METHOD 511.7

EXPLOSIVE ATMOSPHERE

CONTENTS

CONTENTS - Continued

Paragraph **Page**

FIGURES

METHOD 511.7

EXPLOSIVE ATMOSPHERE

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 explosive atmosphere test is performed to either:

a. Demonstrate the ability of materiel to operate in fuel-air explosive atmospheres without causing ignition.

b. Demonstrate that an explosive or burning reaction occurring within encased materiel will be contained, and will not propagate outside the test item.

1.2 Application.

This Method applies to all materiel designed for use in the vicinity of fuel-air explosive atmospheres associated with aircraft, automotive, and marine fuels at or above sea level. The flammable/explosive vapors may originate either from the equipment itself or from an external source. Procedure II specifically relates to atmospheres in a space in which flammable fluids or vapors exist, or can exist, either continuously or intermittently (e.g., in fuel tanks or within fuel systems).

NOTE: Materiel tested to Procedure II is designed such that ignition of an explosive mixture is contained within the materiel without igniting the surrounding explosive atmosphere and, during normal operation, or as a result of any fault, the temperature of any external surface will not rise to a level capable of causing ignition (including hermetically-sealed materiel).

1.3 Limitations.

a. These procedures use an explosive fuel-air mixture that has a relatively low flash point that may not be representative of some actual fuel-air or aerosol (such as suspended dust) mixtures.

b. The explosive atmosphere test is a conservative test. If the test item does not ignite the test fuel-air mixture, there is a low probability that the materiel will ignite prevailing fuel vapor mixtures in service. Conversely, the ignition of the test fuel-air mixture by the test item does not mean the materiel will always ignite fuel vapors that occur in actual use.

c. These procedures are not appropriate for test altitudes above approximately 16 km where the lack of oxygen inhibits ignition.

d. While the Method is not intended to test for high surface temperatures, it does not preclude this possibility (this Method is intended for spark ignition).

2. TAILORING GUIDANCE.

2.1 Selecting the Explosive Atmosphere Method.

After examining requirements documents and applying the tailoring process in Part One of this Standard to determine where explosive atmospheres are 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 Procedure I - Explosive Atmosphere.

This procedure is applicable to all types of sealed and unsealed materiel. This test evaluates the ability of the test item to be operated in a fuel vapor environment without igniting the environment.

2.1.2 Procedure II - Explosion Containment.

This procedure is used to determine the ability of the test item's case or other enclosures to contain an explosion or flame that is a result of an internal materiel malfunction.

2.1.3 Effects of Explosive Atmosphere Environments.

Low levels of electrical energy discharge or electrical arcing by devices can ignite mixtures of fuel vapor and air. Fuel vapors in confined spaces can be ignited by a low energy discharge such as a spark from a short-circuited flashlight cell, switch contacts, electrostatic discharge, etc. High surface temperatures in excess of the auto-ignition temperature of flammable/explosive vapors may result in ignition of the vapors.

2.1.4 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. Considering the approach to conserve test item life by applying what are perceived to be the least damaging environments first, generally apply the explosive atmosphere test late in the test sequence. Vibration, shock, and temperature stresses may distort seals and reduce their effectiveness, thus making ignition of flammable atmospheres more likely. Recommend the test item(s) first undergo the above tests (on the same item(s)) to better approximate the actual operational environment.

2.2 Selecting Procedure Variations.

Before conducting this test, complete the tailoring process by selecting specific procedure variations (special test conditions/techniques for this procedure) based on requirements documents, Life Cycle Environmental Profile (LCEP), and information provided with these procedures. Consider the following:

2.2.1 Fuel.

Unless otherwise specified, use n-hexane as the test fuel, either reagent grade or 95 percent n-hexane with 5 percent other hexane isomers. This fuel is used because its ignition properties in flammable atmospheres are equal to or more sensitive than the similar properties of 100/130-octane aviation gasoline, JP-4 and JP-8 jet engine fuel. Optimum mixtures of n-hexane and air will ignite from temperatures as low as 223 °C, while optimum JP-4 fuel-air mixtures require a minimum temperature of 230 °C for auto-ignition, and 100/130 octane aviation gasoline and air requires 441 °C for hot-spot ignition (see paragraph 1.3d). Minimum spark energy inputs for ignition of optimum fuel vapor and air mixtures are essentially the same for n-hexane and for 100/130-octane aviation gasoline. The minimum ignition energy for n-Hexane in air at standard atmospheric pressure is 0.29mJ. A much higher spark energy input is required to ignite JP-4 or JP-8 fuel-air mixtures. Use of fuels other than n-hexane is not recommended.

WARNING: N-hexane is the flammable liquid used to test products in an explosive atmosphere. This solvent is listed as a hazardous material under Section 313 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (paragraph 6.1, reference a). It is classified by the Clean Air Act as a hazardous air pollutant and a hazardous air contaminant, is a Class 3 hazardous material, and has been identified by the Occupational Safety and Health Administration (OSHA) as requiring a maximum permissible exposure limit. The current OSHA permissible exposure limit (PEL) for n-hexane is 500 parts per million (PPM) (in air at 25 °C (77 °F), 760 Torr) for an 8-hour workday, time weighted average (TWA). OSHA directs an individual shall not exceed this average level per an 8-hour period (workday) based on a 40-hour workweek. N-hexane does not have a specified ceiling limit (as established by OSHA). OSHA has not established a specific PEL for the other fuels listed above. These fuels, AvGas 100/130 octane, JP-4, and JP-8 are blends of various simple and complex organic compounds. In many cases, the fuel formulas can include chemical compounds identified in 29 CFR 1910-1000, Table Z-1 (paragraph 6.1, reference b). If a specific producer/product is consistently employed, the formula for this fuel blend can be analyzed and a specific warning prepared for the individual product. However, it should not be necessary, as the recommended chemical for the test is n-hexane.

2.2.2 Fuel-Vapor Mixture.

Use a homogeneous fuel-air mixture in the correct fuel-air ratios for the explosive atmosphere test. Fuel weight calculated to total 3.8 percent by volume of the test atmosphere represents 1.8 stoichiometric equivalents of n-hexane in air, giving a mixture needing only minimum energy for ignition. This yields an air/vapor ratio (AVR) of 8.33 by weight (paragraph 6.1, reference c).

a. Required information to determine fuel weight:

    (1) Chamber air temperature during the test.

    (2) Fuel temperature.

    (3) Specific gravity of n-hexane (see Figure 511.7-1).

    (4) Test altitude: ambient ground or as otherwise identified.

    (5) Net volume of the test chamber: free volume less test item displacement.

b. Calculation of the volume of liquid n-hexane fuel for each test altitude:

    (1) In metric units:

    Volume of 95 percent n-hexane (ml) =

$$\left(4.27\ x\ 10^{-4}\right)\left[\frac{\left(net\ chamber\ vol\left(liters\right)\right)\ x\ \left(chamber\ pressure\left(pascals\right)\right)}{\left(chamber\ temp\left(K\right)\right)\ x\ \left(specificgravity\ of\ n-hexane\right)}\right]$$

    (2) In English units:

    Volume of 95 percent n-hexane (ml) =

$$\left(150.41\right)\left[\frac{\left(net\ chamber\ vol\left(ft^{3}\right)\right)\ x\ \left(chamber\ pressure\left(psia\right)\right)}{\left(chamber\ temp\left(R\right)\right)\ x\ \left(specificgravity\ of\ n-hexane\right)}\right]$$

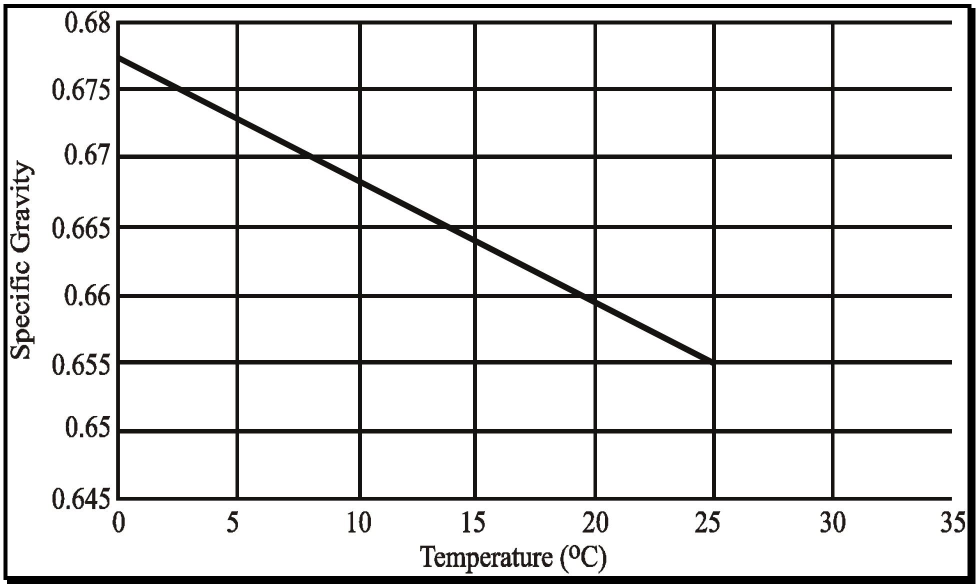

Figure 511.7-1. Specific gravity of n-hexane.

2.2.3 Temperature.

Heat the fuel-air mixture to the highest ambient air temperature at which the materiel is required to operate during deployment and provide the greatest probability of ignition. Perform all testing at this maximum air temperature. For forced-air-cooled materiel, use a test temperature that is the highest temperature at which the materiel can be operated and performance evaluated in the absence of cooling air. Chamber air temperature is typically controlled by indirect heating such as heated chamber walls.

2.2.4 Effect of Humidity on Flammable Atmosphere.

The effect of humidity upon the fuel-air composition need not be considered in the test if the ambient air dewpoint temperature is 10 °C (50 °F) or less because this concentration of water vapor only increases the n-hexane fuel concentration from 3.82 percent to 3.85 percent of the test atmosphere. For example, if the atmospheric pressure is cycled from an equivalent of 1524 m (5000 ft) above the test level to 1524 m (5000 ft) below, (a 34 percent change in pressure), the volume of n-hexane will decrease from 4.61 percent to 3.08 percent. This decrease will compensate for the fuel enrichment effect that results from water vapor dilution of the test air supply. Tailoring may be required to simulate specific geographic areas.

2.2.5 Altitude Simulation.

This test evaluates whether a test item can operate safely in a fuel/air mixture without creating a spark that could ignite the atmosphere. Since the components used in certain test items may make them more susceptible to creating sparks at high altitudes, all items must be tested up to their maximum operating altitude. The energy required to ignite a fuel-air mixture increases as pressure decreases. Ignition energy does not drop significantly for test altitudes below sea level. Therefore, unless otherwise specified, perform all tests with at least two explosive atmosphere steps, one at the highest anticipated operating altitude of the materiel (not to exceed 12,200 m (40,000 ft) where the possibility of an explosion begins to dissipate), and one between 7,000 ft and -1,500 ft (11.3 and 15.5 psi) that is representative of most ground ambient pressures. As noted in paragraph 1.3, because of the lack of oxygen at approximately 16 km (9.94 miles), do not perform this test at or above this altitude.

2.3 Definitions.

For the purpose of this Method, the following definitions apply:

a. Simulated altitude. Any height that is produced in the test chamber by reducing air pressure.

b. Test altitude. The nominal simulated height(s) (generally, above sea level) at which the test item will be tested, i.e., the maximum altitude identified in paragraph 2.2.5.

3. INFORMATION REQUIRED

3.1 Pretest.

The following information is required to conduct explosive atmosphere 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) Additional test altitudes (other than the maximum operating altitude and site pressure).

  (2) The fuel volume and/or weight.

  (3) Calculation for the quantity of fuel required at each test altitude.

  (4) The off/on cycling rate for the test item.

  (5) Any information relative to the location of spark-emitting devices or high temperature components.

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.

  (1) Periods of operation versus test altitude (on/off points).

  (2) Quantity of fuel introduced for each test altitude.

  (3) Occurrence of any explosion caused by the test item and the respective altitude and temperature at which the event occurred.

3.3 Post-Test.

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

a. General. See Part One, paragraph 5.13; and Annex A, Task 406.

b. Specific to this Method.

  (1) Chamber test altitude and temperature for each operational check.

  (2) Occurrence of any explosion caused by the test item.

  (3) Initial analysis of any failures/problems.

  (4) Any deviation from the original test plan.

  (5) Test item temperature for each operational check.

4. TEST PROCESS.

4.1 Test Facility.

The required apparatus consists of a chamber or cabinet, together with auxiliary instrumentation, capable of establishing, maintaining and monitoring (see Part One, paragraph 5.18) the specified test conditions. Use a chamber with a means of determining the explosiveness of a sample of the mixture, such as a spark gap or glow plug ignition source with sufficient energy to ignite a 3.82 percent hexane mixture. An alternative method of determining the explosive characteristics of the vapor is by using a calibrated explosive gas meter that verifies the degree of explosiveness and the concentration of the fuel-air mixture. Chamber air temperature is typically controlled by indirect heating such as heated chamber walls. Due to varying geographic facility locations and differences in site pressure, it is highly recommended that the chamber has the capability to reach 1000 ft (14.17 psia) or below for the low altitude portion of the test. The minimum ignition energy varies inversely with the square of the pressure. Due to the change in ignition energy between sea level (14.7 psia) and 7,000 ft (11.3 psia) it is possible for the equipment under test to pass at 11.3 psia, whereas it may have failed if tested at pressures nearer 14.7 psia. The minimum ignition energy at 1000 ft (14.17 psia) is within 5 percent of the optimum at sea level.

4.2 Controls.

Before each test, verify the critical parameters. Ensure spark devices function properly and the fuel atomizing system is free from deposits that could inhibit proper functioning. Adjust the empty test chamber to the highest test altitude, shut off the vacuum system and measure the rate of any air leakage. Verify that any leakage is not sufficient to prevent the test from being performed as required, i.e., introduce the test fuel and wait three minutes for full vaporization, yet still be at least 1000 m above the test altitude.

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 Test Interruption Due To Chamber Malfunction.

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

b. Specific to this Method. If there is an unscheduled undertest interruption, restore the chamber air pressure to ground ambient pressure and purge the chamber to remove the flammable atmosphere. Achieve the required test altitude, inject the required volume of n-hexane and reinitiate the test using the same test item.

4.3.2 Test 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 Setup.

a. General. See Part One, paragraph 5.8.

b. Unique to this Method. For test item thermal stabilization measurements for both procedures, install thermocouples on the most massive functional part of the test item, and two thermocouples attached to the inside the of test chamber to detect any temperature increase due to burning of the mixture.

4.5 Test Execution.

The following steps, alone or in combination, provide the basis for collecting necessary information concerning the materiel in an explosive atmosphere.

4.5.1 Preparation for Test.

Before starting the test, review pretest information in the test plan to determine test details (e.g., procedures, test item configuration, test temperature, test altitude, etc.).

a. Procedure I - Operation in an Explosive Atmosphere.

    (1) Install the test item in the test chamber in such a manner that it may be operated and controlled from the exterior of the chamber via sealed cable ports. Unless permanently sealed (not to be opened for maintenance or other purposes), remove or loosen the external covers of the test item to facilitate the penetration of the explosive mixture. Test items requiring connection between two or more units may,

because of size limitations, have to be tested independently. In this case, extend any interconnections through the cable ports.

(2) Operate the test item to verify correct remote operation. If possible, identify the location of any sparking components that could cause an explosion. If required, conduct a thermal survey to determine the temperature of components or areas/surfaces that may be potential hot spots. If the test item operates satisfactorily, proceed to paragraph 4.5.2 or 4.5.3 as appropriate. If not, resolve the problems and repeat this Step.

(3) When necessary, simulate in-service mechanical loads on drive assemblies and servo-mechanical systems, and electrical loads on switches and relays; duplicate torque, voltage, current, inductive reactance, etc. In all instances, operate the test item in a manner representative of service use.

b. Procedure II - Explosion Containment.

(1) Make provision to circulate the fuel-air mixture into the case being tested. In the case of forced-air-cooled materiel, the cooling air must contain the proper fuel-air mixture. For materiel not using forced-air cooling, drill and tap the case for insertion of a hose from a blower (to insert the fuel-air mixture), as well as for an outlet hose connection. Take adequate precautions to prevent ignition of the ambient mixture by backfire or release of pressure through the supply or vent hose. Do not alter the case internal volume by more than ± 5 percent with any modification to facilitate the introduction of ignitable vapor.

(2) Provide a positive means of igniting the explosive mixture within the case. Drill or tap the case as necessary for a spark gap, or mount a spark gap internally. Ensure points of ignition are not be more that 1.27 cm (0.5 inch) from any vent holes or flame arresting devices; and, unless the design of the materiel makes this impractical, use as many points of ignition as are practical.

(3) To detect explosions within the case, insert a thermocouple into the case, and attach it to a sensitive galvanometer outside the test chamber.

(4) Ensure the air within the test chamber has a water vapor dew point lower than 10 °C (50 °F) per paragraph 2.2.4.

4.5.2 Procedure I - Operation in an Explosive Atmosphere.

Step 1 Figure 511.7-2 contains a visual representation of typical test conduct. Test altitudes should be tailored to the individual item requirements. With the test item installed, seal the chamber and stabilize the test item and chamber air temperature to the high operating temperature of the test item (±2 °C (±3.6 °F)) for a minimum duration of one hour. Monitor the chamber wall temperature and chamber air temperature throughout the duration of test to ensure uniform heating. Excessive chamber wall temperature could adversely affect the test item.

Step 2 Adjust the chamber air pressure to simulate the highest operating altitude of the test item (not to exceed 12,200 m (40,000 ft)) plus 2000 m (6600 ft) to allow for introducing, vaporizing, and mixing the fuel with the air as described in paragraph 2.2.2.

Step 3 Slowly introduce the required volume of n-hexane into the test chamber and begin reducing the simulated altitude at a rate no faster than 100 m (330 ft) per minute.

Step 4 Circulate the test atmosphere and continue to reduce the simulated chamber altitude for at least three minutes to allow for complete vaporization of fuel and the development of a homogeneous mixture, and for the chamber pressure to reach the test altitude.

Step 5 At a pressure equivalent to 1000 m (3300 ft) above the test altitude, verify the potential explosiveness of the fuel-air vapor by attempting to ignite a sample of the mixture taken from the test chamber using a spark-gap device or glow plug ignition source with sufficient energy to ignite a 3.82 percent hexane mixture. If ignition does not occur, purge the chamber of the fuel vapor and repeat Steps 1-4. An alternative method of determining the explosive characteristics of the vapor is by using a calibrated explosive gas meter that verifies the degree of explosiveness and the concentration of the fuel-air mixture.

Step 6 Although above the maximum operational altitude of the test item, attempt to operate the test item, making and breaking electrical contacts, such as switches, mechanical relays, and connectors as often as possible for minimum of three power/operational cycles. Continue operation from this step until completion of Step 8. Note the altitude at which the test item begins proper operation. If the test item fails to operate as intended, follow the guidance in paragraph 4.3.2 for test item failure.

Step 7 To ensure adequate mixing of the fuel and air, slowly decrease the simulated chamber altitude at a rate no faster than 100 m (330 ft) per minute by bleeding air into the chamber.

Step 8 Stop decreasing the altitude at 1000 m (3300 ft) below the test altitude or at ground level, whichever is reached first, and perform an operational check, and switch off power to the test item. If the test item fails to operate as intended, follow the guidance in paragraph 4.3.2 for test item failure.

Step 9 Verify the potential explosiveness of the air-vapor mixture as in Step 5 above. If ignition does not occur, purge the chamber of the fuel vapor, and repeat the test from Step 1.

Step 10 Adjust the simulated chamber altitude to the equivalent of 2000 m (6600 ft) above site pressure.

Step 11 Slowly introduce the required volume of n-hexane into the test chamber and begin reducing the simulated altitude at a rate no faster than 100 m (330 ft) per minute. (Note: In calculating the fuel volume to be added, providing the chamber has not been purged, subtract the volume introduced in Step 3 to maintain the proper fuel-air mixture.).

Step 12 Circulate the test atmosphere for at least three minutes to allow for complete vaporization of fuel and the development of a homogeneous mixture, and for the chamber pressure to reach the test altitude.

Step 13 At a pressure equivalent to 1000 m (3300 ft) above the site pressure, verify the potential explosiveness of the fuel-air vapor by attempting to ignite a sample of the mixture taken from the test chamber using a spark-gap device or glow plug ignition source with sufficient energy to ignite a 3.82 percent hexane mixture. If ignition does not occur, purge the chamber of the fuel vapor and repeat Steps 10-13. An alternative method of determining the explosive characteristics of the vapor is by using a calibrated explosive gas meter that verifies the degree of explosiveness and the concentration of the fuel-air mixture.

Step 14 Attempt to operate the test item and continue operation from this step until completion of Step 16. Make and break electrical contacts, such as switches, mechanical relays, and connectors as often as possible for minimum of three power/operational cycles. Note whether the test item resumes proper operation. If the test item fails to operate as intended, follow the guidance in paragraph 4.3.2 for test item failure.

Step 15 To ensure adequate mixing of the fuel and air, slowly decrease the simulated chamber altitude at a rate no faster than 100 m (330 ft) per minute by bleeding air into the chamber.

Step 16 At site pressure, perform one last operational check and switch-off power to the test item. If required, ensure the test item temperature has stabilized (in accordance with Part One paragraph 5.4.1) prior to conducting the final operational check.

Step 17 Verify the potential explosiveness of the air-vapor mixture as in Step 5, above. If ignition does not occur, purge the chamber of the fuel vapor, and repeat the test from Step 10.

Step 18 Adjust the chamber to standard ambient conditions and document the test results. See paragraph 5 of this Method for analysis of results.

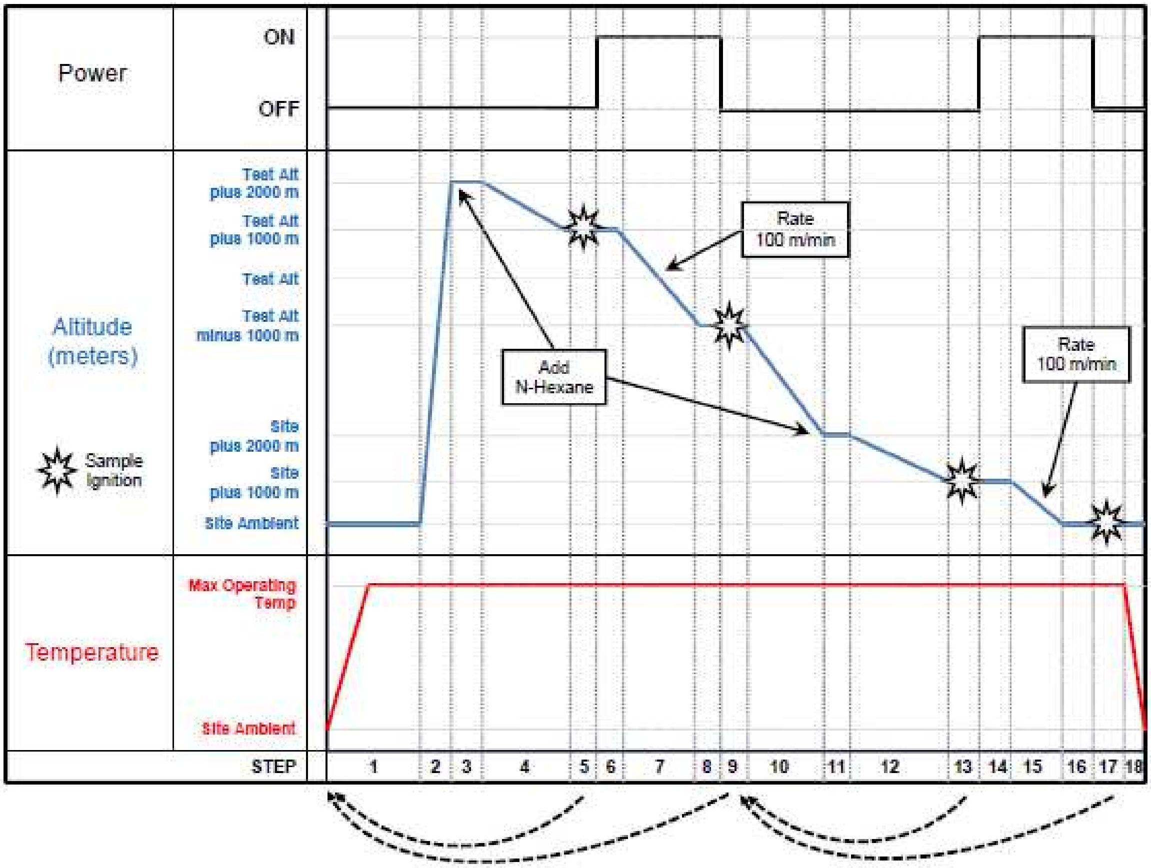

Figure 511.7-2. Typical representation of Procedure I conduct.

4.5.3 Procedure II - Explosion Containment.

Step 1 Place the test item or a model of the test item of the same volume and configuration within the case, and install the case in the explosion chamber.

Step 2 Ensure the air within the test chamber has a water vapor dew point lower than 10 °C (50 °F) per paragraph 2.2.4.

Step 3 Seal the chamber with the test item inside, and raise the chamber air temperature to the high operating temperature of the test item.

Step 4 When the temperature of the both the test item and the test chamber inner walls come to within 11 °C (20 °F) of the chamber air temperature, reduce the chamber air pressure to 2000 m (6600 ft) of simulated altitude above the site ambient pressure (i.e., ground level).

Step 5 Slowly introduce the required quantity of n-hexane into the test chamber to obtain an optimum fuel-vapor/air mixture, and then introduce it into the interior of the test item.

Step 6 Slowly decrease the simulated chamber altitude (no faster than 100 m (330 ft) per minute) to return the pressure altitude to site pressure (i.e., ground level).

Step 7 Energize the internal case ignition source and confirm the occurrence of an explosion within the test item using the installed thermocouple. If no explosion occurs, purge the chamber and the test item of all air/fuel vapor and return to Step 3.

Step 8 If an explosion does occur inside the test item's case and did not propagate to the fuel/air mixture outside the test item, repeat Steps 4-10 four times if the test item's case is not in excess of 0.02 times the chamber volume. If the test item volume is equal to or greater than 0.02 times the chamber volume, purge the chamber and test item of air/fuel vapor and repeat Steps 3-10 four times.

Step 9 Check the potential explosiveness of the air/fuel vapor mixture by attempting to ignite a sample of the mixture by a spark or glow plug. If the chamber sample does not ignite, purge the chamber of all air/fuel vapor mixture, and repeat the entire test from Step 3.

Step 10 Document the test results. See paragraph 5 of this Method for analysis of results.

5. ANALYSIS OF RESULTS.

In addition to the guidance provided in Part One, paragraphs 5.14 and 5.17, ignition of test fuel vapor constitutes test item failure. For Procedure II, propagation of flame to, or ignition of, a flammable atmosphere surrounding the test item when the test atmosphere within the enclosure or case of the test item is intentionally ignited constitutes failure of the test. Apply any data relative to failure of a test item to meet the requirements of the materiel specifications to the test analysis.

6. REFERENCE/RELATED DOCUMENTS.

6.1 Referenced Documents.

a. Section 313 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); Air Force Institute of Technology/Air Force Research Laboratory Library.

b. Code of Federal Regulations 29 CFR 1910-1000, Air Contaminants, Table Z-1; Occupational Safety & Health Administration Website.

c. Combustion Fundamentals, Roger A. Strehlow, McGraw Hill Book Co.

6.2 Related Documents.

a. 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.

b. Haskin, W.L., Explosion-Proof Testing Techniques. 1963. ASD-TDR-62-1081. DTIC number AD-400-483.

c. Zabetakis, M.G., A.L. Furno, and G.W. Jones. "Minimum Spontaneous Ignition Temperatures of Combustibles in Air", Industrial and Engineering Chemistry 46 (1954), 2173-2178.

d. Washburn, E.W., ed. International Critical Tables of Numerical Data. Chemistry and Technology. Vol. III. New York: National Research Council/McGraw-Hill, 1928. pp 27-29.

e. Kuchta, J.M. Summary of Ignition Properties of Jet Fuels and Other. 1975. AFAPL-TR-75-70, pp 9-14. DTIC number AD-A021-320.

f. ASTM E 380-79. Standard for Metric Practice.

g. Allied Environmental Conditions and Test Publication (AECTP) 300, Climatic Environmental Tests (under STANAG 4370), Method 316.

(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/.