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Materiel Test Procedure 10-4-010
U. S. Army Arctic Test Center

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

ARCTIC ENVIRONMENTAL TESTS OF GENERATORS AND
GENERATING EQUIPMENT

1. OBJECTIVE

The objective of the procedures outlined in this MPP is to determine the suitability of generators of other generating equipment for operation under arctic winter environmental conditions.

2. BACKGROUND

Engineering tests of equipment are conducted to determine the characteristics and performance of the equipment under various conditions of operation, and to ensure their compliance with specified requirements.

Testing in a natural arctic winter environment is used to substantiate or supplement data obtained from simulated tests conducted during the Engineering Design and Engineering Test phase. Testing in the arctic winter environment generally is 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. Electrical load banks.
- c. Test equipment as required.
- d. Tools as required (to make physical measurements).
- e. Suitable timing device.
- f. Meteorological instrumentation.
- g. Photographic equipment (black and white or color).
- h. Fuel and Lubricant.
- i. Winterization Kit.
- j. All general and special tools and ancillary items required to perform maintenance on the test item.

4. REFERENCES

- A. AR 70-8, Human Factors and Social Sciences Research.
- B. AR 70-10, Army Materiel Testing.
- C. AR 705-5, Army Research and Development.
- D. AR 750-6, Maintenance Support Planning.
- E. AR 705-15, Operation of Materiel Under Extreme Conditions of Environment.
- F. AR 705-25, Reliability Program for Materiel and Equipment.
- G. USATECOM Regulation 350-6, Training in New or Modified Equipment and Training Devices.

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- H. USATECOM Regulation 705-2, Documenting Test Plans and Reports.
- I. USATECOM Regulation 750-15, Maintenance Portion Of The Service Test.
- J. MTP 9-2-095, Electrical Power Equipment.
- K. MTP 10-2-500, Physical Characteristics.
- L. MTP 10-4-500, Arctic Preoperational Inspection, Physical Characteristics, Human Factors, Safety and Maintenance Evaluation.

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP are designed to provide guidance for the testing of generators or other generating equipment for field use under arctic winter environmental conditions.

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

a. Preoperational Inspection and Physical Characteristics - The objective of this subtest is:

- 1) To determine:
 - a) If the test generator is in proper condition for testing.
 - b) If the test generator physical characteristics conform to applicable criteria.
- 2) To install winterization kit.
- 3) To prepare the equipment for testing if not operating properly on receipt.

b. Cold Starting - The objective of this subtest is to determine the starting characteristics of the test generator under arctic winter environmental conditions.

c. Functional and Operational Suitability - The objective of this subtest is to determine if the test generator can adequately perform the functions for which it was designed under arctic winter environmental conditions.

d. Fuel and Oil Consumption and Analysis - The objective of this subtest is to determine:

- 1) The fuel and oil consumption rates of the test generator.
- 2) The extent of crankcase oil dilution by water and fuel during the operation of the test generator.

e. Human Factors Engineering - The objective of this subtest is to determine if the test generator is easy and safe to operate by test personnel wearing appropriate arctic winter uniform.

f. Maintenance Evaluation - The objective of this subtest is to

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determine if the test generator meets the maintenance and maintainability requirements as defined in QMR's, SDR's, TC's, MC's or other established criteria under arctic winter environmental conditions.

5.2 LIMITATIONS

The procedures described in this MTP are limited to the testing of generators for field use under arctic winter environmental conditions.

6. PROCEDURES

6.1 PREPARATION FOR TEST

- a. Prepare adequate safety precautions to provide safety for personnel and equipment, and to ensure that all safety SOP's are observed throughout the test.
- b. Arctic winter environmental tests are normally scheduled from October through March (6 months). Test, test comparison and support equipment should be delivered to the Arctic Test Center prior to 1 October.
- c. Select operator personnel with the same MOS as those expected to operate the equipment in a TOE unit.
- d. Select maintenance personnel with the same MOS as those expected to maintain the equipment in a TOE unit.
- e. TDY personnel shall be used to augment assigned personnel and shall be trained to the degree that they are as proficient on the equipment as the personnel who are assigned to the equipment.
- f. Ensure that all test personnel are familiar with the required technical and operational characteristics of the equipment under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), and Military Characteristics (MC, record this criteria in the test plan.
- g. Record the grade, MOS, background, and training of all test personnel and ensure that all personnel receive new equipment training (NET) as required.
- h. Review all instructional material issued with the test item by the manufacturer, contractor, or government, as well as reports of previous tests conducted on the same type of equipment, and familiarize all test personnel available for reference.
- i. Select test equipment having an accuracy ideally at least 10 times greater than that of the function to be measured.
- j. Prepare record forms for systematic entry of data, chronology of test, and analysis in final evaluation.
- k. In the event the test item is intended to replace a standard item, the standard item shall be used as a comparison item during the subtests.
- l. All instruments required for testing the item shall be connected prior to the start of the test, and the type of instrument and connection point shall be recorded in the test log.

6.2 TEST CONDUCT

NOTE: 1. When not undergoing tests, the test and comparison items

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- shall be stored outdoors and exposed to arctic winter environment, except when indoor maintenance is required.
2. Record the prevailing meteorological conditions during the storage phase, as well as test conduct, to include:
 - a) Temperature
 - b) Humidity, relative or absolute
 - c) Temperature gradient
 - d) Atmospheric pressure
 - e) Precipitation
 - f) Solar radiation
 - g) Wind speed and direction
 - h) Frequency of readings
 - i) Source of data
 3. During testing, personnel shall accumulate data and compare performance of the test and comparison items in ambient air temperatures between 0°F and 25°F to the lowest ambient air temperature available.

6.2.1 Preoperational Inspection and Physical Characteristics

- a. Upon receipt, carefully inspect all test items and their shipping or packaging containers for completeness, damage and general conditions with the applicable section of MTP 10-4-500.
- b. Install the winterization kit in accordance with applicable documentation.
- c. Prepare all equipments for testing even if the equipment is not operating properly on receipt.
- d. Record results of inspection and physical measurements. Carefully note any difficulties encountered in installing the winterization kit or in preparing equipments for testing.

6.2.2 Cold Starting

6.2.2.1 Engineering Test

- a. Cold soak all test items until oil sump temperature is within $\pm 5^\circ\text{F}$ of ambient temperature.
- b. Start the test item in accordance with the procedure (including the use of the winterization kit as a starting aid) contained in the operation manuals.
- c. Record the following data:
 - 1) Length of cold soak (conditioning) period prior to starting attempt.
 - 2) High and low ambient air temperatures during cold-soak.
 - 3) Ambient air temperature during starting attempt.
 - 4) Engine oil sump temperature prior to start.
 - 5) Cylinder head temperatures prior to start.

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- 6) Battery electrolyte specific gravity (if applicable).
- 7) Use of winterization kit.
- 8) Number of starting attempts.
- 9) Cranking time during each attempt.

6.2.2.2 Service Test

a. Whenever the test item is used during normal operations observe and record the following data:

- 1) Length of exposure time prior to starting attempt.
- 2) High and low temperature during exposure time.
- 3) Ambient air temperature during starting attempt.
- 4) Use of winterization kit.
- 5) Number of starting attempts.
- 6) Cranking time during each attempt.

6.2.3 Functional and Operational Suitability

- a. Cold soak all test items for at least 24 hours.
- b. Start in accordance with instructions.
- c. Load generator to 1/3, 2/3 and full rate.
- d. Operate the test item for varying periods of time (4 hours, 12 hours, 24 hours, and 48 hours), in temperature ranges -25°F to -40°F, and -40°F to lowest available temperature.

NOTE: Use winterization kits as specified in the maintenance package.

e. Record the following data:

- 1) High and low ambient temperatures during test.
- 2) Generate load (watts or kw).
- 3) Length of test run.
- 4) Temperatures during cold-soak period.

6.2.4 Fuel and Oil Consumption and Analysis

NOTE: The following subtest procedure is conducted concurrently with the operational tests in this MTP (cold starting and functional and operational suitability).

6.2.4.1 Fuel and Oil Consumption

- a. Fill fuel tanks and oil reservoirs to capacity as specified in appropriate operating manual, prior to conduction of environmental tests.
- b. Record engine operating time as shown on installed instrumentation.
- c. Perform operational tests as directed in paragraphs 6.2.2 and 6.2.3.
- d. Upon completion of operational tests refill fuel tanks to

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capacity level, and record the following data:

- 1) Amount of fuel added to restore tanks to capacity level
- 2) Amount of oil added to restore reservoirs to capacity level
- 3) Engine operating time
- 4) Loads employed in operational tests

6.2.4.2 Fuel and Oil Analysis

a. Take a sample of engine oil during the following times:

- 1) When the engine is received at the arctic test center.
- 2) When oil is installed prior to, or during test runs.
- 3) Prior to complete oil changes.
- 4) After an engine failure.
- 5) Before and after cold starts where ambient air temperature is below -25°F.

b. Mark all samples taken for identification and record the following data.

- 1) Engine serial number.
- 2) Hours of engine operation at time the sample is taken.
- 3) Temperature ranges during engine operation.
- 4) Engine operating conditions prior to time sample is taken.

6.2.5 Human Factors Evaluation and Safety

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

b. Conduct these tests concurrently with the operational tests (Cold Starting, Functional and Operational Suitability).

6.2.6 Maintenance Evaluation

a. Conduct all Maintenance Evaluation Tests in accordance with the applicable sections of MTP 10-4-500.

b. Conduct these tests concurrently with the operational tests (Cold Starting, Functional and Operational Suitability).

6.3 TEST DATA

All test data to be recorded will 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.

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Specific instructions for the reduction and presentation of individual test data are outlined in the 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 and paragraph 6.2.1.

6.4.2 Cold Start

Review the recorded data and evaluate the performance of the test item in accordance with applicable QMR's and TC's, noting the suitability of the test item in the various test temperature ranges.

6.4.3 Functional and Operational Suitability

The operation of the generator under test in extreme arctic winter conditions shall be determined by comparison with previously accepted items of like nature and specifications. The damage to the equipment attributed to environmental effects or handling shall be compared with equipment specifications contained in appropriate QMR's and TC's. An evaluation shall be prepared noting the effects of various loads and temperature ranges.

6.4.4 Fuel and Oil Consumption and Analysis

Compute the amounts of fuel and oil consumption by dividing total volume used by engine operating time. Annotate this data with operating load conditions to derive fuel consumption versus load temperature chart.

Analyze the oil samples by laboratory analysis and determine the amount of fuel, water, metallic and silicon contamination in the sample.

6.4.5 Human Factors Evaluation and Safety

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

6.4.6 Maintenance Evaluation

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