. Unless otherwise specified or when steady state conditions are specified, recommend this velocity. Where facility limitations preclude the use of wind, use Procedure II.

NOTE: Without straightening vanes, fans may not produce the required wind velocity near the center of the wind stream.

1/Observations show there are no drops of less than roughly 500 µm diameter during intense rains (paragraph 6.1, reference b).

2.3.5 Test Item Exposure Surface (Orientation).

Wind-blown rain will usually have more of an effect on vertical surfaces than on horizontal surfaces, and vice versa for vertical or near-vertical rain. Expose all surfaces onto which the rain could fall or be driven to the test conditions. Rotate the item as required to expose all vulnerable surfaces.

2.3.6 Water Pressure.

Procedure II relies on pressurized water. Vary the pressure as necessary to comply with the requirements documents, but a minimum value of 276 kPa (40 psig) nozzle pressure is given as a guideline based on past experience. This value will produce water droplets traveling at approximately 64 km/h (40 mph) when using a nozzle as specified in paragraph 4.1.2.

2.3.7 Preheat Temperature.

Experience has shown that a temperature differential between the test item and the rainwater can affect the results of a rain test. When specified for nominally sealed items, increasing the test item temperature to about 10 °C (18 °F) higher than the rain temperature at the beginning of each exposure period to subsequently produce a negative pressure inside the test item will provide a more reliable verification of its watertightness. Ensure the heating time is the minimum required to stabilize the test item temperature, and not sufficient to dry the test item when not opened between exposures.

2.3.8 Exposure Duration.

Determine the exposure duration from the life cycle profile, but do not use a duration less than that specified in the individual procedures. For items made of material that may absorb moisture, the duration may have to be significantly extended to reflect real life cycle circumstances and, for drip tests, the drip rate appropriately reduced. With certain materials, the water penetration and thus the degradation is more a function of time (length of exposure) than the volume or rain/drip rate exposure.

3. INFORMATION REQUIRED.

3.1 Pretest.

The following information is required to conduct rain 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) Rainfall rate.

(2) Exposure surfaces/duration.

(3) Test item preheat temperature.

(4) Initial water temperature.

(5) Wind velocity.

(6) Water pressure (if appropriate).

(7) Photographs as appropriate.

(8) Test item weight, if required. This may be useful for detecting moisture intrusion in small test items where an internal visual inspection may not be feasible. In large test items, the precision of the scale limits ability to detect small amounts of water intrusion, so weighing of large items is not typically performed.

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

3.2 During Test.

Collect the following information 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. For test validation purposes, record deviations from planned or pre-test procedures or parameter levels, including any procedural anomalies that may occur.

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) Surfaces of the test item subjected to rainfall.

(2) Duration of exposure per face.

(3) Results of inspection for water penetration (amount and probable point of entry).

(4) Results of operational checks.

(5) Length of time for each performance check.

(6) Any modifications from the test plan.

(7) Photographs as appropriate.

(8) If required, test item weights prior to and following exposures.

4. TEST PROCESS.

4.1 Test Facility.

4.1.1 Procedure I - Rain and Blowing Rain.

a. Use a rain facility capable of producing falling rain at the rate specified herein. To produce the rain, use a water distribution device that produces droplets having a diameter range predominantly between 500 µm and 4500 µm.. Ensure the rain is dispersed completely over the test item when accompanied by the prescribed wind. A water-soluble dye such as fluorescein may be added to the rainwater to aid in locating and analyzing water leaks. For steady state rain, use either spray nozzles or the apparatus shown in Figure 506.6-1 (with the polyethylene tubing removed), and position the dispenser at a height sufficient to ensure the drops approach terminal velocity (about 9 m/s (29.5 ft/sec.)). It is not necessary to use de-ionized or distilled water for this test. Do not allow rust or corrosive contaminants from the facility infrastructure to impact the test item.

b. Position the wind source with respect to the test item so that it will cause the rain to beat directly, with variations up to 45° from the horizontal, and uniformly against one side of the test item. Use a wind source that can produce horizontal wind velocities equal to and exceeding 18 m/s (59.1 ft/sec.). Measure the wind velocity at the position of the test item before placement of the test item in the facility.

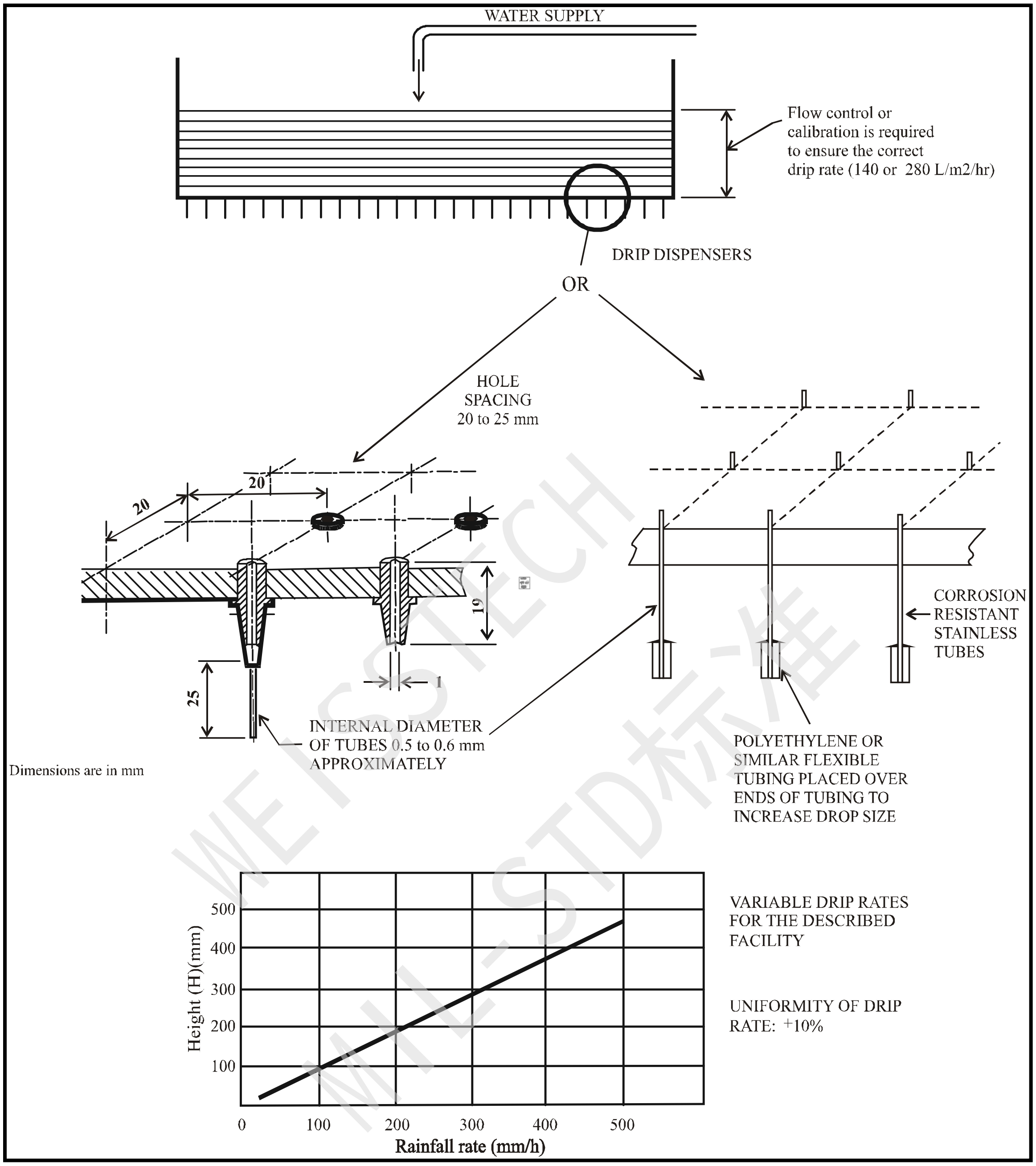
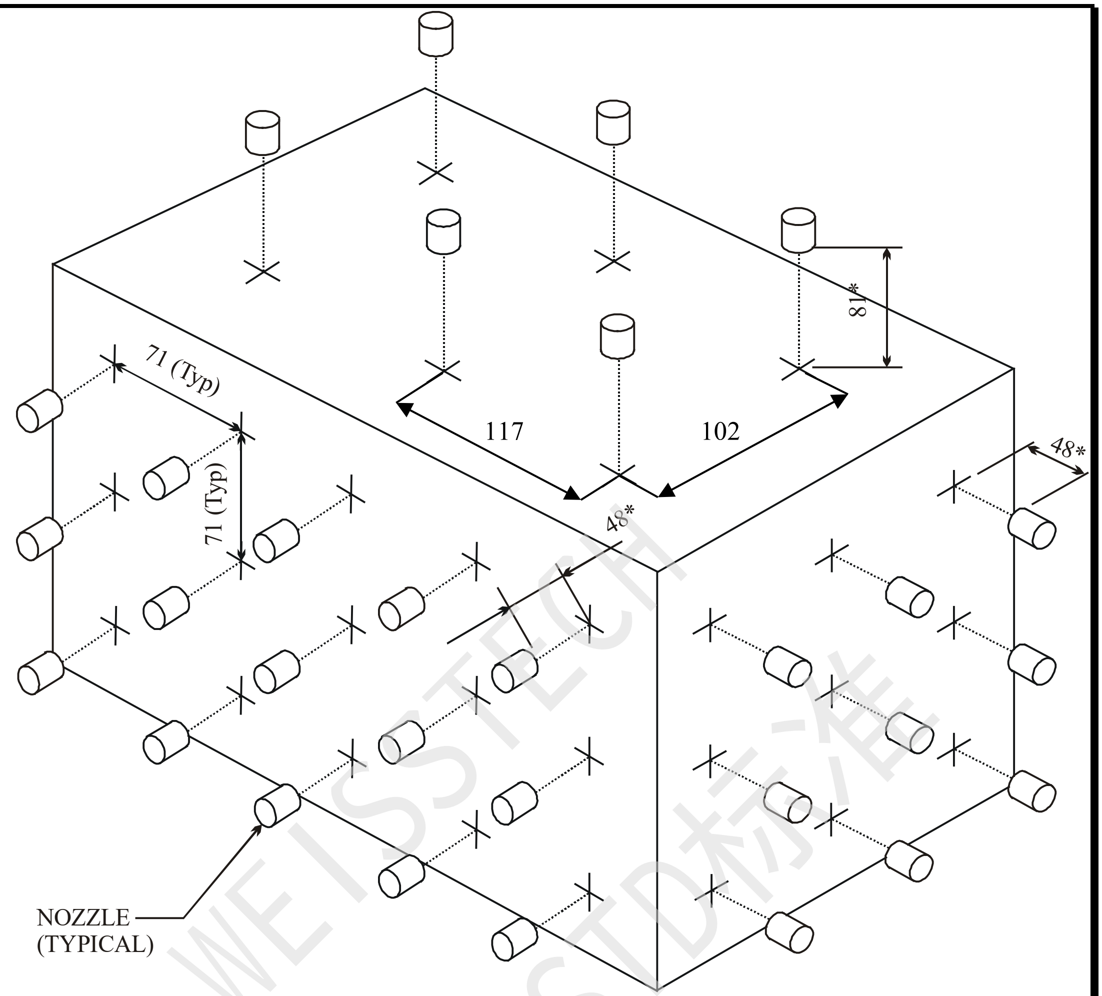


Figure 506.6-1. Sample facility for steady state rain or drip test.

4.1.2 Procedure II - Exaggerated.

Use nozzles that produce a square spray pattern or other overlapping pattern (for maximum surface coverage) and with a droplet size predominantly in the 500 to 4500 µm range at approximately 276 kPa (40 psig). Use at least one nozzle for each 0.56 m^2 (6 ft^2) of surface area and position each about 48 cm (19 in.) from the test surface. Adjust this distance as necessary to achieve overlap of the spray patterns. A water-soluble dye such as fluorescein added to the rainwater may aid in locating and analyzing any water leaks. For Procedure II, position the nozzles as required by the test plan or as depicted on Figure 506.6-2. Although Figure 506.6-2 shows an S-280 shelter, the nozzle configuration is typical for larger test items. In general, ensure the sides and top of the test item are subjected to overlapping water spray patterns.



* Adjust as necessary to get spray overlap

NOTE: Dimensions are in cm. Ensure nozzles are perpendicular to the surface(s) and situated such that each surface (especially vulnerable areas) is sprayed.

Figure 506.6-2. Typical nozzle setup for exaggerated test, Procedure II (not intended for use when conducting Procedure I testing).

4.1.3 Procedure III - Drip.

Use a test setup that provides a volume of water greater than 280 $l/m^2/hr$ (7 $gal/ft^2/hr$) dripping from a dispenser with drip holes on a 20 to 25.4 mm (0.79 – 1.0 inch) pattern (depending on which dispenser is used) but without coalescence of the drips into a stream. Figures 506.6-1 and 506.4-3 provide possible dispenser designs. Either arrangement shown on Figure 506.6-1 is recommended over that of Figure 506.6-3 due to its simplicity of construction, maintenance, cost, and reproducibility of tests. The polyethylene tubing is optional, but it ensures maximum droplet size. Use a drip height from a specified height (no less than 1 meter (3 feet)) as measured from the upper main surface of the test item Use a dispenser with a drip area large enough to cover the entire top surface of the test item. For known conditions where a 280 $L/m^2/hr$ (7 $gal/ft^2/hr$) drip rate cannot occur, test the item by reducing the drip rate and increasing the test duration. For example, for an item exposed only to 140 $L/m^2/hr$ (3.5 $gal/ft^2/hr$), appropriately reduce the drip rate as long as the duration of the test is extended to 30 minutes to ensure the equivalent volume of water falls on the test item. A water-soluble dye such as fluorescein added to the rainwater may aid in locating and analyzing water leaks. Recommend the water be filtered using a fine sediment filter to ensure particulate buildup does not block the tubing.

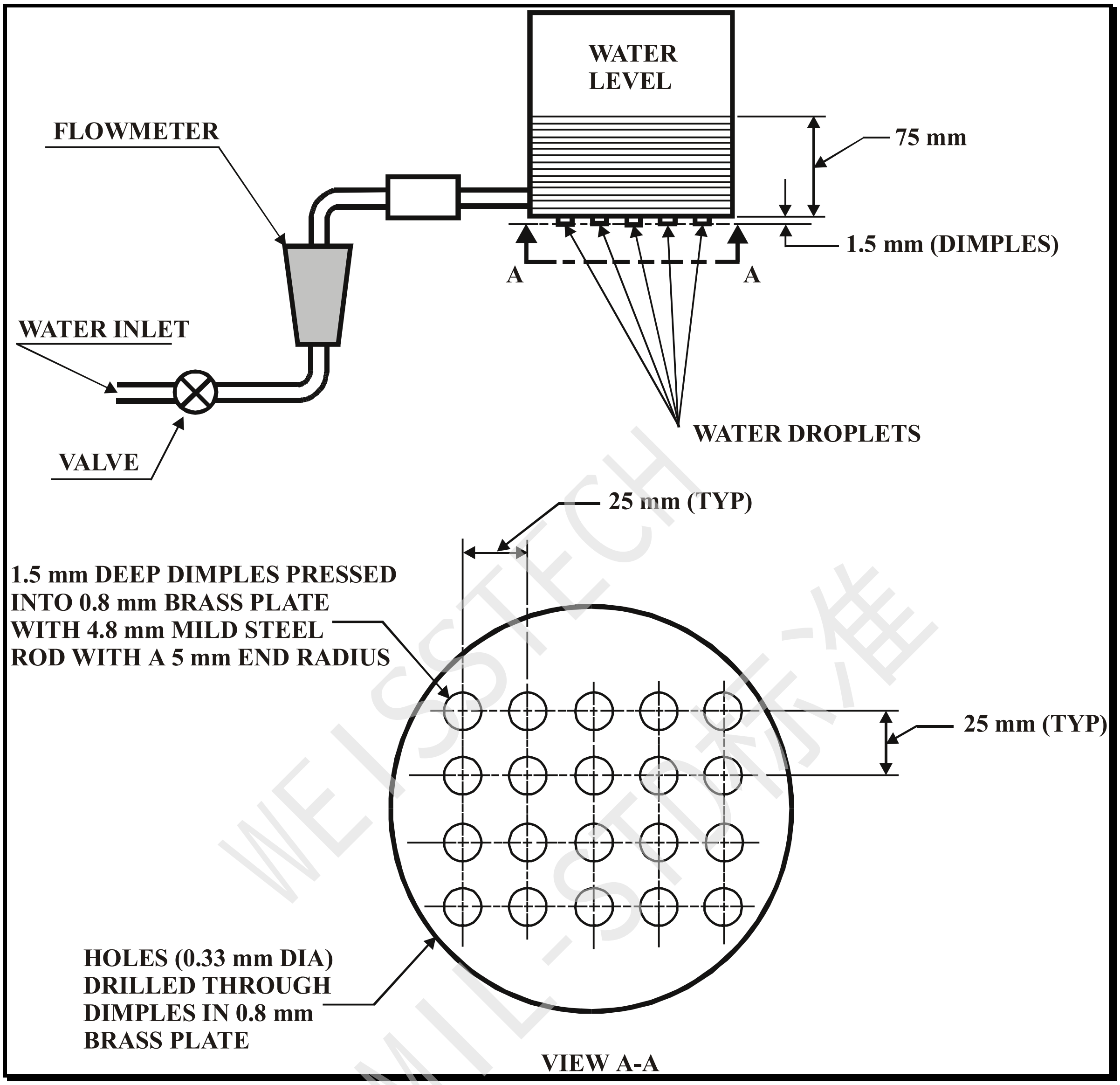


Figure 506.6-3. Details of dispenser for drip test, Procedure III.

4.2 Controls.

a. For Procedures I and II, verify the rainfall rate immediately before each test.

b. For Procedure I, verify the wind velocity immediately before each test.

c. For Procedures I and II, verify the nozzle spray pattern and pressure before each test.

d. For Procedure III, verify the flow rate immediately before and after the test to ensure test tolerances are met throughout the test, and ensure that only separate (or discrete) drops are issuing from the dispensers.

e. Unless otherwise specified, water used for rain tests can be from local water supply sources.

f. Record test parameters at a sufficient rate to capture data necessary for post-test analysis (see Part One, paragraph 5.18).

4.3 Test Interruption.

Test interruptions can result from two or more situations, one being from failure or 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 required or optional performance checks.

4.3.1 Interruption Due to Chamber Malfunction.

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

b. Specific to this Method. Interruption of a rain test is unlikely to generate any adverse effects. Normally, continue the test from the point of interruption.

4.3.2 Interruption Due to Test Item Operation Failure.

Failure of the test item(s) to function as required during mandatory or optional performance checks during testing presents a situation with several possible options.

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 Execution.

The following steps, alone or in combination, provide the basis for collecting necessary information concerning the materiel's watertightness.

4.4.1 Preparation for Test.

4.4.1.1 Preliminary Steps.

Before starting the test, review pretest information in the test plan to determine test details (e.g., procedures, test item configuration/orientation, cycles, durations, parameter levels for storage/operation, rainfall rates and wind velocities (for Procedure I), etc.). (See paragraph 3.1, above.)

4.4.1.2 Pretest Standard Ambient Checkout.

All test items require a pretest standard ambient checkout to provide baseline data. Conduct the checkout as follows:

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

Step 2. Conduct a complete pretest examination and document the results.

Step 3. Prepare the test item in accordance with Part One, paragraph 5.8 and in the required test item configuration.

Step 4. To establish baseline data, conduct an operational checkout in accordance with the test plan, and record the results. If required to support detection of water intrusion, weigh the test item.

Step 5. If the test item operates satisfactorily, proceed to paragraph 4.4.2, 4.4.3, or 4.4.4 as appropriate. If not, resolve the problems and repeat Steps 3 and 4 above.

4.4.2 Procedure I - Rain and Blowing Rain.

Step 1. Heat the test item or cool the water so that the stabilized test item temperature is a minimum of 10 °C (18 °F) above the rain water temperature at the start of each exposure period (see paragraph 2.3.7).

Step 2. Install the test item in the facility in the configuration defined in the test plan.

Step 3. Initiate the wind speed and rain rate specified in the test plan and maintain these conditions for a minimum of 30 minutes. If required, operate the test item for the last 10 minutes of the 30-minute rain exposure. If the test item fails to operate as intended, follow the guidance in paragraph 4.3.2 for test item failure.

Step 4. Examine the test item in the test chamber (if possible), otherwise, remove the test item from the test facility and conduct a visual inspection.

Step 5. Measure and document any free water found inside the protected areas of the test item. If required, weigh the test item.

Step 6. Repeat Steps 1 through 5 until all exposure surfaces of concern have been tested.

Step 7. Operate the test item for compliance with the requirements document, and document the results. See paragraph 5 for analysis of results. If water has penetrated the test item, judgment must be used before operation of the test item. It may be necessary to empty water from the test item (and measure the quantity) to prevent a safety hazard.

4.4.3 Procedure II - Exaggerated.

Step 1. Install the test item (with all doors, louvers, etc., closed) in the test facility.

Step 2. Position the nozzles as required by the test plan or as indicated in Figure 506.6-2.

Step 3. Spray all exposed surfaces of the test item with water for not less than 40 minutes per face.

Step 4. After each 40-minute spray period, inspect the interior of the test item for evidence of free water. Estimate its volume and the probable point of entry and document. If required, weigh the test item.

Step 5. Conduct an operational check of the test item as specified in the test plan, and document the results. See paragraph 5 for analysis of results.

4.4.4 Procedure III - Drip.

Step 1. Install the test item in the facility in accordance with Part One, paragraph 5.8 and in its operational configuration with all connectors and fittings engaged. Ensure the temperature differential between the test item and the water is 10 °C (18 °F) or greater. If necessary, either raise the test item temperature or lower the water temperature to achieve the differential in paragraph 2.3.7, and restore the test item to its normal operating configuration immediately before testing.

Step 2. Verify the proper water flow rate and ensure that only separate (or discrete) drops are issuing from the dispensers.

Step 3. With the test item operating, subject it to water falling from a specified height (no less than 1 meter (3 feet)) as measured from the upper main surface of the test item at a uniform rate for 15 minutes or as otherwise specified (see Figure 506.6-1 or Figure 506.6-3). Use a test setup that ensures that all of the upper surfaces get droplets on them at some time during the test. For test items with glass-covered instruments, tilt them at a 45° angle, dial up. If the test item fails to operate as intended, follow the guidance in paragraph 4.3.2 for test item failure.

Step 4. At the conclusion of the 15-minute exposure, remove the test item from the test facility and remove sufficient panels or covers to allow the interior to be seen. Verify the proper water flow rate.

Step 5. Visually inspect the test item for evidence of water penetration.

Step 6. Measure and document any free water inside the test item. If required, weigh the test item.

Step 7. Conduct an operational check of the test item as specified in the test plan, and document the results. See paragraph 5 for analysis of results.

5. ANALYSIS OF RESULTS.

In addition to the guidance provided in Part One, paragraphs 5.14 and 5.17, the following information is provided to assist in the evaluation of the test results. Analyze any failure of a test item to meet the requirements of the materiel specifications and consider related information such as follows.

5.1 Operational Failures.

a. Degradation allowed in the performance characteristics because of rainfall exposure.

b. Necessity for special kits for special operating procedures.

c. Safety of operation.

5.2 Water Penetration.

Based on the individual materiel and the requirements for its non-exposure to water, determine if one of the following is applicable:

a. Unconditional failure. Any evidence of water penetration into the test item enclosure following the rain test.

b. Acceptable water penetration. Water penetration of not more than 4 cm^3 per 28,000 cm^3 (1 ft^3) of test item enclosure provided the following conditions are met:

(1) There is no immediate effect of the water on the operation of the materiel.

(2) The test item in its operational configuration (transit/storage case open or removed) can successfully complete the aggravated temperature/humidity procedure of Method 507.

6. REFERENCE/RELATED DOCUMENTS.

6.1 Referenced Documents.

a. MIL-HDBK-310, Global Climatic Data for Developing Military Products.

b. Huschke, R. E. (ed.), Glossary of Meteorology. Boston: American Meteorological Society, 1970; Air Force Institute of Technology.

c. Rogers, R.R., Short Course in Cloud Physics, Oxford; Boston: Butterworth-Heinemann, 1989; Air Force Institute of Technology.

d. AMR-PS-08-01, Kinetic Energy Interceptor Flight Weather Encounter Requirements Development, November 2007.

6.2 Related Documents.

a. NATO STANAG 4370, Allied Environmental Conditions and Test Publication (AECTP) 230, Climatic Conditions and AECTP 300, Climatic Environmental Testing.

b. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.

c. 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.

d. Army Materiel Command Pamphlet AMCP-706-116, Engineering Design Handbook, Environmental Factors

e. RTCA/DO-160D, Environmental Conditions and Test Procedures for Airborne Equipment

f. Tattelman, P.I., and Sissenwine, N., Extremes of Hydrometers at Altitude for MIL-STD-210B: Supplement Drop Size Distributions (1973), AFCRL-TR-73-0008, AFSG 253

g. R.M. Clayton et al, Rain Simulation for High-Intensity Acoustic Noise Cavities. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, Report NPO-17237/6745.

h. Synopsis of Background Material for MIL-STD-210B, Climatic Extremes for Military Equipment. Bedford, MA: Air Force Cambridge Research Laboratories, 24 January 1974, DTIC number AD-780-508.

(Copies of Department of Defense Specifications, Standards, and Handbooks, and International Standardization Agreements are available online at https://assist.dla.mil.

Requests for other defense-related technical publications may be directed to the Defense Technical Information Center (DTIC), ATTN: DTIC-BR, Suite 0944, 8725 John J. Kingman Road, Fort Belvoir VA 22060-6218, 1-800-225-3842 (Assistance--selection 3, option 2), http://www.dtic.mil/dtic/; and the National Technical Information Service (NTIS), Springfield VA 22161, 1-800-553-NTIS (6847), http://www.ntis.gov/.

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