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Materiel Test Procedure 8-4-011
U. S. Army Arctic Test Center

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U. S. ARMY TEST AND EVALUATION COMMAND
ENVIRONMENTAL TEST PROCEDURE

ARCTIC ENVIRONMENTAL TEST OF SMOKE MUNITIONS AND GENERATING EQUIPMENT

1. OBJECTIVE

The objective of the procedures outlined in this MTP is to provide a means of evaluating the performance, safety, human factors engineering and maintenance characteristics of smoke munitions and generating equipment under arctic winter conditions.

2. BACKGROUND

Smoke munitions and generating systems have long been used to disseminate smoke intended to mask or obscure installations or maneuvers.

Smoke munitions consist of the fuze initiated burning type (smoke grenades, smoke cartridges, smoke pots) or the nonburning type which function upon container rupture with resulting filler contact with air. Smoke generation equipment may consist of fog oil pulse jet smoke generators, aircraft gravity discharge tanks using electrically detonated frangible seals, integral systems for injection of fog oil smoke agent into hot engine exhaust, or rotary dissemination devices (such as the Ram Air Turbine Disc type).

This MTP is intended to provide an outline of the accepted test procedures that might be used in the conduct of arctic environmental tests of smoke munitions and smoke generating equipment. Testing in the arctic winter environment is generally not authorized until data from simulated environmental tests provides reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the arctic.

3. REQUIRED EQUIPMENT

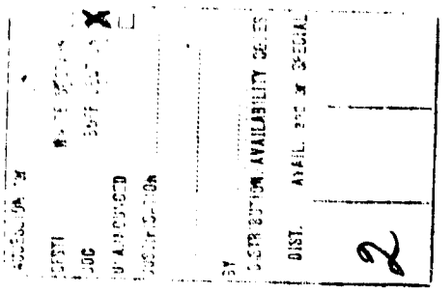
a. Appropriate arctic winter uniforms.
b. General and special tools and ancillary items required for repairs on the test item.
c. Meteorological support facility.
d. Photographic equipment.
e. Vehicles (air and ground).
f. Pressurizing equipment (i.e., gages, chambers and containers).
g. Smoke munitions.
h. Smoke generating equipment.
i. Control munitions and generating equipment (when specified).
j. Fire fighting and related safety equipment.
k. Aircraft (observation).
l. Suitable test area.
m. Timing devices.
n. Binoculars.

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4. REFERENCES

A. AR 70-8, Human Factors and Social Sciences Research.
B. AR 70-10, Test and Evaluation During Research and Development of Materiel.
C. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
D. AR 705-5, Army Research and Development.
E. AR 750-6, Maintenance Support Planning.
F. AR 705-35, Criteria for Air Portability and Airdrop of Materiel.
G. USATECOM Regulation 350-6, Training in New or Modified Equipment and Training Devices.
H. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
I. USATECOM Regulation 70-24, Documenting, Test Plans and Reports.
J. FM 3-8, Chemical Reference Handbook.
K. FM 3-50, Chemical Smoke Generator Units and Smoke Operations.
L. FM 21-40, Chemical, Biological, and Nuclear Defense.
M. FM 23-30, Grenades and Pyrotechnics.
N. MIL-STD-810B, Environmental Test Methods.
O. MIL-STD-331, Fuze and Fuze Components, Environmental and Performance Tests for.
P. MTP 8-2-503, Rough Handling and Surface Transport.
Q. MTP 10-4-500, Arctic Environmental Test, Preoperational Inspection, Physical Characteristics, Human Factors, Safety, and Maintenance.

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP provide general guidance for the conduct of arctic environmental testing of smoke munitions and generating equipment under arctic winter environmental conditions. Specific procedures and testing requirements shall be determined by the discrete characteristics and performance criteria of the particular test item.

The specific tests to be performed and their intended objectives are listed below:

a. Preoperational Inspection and Physical Characteristics - The objectives of this subtest are to determine:

1) If the test items are in proper condition for testing.
2) If the test items physical characteristics conform to applicable criteria.

b. Human Factors Evaluation and Safety - The objective of this subtest is to determine the human factors and safety aspects of the test items under arctic winter environmental conditions.

c. Rough Handling and Surface Transport - The objective of this subtest is to determine the effect of handling and transport under arctic winter

environmental conditions.

d. Pressure Subtest - The objective of this subtest is to determine if the test item and its accessories such as valves, hoses and couplings maintain required pressure and do not leak.

e. Operational Reliability - The objective of this subtest is to estimate the reliability of the test items based upon the data collected during tests under arctic winter environmental conditions.

f. Maintenance Evaluation - The objective of this subtest is to determine if the test items meet maintenance and reliability requirements as defined by QMR's, SDR's, TC's, Test Directives or other established criteria.

5.2 LIMITATIONS

The procedures described in this MTP are limited to general testing only of smoke munitions and generating equipment. Individual commodity MTP's should be referenced for additional data that will aid in conducting tests.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Since arctic winter environmental tests are normally scheduled from October through March (6 months), ensure that the test items, comparison (control) items and support weapons and equipment are delivered to the Arctic Test Center prior to 1 October.

b. For all suitability type tests, write the test plan and obtain approval from higher headquarters.

c. When notified of the arrival of the test item(s), select and schedule for the use of testing sites, facilities and equipment.

d. When necessary to augment assigned personnel, arrange for TDY personnel who are representative of the soldiers who will operate and maintain the test item(s) under field conditions. TDY personnel shall be trained to the degree that they are as proficient on individual test and comparison items as the troops who will use these items.

e. Ensure that all test personnel are familiar with required technical and operational characteristics of the test item under test, such as stipulated in Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), and Technical Characteristics (TC's). Record all such criteria in the test plan.

f. Ensure that all personnel receive New Equipment Training (NET) as referenced in paragraph 4g.

g. Review all instructional material issued with the test item(s) by manufacturer, contractor, or government agencies, as well as reports of previous tests conducted on the same type of equipment, and familiarize all test personnel with such documents.

h. Select test equipment ideally having an accuracy 10 times greater than that of the specified tolerance of the function(s) to be measured.

i. Prepare record forms for systematic entry of data, chronology of tests, and analysis in final evaluation.

j. Prepare adequate safety precautions to provide safety for personnel and equipment. Ensure that a safety release has been obtained prior to

test conduct.

k. Outfit all personnel in appropriate arctic uniform as described in MTP 10-4-500.

l. Insure that when not in use, or when indoor maintenance is not required, all test items are stored and maintained in an unsheltered area exposed to ambient air temperature and prevailing weather conditions, except these items will be covered by a tarpaulin while in storage.

m. Record:

1) Grades, MOS, background, training of all test personnel.
2) Nomenclature, serial number(s), and manufacturer's name on all test items.
3) Nomenclature, serial number(s), accuracy tolerances, calibration requirements, and last date calibrated of the test measuring equipment selected for the test.
4) Date test item(s) was packed.

6.2 TEST CONDUCT

NOTE: Subtests shall be conducted concurrently with other subtests whenever possible to minimize test time, duplication of data and more efficiently utilize personnel and resources available.

6.2.1 Preoperational Inspection and Physical Characteristics

a. Upon receipt, carefully inspect all test and comparison items and their shipping or packaging containers for completeness, damage and general condition in accordance with the applicable sections of MTP 10-4-500.

b. Adjust and align the equipments and record any problems incurred during these adjustments.

6.2.2 Human Factors Evaluation and Safety

a. Conduct all Human Factors and Safety Tests in accordance with applicable sections of MTP 10-4-500.

b. Throughout the conduct of testing, note and record any unsafe features of the test item, as well as any unduly restrictive safety limitations or safety precautions difficult to comply with.

6.2.3 Rough Handling and Surface Transport

NOTE: This subtest is performed only when specifically required by the test directive.

a. Inspect the test item for loose, damaged or missing parts, and place in the best possible conditions using only those parts and tools supplied with the equipment, or otherwise authorized to be used.

b. Load the test items packaged in their original containers on a suitable vehicle observing the general loading and transporting requirements of MTP 8-2-503.

NOTE: This subtest shall be conducted in ambient temperatures ranging from 0°F to the lowest temperature specified in criteria from higher headquarters.

c. Transport the test item over cross country and secondary roads. A minimum of one-half of the test items shall be subjected to at least 50 kilometers of cross-country, and to 100 kilometers of secondary road transportation.

d. Inspect the test item and container for damage after each phase of transportation.

e. When vehicular mounting is required during the above test, note the time required to install and remove test item(s) from vehicle.

f. If appropriate, one-half of the test items shall be unpackaged and transported over the same course and in a similar manner as described in Steps b, c, and d above.

g. Record the following data:

1) Test item identification number
2) Presence of cracks or breaks in test item container
3) Undone bindings, if applicable
4) Damage and deformation to the test item's exterior
5) Temperature (°F) every 30 minutes
6) Type and amount of precipitation
7) Time to load and secure test item in vehicle (if required)
8) Time to unload test item from vehicle (if required)

6.2.4 Pressure Subtest

a. Select a representative number of test items (number to be determined from test criteria) that both have, and have not been subjected to rough handling (paragraph 6.2.3).

b. Prepare the test site, ensuring that the site contains a safety enclosure large enough to contain the test items, and components of the test items, and that a safety wall or enclosure has been provided to protect test personnel.

NOTE: The test site and equipment shall meet all safety requirements listed above and required by appropriate SOP's.

c. Conduct the pressure test as follows:

1) Attach a pressure gage to the test item at appropriate point.
2) Pressurize the test item to required or specified pressure.
3) After the specified pressure has been reached and stabilized for 1 minute, shutoff pressure source and monitor pressure until it stabilizes for 30 minutes.
4) Attempt to determine leak(s) using solution of soapy water or other appropriate device.
5) Determine if the test item and accessory valves, hoses and couplings leak and lose pressure. When repair is performed to prevent leakage, retest the test item and note effectiveness of the repair(s).

d. Record the following data:

1) Test item identification
2) Prior history of test item
3) Leakage data
4) Temperature (°F)
5) Type and amount of precipitation (if appropriate)
6) Malfunctions
7) Required pressure
8) Stabilized pressure

6.2.5 Operational Reliability

6.2.5.1 Smoke Munitions

NOTE: At least one-half of the test items selected to undergo operation reliability testing shall have previously been subjected to the rough handling and surface transport tests.

a. Prepare the test site, ensuring that all safety requirements have been met.

NOTE: The test site should provide sufficient area to ensure that the cloud (from the functioning of the test item) is confined on the test site.

b. Emplace markers and stakes around and throughout the test area to aid observers in estimation of cloud size.

c. Emplace motion picture cameras at key positions so as to best photograph cloud formation, drift and dispersion, for a representative number of test items.

d. Station observers, equipped with binoculars, at a minimum distance of 4 miles from the functioning point of the test item. Multiple observation points, located to provide various background or light conditions, may be used. The observation sites shall be selected in accordance with the particular military characteristics of the item under test.

e. Instruct observers in an appropriate aircraft to fly over the functioning point at an appropriate altitude (determined from the test criteria). The aircraft should fly in increasing slant range from the point until observers can no longer distinguish the color of the cloud.

NOTE: An attempt shall be made to conduct 65 percent of this subtest in temperatures between 0°F and -25°F, 25 percent of this subtest in temperatures between -25°F and -40°F, and 10 percent in temperatures below -40°F.

f. Make a final range area check to ensure all safety precautions are observed.

NOTE: This subtest shall not be conducted if the windspeed is

greater than 10 miles per hour, during precipitation, or in visibility of less than 10 miles.

g. Activate the test item in accordance with instructions of appropriate equipment manuals.

NOTE: The activation of the test item shall be coordinated with observers and shall be time referenced for correlation of data.

h. Coincident with Step g, above, measure the following functioning parameters: fuze delay time (interval between release of the handle and first smoke emission), and burning time measured against the criteria of "smoke under pressure" (recognized by emission of colored smoke and does not apply to the first puff of smoke or flash emitted from the ignition mixture). Functioning times described above shall be measured by observers using stopwatches.

i. Coincident with Step g, above, the observers on the ground and in the aircraft shall indicate cloud color, estimate cloud size and duration of visible cloud, and give appropriate comments as to effect of background color, position of sun or visibility condition for a representative number of clouds.

j. Record the following data:

1) Test item identification number.
2) Temperature °F.
3) Relative humidity.
4) Windspeed.
5) Camera speed (frames per second).
6) Damage to test item incurred during functioning.
7) Malfunction of test item if appropriate.
8) Any occurrences which deviate from normal functioning (e.g., exploding munition).
9) Unusual smoke characteristics.
10) Aircraft type used, if appropriate.
11) Aircraft altitude, if appropriate.
12) Cloud length.
13) Cloud height.
14) Cloud density.
15) Fuze delay time.
16) Ignition lag time.
17) Burning time.
18) Weather conditions pertinent to flying (cloud formation and altitude, ceiling, presence of haze, smoke, fog, etc.).

6.2.5.2 Smoke Generating Equipment

a. Prepare the test site in accordance with procedures delineated in paragraph 6.2.5.1.

b. Emplace motion picture cameras, and locate observers as in paragraph 6.2.5.1 to photograph and observe cloud formation and cloud drift for a representative number of test items.

NOTE: 1. An attempt will be made to conduct 65 percent of this subtest in temperatures between 0°F and -25°F, 25 percent of this subtest in temperatures between -25°F and -40°F and 10 percent of this subtest at temperatures below -40°F.
2. This subtest will not be conducted if ground windspeed at the test site is greater than 10 miles per hour, during periods of precipitation, or when visibility is less than 10 miles.

c. Make a final range area check to ensure all safety precautions are observed.

d. Activate the test item in accordance with instructions of appropriate equipment manuals.

NOTE: The test item may be vehicle or aircraft mounted, if appropriate, during functioning to simulate actual use. If a vehicle mounting is required, the test item shall be installed in accordance with the technical manual and functioned while the vehicle is traveling cross-country or on secondary roads, if appropriate, at a speed determined by the characteristics of the generating equipment. If an aircraft mounting is required, the test item will be installed in the aircraft in accordance with applicable instructions and activated when the aircraft passes over the test site at the appropriate (determined from Test Criteria) height and speed. Under certain conditions a smoke system may require more than one "pass" or "functioning" to complete its mission.

e. Coincident with Step d, above, the cameras shall be activiated and the observers shall measure the following functioning parameters; the smoke fuel (fog, oil, etc.) and consumption rate (defined as amount of smoke fuel used per hour of operation). Other parameters will be determined and measured, if appropriate.

NOTE: Functioning parameters described above will be measured by observers using stopwatches.

f. Record the following data:

1) Test item identification number.
2) Temperature.
3) Relative humidity.
4) Windspeed.
5) Wind direction.
6) Any damage to test items incurred during functioning.
7) Any malfunction of test item, if appropriate.
8) Unusual smoke characteristics.
9) Aircraft type used, if appropriate.
10) Aircraft speed at release point, if appropriate.
11) Vehicle type used, if appropriate.
12) Vehicle speed during functioning.

13) Cloud length.
14) Cloud height.
15) Cloud density.
16) Smoke fuel consumption rate.
17) Weather conditions pertinent to flying (cloud formation and altitude, ceiling, pressence of haze, smoke, fog, etc.).

6.2.6 Maintenance Evaluation

a. Conduct all maintenance evaluation tests (maintenance and reliability) in accordance with applicable sections of MTP 10-4-500.

b. Conduct these subtests concurrently with operational subtests in this MTP.

6.3 TEST DATA

All test data to be recorded shall be as specified in the individual subtests of this MTP.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data shall, in general, consist of organizing, marking for identification and correlation, and grouping the test data according to test title.

Specific instructions for the reduction and presentation of individual test data are outlined in succeeding paragraphs.

6.4.1 Preoperational Inspection and Physical Characteristics

Preoperational inspection and physical characteristics data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.2 Human Factors Evaluation and Safety

Human Factors and Safety data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.3 Rough Handling and Surface Transport

Evaluate the suitability of the test item for transport and response to rough handling under Arctic winter environmental conditions in accordance with applicable sections of MTP 8-2-503.

6.4.4 Pressure Test

Evaluate the capability of the test item and accessories such as valves, hoses, and couplings to maintain required pressure during operation under Arctic winter environmental conditions, in accordance with their stated specifications in QMR's, SDR's or TC's.

6.4.5 Operational Reliability

Prepare a comprehensive report delineating the operational characteristics of the test item and estimating the reliability of each test item, based on results of testing and the operational requirements as stated in appropriate QMR's, SDP's or TC's.

6.4.6 Maintenance Evaluation

Maintenance data shall be reduced and presented in accordance with MTP 10-4-500.

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13. ABSTRACT

This Environmental Test Procedure describes test methods and procedures for evaluating the performance and characteristics of Smoke Munitions and Smoke Generating Equipments under Arctic winter environmental conditions. The evaluation is related to criteria established in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

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