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6 November 1970

Materiel Test Procedure 9-2-010
General Equipment Test Activity

U.S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

BATH UNITS

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1. OBJECTIVE

This document provides test methodology and testing techniques to determine the technical performance and safety characteristics of bath units and associated tools and equipment as described in Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), and Technical Characteristics (TC's), and to determine the items' suitability for service tests.*

2. BACKGROUND

An essential requirement of a field service facility is the bath unit.

A typical requirement is the portable bath unit. It is a liquid-fuel-fired water heating plant designed to supply warm water to each of the shower nozzles. The bath unit is equipped with the necessary hoses, water heater, water pump assembly, and shower stands to supply all the warm water needed for operation. The electric power to operate the bath unit is supplied by a self-contained portable skid mounted generator set.

3. REQUIRED EQUIPMENT

In general, the following should be available for use in the accomplishment of procedures as listed by this document.

- a. Steel measuring tape (12 feet long).
- b. Stop watch.
- c. Still camera and film.
- d. Motion picture camera and film.
- e. Suitable cell voltage tester for battery (where applicable).

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*This MTP is intended to be used as a basic guide in preparing actual test plans for the subject equipment. Specific criteria and test procedures must be determined only after careful appraisal of pertinent QMR's, SDR's, TC's, and any other applicable documents.

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- f. Suitable scales for weighing the test item and its shipping container.
- g. Thermometer(s)/pressure gages.
- h. Feeler gages.
- i. Tachometer. Range 0-4000 RPM.
- j. Ohmmeter.
- k. Pyrometer calibrated in °F., Range 100° - 600°.
- l. Liquid-in-glass thermometer, Range 0 - 200°F., 2° scale divisions.
- m. Maintenance and lubrication facilities.
- n. Suitable test site for use in evaluation of the test items.
- o. Appropriate material handling equipment (MHE).

4.

REFERENCES

- A. Army Regulation 70-38 Research and Development: Research, Development, Test and Evaluation of Materiel for Extreme Conditions of Environment.
- B. USATECOM Regulation 70-23 Research and Development: Performance Reports (EPRs).
- C. USATECOM Regulation 385-6 Safety: Verification of Safety of Materiel During Testing.
- D. USATECOM Regulation 700-1 Quality Assurance: Value Engineering.
- E. USAGETA Document Human Factors Evaluation Data for General Equipment (HEDGE).
- F. FED-STD-141 Paint, Varnish, Lacquer, and Related Materials: Methods of Inspection, Sampling and Testing.
- G. FED-STD-151 Metals: Test Methods.
- H. FED-STD-406 Plastics, Methods of Testing.
- I. MIL-STD-10 Surface Roughness, Waviness and Lay.
- J. MIL-STD-101 Preservation, Packaging, and Packing Materials, Test Procedures.
- K. MIL-STD-129 Marking for Shipment and Storage.
- L. MIL-STD-130 Identification Marking of US Military Property.
- M. MIL-STD-209 Slings and Attachments for Lifting and Tying Down Military Equipment.
- N. MIL-STD-271 Non-Destructive Testing Requirements for Metals.

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- O. MIL-STD-461A Electromagnetic Interference Requirements for Equipment.
- P. MIL-STD-462 Electromagnetic Interference Characteristics, Measurement of.
- Q. MIL-STD-463 Definitions and Systems of Units - Electromagnetic Interference Technology.
- R. MIL-STD-810 Environmental Test Methods.
- S. MIL-STD-1186 Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, and Appropriate Test Methods.
- T. MIL-STD-1400 Engines, Gasoline or Diesel, Methods of Test.
- U. MTP 2-2-601 Electrical Systems (Automotive).
- V. MTP 2-2-613 Broadband Radio Interference Tests of Vehicles and Electrical Equipment.
- W. MTP 2-2-700 Laboratory Test of Reciprocating Engines.
- X. MTP 2-2-701 Fuels and Lubricants.
- Y. MTP 9-2-100 Engines.
- Z. MTP 9-2-101 Engine, Diesel.
- AA. MTP 9-2-102 Engine, Gasoline.
- AB. MTP 9-2-155 Motors, Electrical.
- AC. MTP 9-2-181 Pump, Centrifugal.
- AD. MTP 9-2-286 Power Generators.
- AE. MTP 9-2-503 Durability.
- AF. MTP 9-4-003 Tropic Environmental Test of Construction, Support and Service Equipment.
- AG. MTP 10-2-500 Physical Characteristics.
- AH. MTP 10-2-501 Operator Training and Familiarization.
- AI. MTP 10-2-503 Surface Transportability (General Supplies and Equipment).
- AJ. MTP 10-2-505 Human Factors Evaluation.
- AK. MTP 10-2-507 Maintenance Evaluation.
- AL. MTP 10-2-508 Safety.
- AM. MTP 10-2-511 Quality Assurance.

5. SCOPE

5.1 SUMMARY

This procedure describes the preparation for, and methods of, evaluating the technical performance and safety characteristics of both units. To assess the degree of conformance with required standards and established criteria, the test item should be subjected to the following:

a. Preparation for Test - A pretest inspection to determine the condition of the test item and its associated package, upon arrival at the test site. A determination of the test item's physical characteristics, an operator training and familiarization program, and an operational check and functional verification.

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- b. Operation and Performance - A series of subtests to determine the operating characteristics of both units under operational conditions.
- c. Kits - An evaluation to determine the adequacy and usability of all kits as furnished with the test item.
- d. Electromagnetic Compatibility - An evaluation to determine the degree to which the test item produces radiated interference.
- e. Environmental Tests - A series of evaluation designed to examine and measure changes in the performance and physical characteristics of the test item when it is subjected to controlled changes in environmental parameters.
- f. Durability - An evaluation of the test item's ability to retain original physical and performance characteristics after periods of extended operation.
- g. Transportability - An evaluation to determine the ability of the test item and its shipping container to withstand the forces which it will experience during normal handling and transporting.
- h. Maintenance Evaluation - An evaluation to determine and appraise the maintenance characteristics and requirements of the test item, a verification and appraisal of its malfunctions, an evaluation of the test item's associated publications and other common and special support elements (maintenance test package), an appraisal of the test item's design for maintainability (AMCP 706-134: accessibility, ease of maintenance, standardization, and interchangeability).
- i. Reliability Evaluation - An evaluation of component and system reliability and an analysis of the results of this evaluation.
- j. Safety - An evaluation to determine the safety characteristics and possible hazards of test item.
- k. Human Factors - An evaluation to determine the adequacy of the design and performance characteristics of the test item and associated equipment in terms of conformance to accepted human factors engineering design criteria.
- l. Value Analysis - An evaluation directed at analyzing the primary function and features of the test item for the purpose of cost reduction without compromising performance, reliability, quality, maintainability or safety.
- m. Quality Assurance - A review to determine and evaluate defects in material and workmanship.

5.2 LIMITATIONS

NONE

6. PROCEDURES

6.1 PREPARATION FOR TEST

NOTE: Prepare an Equipment Performance Report (EPR) in accordance with applicable procedures in USATECOM Regulation 70-23 for any items that are missing, damaged or considered inadequate when completing the following procedures:

6.1.1 Initial Inspection

Upon receipt of the test item at the test site, perform the following:

a. Visually inspect the packed test item. Record and photograph evidence of damage incurred during transport or storage.

b. After the test item has been offloaded, remove all items from the shipping container and proceed as follows:

1) Visually inspect the shipment; evaluate with regard to and record any deviations from the applicable portions of the following military standards:

- a) MIL-STD-101 Preservation, Packaging, and Packing Materials, Test Procedures.
- b) MIL-STD-129 Marking for Shipment and Storage.
- c) MIL-STD-130 Identification Marking of U.S. Military Property.
- d) MIL-STD-1186 Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, and Appropriate Test Methods.

2) Record any damage or deterioration resulting from handling, improper packaging, and/or inadequate preservation.

3) Observe and record the extent of depreservation required.

NOTE: Care should be taken to ensure that all applicable protective materials have been removed.

4) Prior to accomplishing sub-paragraph 5) below, members of the inspection group should become familiar with the applicable portions of the following:

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- a) MIL-STD-10 Surface Roughness, Waviness and Lay.
 - b) MIL-STD-271 Nondestructive Testing Requirements for Metal.
 - c) FED-STD-151 Metals: Test.
 - d) Federal Test Method Std. No. 141 Paint, Varnish, Lacquer, and Related Materials, Methods of Inspection, Sampling, and Testing.
 - e) Federal Test Method Std. No. 406 Plastics, Methods of Testing.
- 5) Inspect the test item and record any evidence of defects in the following areas:
- a) Workmanship/Construction/Materials: In general the test item should be well made and free from defects. Methods of construction should indicate sound design and good shop practice. Materials should be new and as authorized by the applicable component specifications.
 - b) Visual inspection shall concentrate on the following:
 - a. Plastic/Rubber, shall be neatly molded and free from roughness, irregularities, foreign material or detrimental defects. Other than as specifically permitted by the applicable component specifications, the surface shall contain no porous areas or bubbles.
 - b. Metallic Materials, should be free from kinks, excessive scratches, and sharp bends. All burrs and rough edges shall be removed which offer a potential hazard to personnel.
 - c. Castings and Forgings shall be uniform in quality and condition and shall be free from patching, warping, tears, cracks, ruptures, imbedded scale, segregations, or other defects which would render them unsound for use, or detrimentally affect the test item's suitability for its intended purpose and/or continued testing.
 - d. Joints, Connections and Attachments shall be in accordance with the applicable specifications and adequate to ensure watertightness and strength. All seams shall be smooth, uniform, and free from faults, dirt, sand, flux, slag, or other extraneous material.
 - e. Painted Surfaces should be adequately covered, even and smooth in finish, texture, and appearance, and consistent in color.

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- 6) Record and bring to the attention of the test officer any observed defect or condition which is considered to be potential hazard to the safety of test personnel or facilities.
- 7) Photograph the test item, accessories, and special equipment in the received condition.

6.1.2 Inventory Check

a. Conduct an inventory against the Basic Issue Item List (BIIL). Record evidence of the following:

- 1) Missing maintenance literature or draft technical manuals.
- 2) Shortages in repair parts, accessories, or tools.
- 3) Missing kits.

b. Submit an Equipment Performance Report (EPR) for each noted shortage or discrepancy in accordance with applicable procedures in USATECOM Regulation 70-23.

6.1.3 Physical Characteristics

Perform the applicable procedures of MTP 10-2-500, record the appropriate data and as follows:

- a. Manufacturer and model, military specification/type/class.
- b. Center of gravity (crated).
- c. Safety equipment supplied.
- d. Weight and overall dimensions of the test item.
- e. Fuel tank data.
- f. Battery data (where applicable).
- g. Other.

6.1.4 Operator Training and Familiarization

Members of the test team shall be oriented in accordance with MTP 10-2-501.

a. Record the rank, MOS, past experience, and extent of additional training required for each test team member.

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b. Test personnel shall receive a review of all safety precautions and hazards associated with the appropriate test facilities and the test item. This review shall include but not be limited to the following:

- 1) General test facility hazards and safety precautions.
- 2) Hazards and safety precautions as applicable to the operation of bath units and associated components.
- 3) Fire hazards, fighting, and prevention.
- 4) Hazards and precautions associated with manual lifting.
- 5) Safety precautions relating to mechanical equipment.
- 6) Noise level hazards associated with operating equipment and precautions required.
- 7) Hazards and precautions associated with the use of rotating equipment.

c. Test personnel shall be instructed in the capabilities, operational characteristics, and limitations of the test item. Training, instruction, and familiarization shall include but not be limited to the following:

- 1) Applicable terminology.
- 2) Operation and use of test facilities.
- 3) The team members shall be furnished information concerning the test item as follows:
 - a) Physical characteristics and description.
 - b) Limitations.
 - c) Maintenance and service requirements.
 - d) Tools, accessories, and repair parts.
 - e) Kits.
 - f) Other information as appropriate.
- 4) Test team members shall receive instructions pertaining to test objectives and detailed procedures for subtests.
- 5) Record the adequacy and completeness of the draft technical manual(s) and/or other instructional material.

6.1.5 Pre-Operational Inspection, Assembly, and Functional Check

Procedures as outlined in this section are intended to accomplish the following:

a. Ensure that all items removed for shipment are reinstalled and that the test item is complete in all respects.

h. Detect prior to accomplishment of testing procedures any condition of the test item, its attachments or accessories, which constitutes a potential hazard to personnel, the test item, or the test facilities.

c. Detect, repair, or adjust defects, malfunctions, or conditions of the test item which would alter its operational characteristics such that the test data taken would not be representative of the commodity item.

d. In general, to determine that the test item is safe, operable and otherwise ready for further testing.

6.1.5.1 Inspection and Assembly

Review the draft technical manual(s) and other literature and instructional material as furnished with the test item; observe the procedures and precautions as listed therein and proceed as follows:

a. Ensure that all preservatives and protective materials have been removed as appropriate.

b. Refer to the draft technical manual(s) and accomplish the specified post arrival assembly and installation of components and accessories, including reinstallation of those items which were removed for the purpose of shipment.

c. Accomplish the following and record any faults, failures, malfunctions, or discrepancies.

- 1) Check thoroughly for physical damage, missing parts, and loose connections.
- 2) Manipulate all controls and check for proper operation and adjustment.
- 3) Record the presence and adequacy of name plates, warning plates, and instruction plates.

6.1.5.2 Operational Check and Functional Verification

Ensure that the test item is operational. Proceed as follows:

a. Operate test item for one mission cycle as a "burn in" period with all defects reported but not chargeable to maintainability or reliability.

b. Refer to the draft technical manual(s) and accomplish all appropriate pre-operational maintenance and service.

c. Record the following:

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- 1) Any condition of excessive vibration and/or noise.
- 2) Satisfactory operation.
- 3) Adequacy of the draft technical manual(s) and other instructional material.
- 4) Any fault, malfunction, failure, or discrepancy observed.
- 5) Test item suitability for continued testing.

6.1.6 Components and Subsystems

The following component and subsystem tests are given for the purpose of providing general background and reference material for use by the test activity and testing personnel.

6.1.6.1 Internal Combustion Engine

Refer to the applicable procedures MTP 9-2-101, MTP 9-1-102, and MIL-STD-1400.

6.1.6.2 Electrical System

Refer to the applicable procedures of MTP 2-2-601.

6.1.6.3 Power Generators

Refer to the applicable procedures of MTP 9-2-286.

6.2 TEST CONDUCT

The testing program shall be arranged to determine by controlled, measured, and instrumented testing, the technical performance and safety characteristics of the test item.

- NOTE:
1. All equipment malfunctions occurring during the testing procedures shall be reported in accordance with USATECOM Regulation 70-23.
 2. Prior to initiating test procedures the test officer will review and implement all safety considerations contained in Section 6.2.8.

6.2.1 Operation and Performance

Determine the operational and performance characteristics of the test item by subjecting it to the procedures listed below.

6.2.1.1 Fuel Pump

a. Attach a gage connected to a pressure tap in the discharge line of the pump. Measure fuel supply pressure.

b. Note the following:

- 1) Maximum pump output (gal./hr.).
- 2) RPM.
- 3) Fuel pressure (psi).
- 4) Any unusual noises or vibrations.
- 5) Any difficulties encountered.
- 6) Any faults, or malfunctions noted.

6.2.1.2 Fuel Pump Electric Motor

Subject the test item to the applicable procedures of MTP 9-2-155. Note the appropriate data.

6.2.1.3 Water Pump

Subject the test item to the applicable procedures of MTP 9-2-181. Note the appropriate data.

6.2.1.4 Water Pump Electric Motor

Subject the test item to the applicable procedures of MTP 9-2-155. Note the appropriate data.

6.2.1.5 Water Heater

The water heater contains a water tank jacket which shall be hydrostatically tested to the specified proof load and a pressure relief which shall be tested for specified pressure opening.

a. Water tank jacket.

- 1) Check water tank and cap all open connections to assure watertightness.
- 2) Attach pressure cylinder and gage.
- 3) Fill tank water jacket with water.
- 4) Check for leaks.
- 5) Apply a pressure of 75 psig unless otherwise specified for a period of 5 minutes.
- 6) If pressure fluctuated, repeat test.
- 7) Note the following:
 - a) Water tank capacity (gallons).
 - b) Maximum pressure attained.
 - c) Leaks.
 - d) Tank deformation.
 - e) Any difficulties encountered.
 - f) Any faults, or malfunction noted.
 - g) Adequacy of heater water tank.

b. Pressure relief value.

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- 1) Attach pressure relief valve.
- 2) Fill tank with water.
- 3) Apply pressure.
- 4) Observe relief valve opening.
- 5) Repeat above test 4 more times.
- 6) Note the following:
 - a) Pressure required to open valve.
 - b) Any deformation.
 - c) Any difficulties encountered.
 - d) Any faults, or malfunctions noted.

6.2.1.6 Performance

Evaluate the test item for performance capabilities. Proceed as follows:

a. Perform the following steps:

- 1) Check the generator fuel tank and the water heater fuel drum for adequate fuel.
- 2) Make certain the power cord cables, the water hose assemblies, and the fuel line assemblies are properly connected.
- 3) Check water pump motor switch and the blower and fuel pump motor switch for OFF position.
- 4) Close burner fuel shutoff valve and the blower shutter.
- 5) Check shower stand control valve for open position.
- 6) Check water pump drain cock, water heater drain cock, and the water pressure and temperature control drain cock for OFF position.

b. Start the generator.

c. Remove water pump dust cap and fill the pump prime port with water.

d. Move the water pump motor switch to the ON position.

e. Observe shower stands for water flow from nozzles.

f. Move the blower and fuel pump motor switch to ON position.

g. Check the fuel pressure gage.

h. Check ignition spark on the tips of the electrodes.

i. Open the burner fuel control valve.

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- j. Open the blower shutter.
- k. Open the burner fuel shutoff valve.
- l. Check for presence of combustion flame.
- m. Adjust the blower shutter so that exhaust from the water heater is transparent and smokeless.
- n. Check water temperature gage for water temperature.
- o. Operate either one or both shower stands.
- p. Check temperature gage for water temperature after 5 minutes of operation and periodically thereafter during operation.
- q. After 15 minutes of satisfactory performance operate the bath unit for 10 cycles of 8 hour periods of continuous operation for a total of 80 hours of operation.
- r. Note the following:
 - 1) Ambient weather conditions.
 - 2) Water pump prime port filled with water.
 - 3) Water flow from shower stand.
 - 4) Fuel pressure.
 - 5) Ignition spark.
 - 6) Presence of combustion flame.
 - 7) Exhaust, transparent and smokeless.
 - 8) Water temperature.
 - 9) Adequacy of shower operation.
 - 10) Adequacy of instructional material.
 - 11) Any unusual noises or vibrations.
 - 12) Any difficulties encountered.
 - 13) Any faults, failures or malfunctions noted.
 - 14) Leaks (water or fuel).

6.2.2

Kits

a. All kits as furnished with the test item shall be tested for usability and satisfactory results by using them in accordance with the draft technical manual(s) and appropriate instructions.

b. Record appropriate data as applicable including the following:

- 1) Time required to accomplish the operation.

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- 2) Adequacy of furnished material and associated tools.
- 3) Adequacy of instructional material.
- 4) Adequacy of the completed product.
- 5) Any faults or difficulties experienced.

6.2.3 Environmental Effects Evaluation

The purpose of these tests is to determine the ability of the test item and its various components and accessories to resist physical damage and/or deterioration when subjected to accelerated climatic and environmental conditions. Testing should be conducted as necessary to ensure that the test item is capable of operating satisfactorily under conditions existing within the operating areas and/or environments as specified by the applicable QMRs and as defined by AR 70-38. In the preparation for conduct of appropriate testing, test personnel should consult the applicable portions of MIL-STD-810.

6.2.3.1 Salt Spray Test

a. A 100-hour salt spray test, in accordance with FED-STD-151, Method 811.1, shall be conducted on sample type test item components and accessories which are manufactured from metallic materials.

b. Following completion of the test, inspect each item for corrosion and/or wear. Record the following:

- 1) Item or component under evaluation.
- 2) Description of results.

6.2.3.2 Tropic Environment Evaluation

Accomplish the applicable procedures of MTP 9-4-003. Record the appropriate data.

6.2.3.3 Climatic Tests

Subject the test item to appropriate climatic conditions as defined by AR 70-38 and as specified by the applicable QMRs. Use the following procedures and applicable tests as contained in MIL-STD-810. Record the appropriate data.

6.2.3.3.1 Low Temperature Test -

Evaluate the test item under conditions of low temperature not to exceed appropriate limits as established by the applicable QMRs and as defined by AR 70-38. Accomplish low temperature testing in accordance with MIL-STD-810, Method 502.

6.2.3.3.2 High Temperature Test -

Evaluate the test item under conditions of high temperature not to exceed appropriate limits as established by the applicable QMRs and as defined by AR 70-38. Accomplish high temperature testing in accordance with MIL-STD-810, Method 501.

6.2.3.3.3 Dust Test -

Subject the test item to a dust test in accordance with the applicable procedures of MIL-STD-810, Method 510.

6.2.4 Electromagnetic Interference

Subject the test item to appropriate procedures of MTP 2-2-613, MIL-STD-461, MIL-STD-462, and MIL-STD-463.

6.2.5 Durability

The test item's durability shall be verified by performing the applicable procedures of MTP 9-2-503 and the following:

a. During accomplishment of testing as described by this document, the durability characteristics of the test item shall be observed. In the event of equipment failure during testing, the appropriate maintenance and repair procedures shall be accomplished and the testing shall be continued.

b. Upon completion of all testing as described in this document, the test item shall be inspected for signs of excessive or accelerated wear and potential equipment failure.

c. Record appropriate data as required by MTP 9-2-503 and any indication of the following:

- 1) Fastening failure.
- 2) Loose or missing hardware.
- 3) Excessive wear.
- 4) Leaking gaskets.
- 5) Warping and/or distortion.
- 6) Damage to any component, material or finish.

6.2.6 Transportability

Evaluate the transportability characteristics of the test item.

NOTE: Personnel should be familiar with the applicable portions of the following documents.

- 1) MIL-STD-101 Preservation, Packaging, and Packing Materials, Test Procedures.
- 2) MIL-STD-129 Marking for Shipment and Storage.

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- 3) MIL-STD-209 Slings Eyes and Attachments for Lifting and Tying Down Military Equipment.
- 4) MIL-STD-1186 Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, Appropriate Test Methods.

a. The draft technical manual shall be reviewed or consulted for proper procedures for tying down, and lifting, and transporting the item by various media. Any inadequacy of instructions should be reported by EPR.

b. Evaluate the transportability characteristics of the test item by accomplishing the applicable procedures of MTP 10-2-503. Record the appropriate data.

c. Evaluate the effectiveness of tie-down/securing devices and lifting attachments using MIL-STD-209 as a basis for the evaluation.

6.2.7 Maintenance and Reliability Evaluation

a. Evaluate and appraise the maintenance/reliability - related factors of the test item as described in MTP 10-2-507, MTP 10-2-512 and AMC Pamphlet 706-134 with emphasis on the following:

- 1) Organizational (O), Direct Support (F), and General Support (H) maintenance requirements.
- 2) Operator through General Support Maintenance Literature.
- 3) Repair parts.
- 4) Tools.
- 5) Test and handling equipment.
- 6) Calibration and maintenance facilities.
- 7) Personnel skill requirements.
- 8) Maintainability.
- 9) Reliability.
- 10) Availability.

b. Calculate those indicators which express the effects of appropriate preceding aspects. Perform calculations in accordance with Appendix A.

6.2.8 Safety

Evaluate the safety characteristics and features of the test item in accordance with the applicable procedures in MTP 10-2-508.

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- NOTES:
1. Provide a safety recommendation in accordance with USATECOM Regulation 385-6, and the test directive, as applicable.
 2. During the conduct of all tests, test personnel shall observe the proper safety precautions and, in particular, shall adhere closely to the draft technical manual for the handling and use of the test item.
 3. The procedures for all tests shall be examined and any condition which might constitute a safety hazard shall be recorded and also reported to the testing officer.

Perform the following:

a. Examine the safety characteristics of the test item including the procedures for its operation and its design to ensure that maximum safety has been provided consistent with military requirements. Hazards shall be classified as safe, marginal, critical, and catastrophic. Consider the following:

- 1) Examine operating procedures in the light that improperly executed or misinterpreted instructions could result in bodily harm or equipment damage.
- 2) Where unsafe conditions cannot be avoided, ensure that the test item is properly and conspicuously marked for the condition.
- 3) Are all moving parts shielded and completely enclosed.
- 4) Are environmental limitations explicitly denoted.
- 5) Are fuels properly protected and handling procedures given.

b. Prepare a list of all test item safety features and/or devices; indicate the type of feature, its purpose, and the suitability and adequacy of the feature.

c. For each device listed, a minimum of 2 cycles of operation will be caused by simulating the type failure which the device is to detect or otherwise utilizing the feature. Record the following:

- 1) The device/feature tested.
- 2) Failure which the device is to detect or prevent.
- 3) Proper operation of the device or failure detected.

d. Prepare a listing of all warning plates, instructions, and markings. Record the location and adequacy of each item listed.

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e. Ensure that noise levels during periods of engine operation do not exceed the maximum allowable limits. Refer to the Human Factors Evaluation portion of this document.

f. Test personnel shall record any worthwhile comments or suggestions relative to improvement of safety features, safety measures, and/or precautions.

6.2.9 Human Factors Evaluation

Accomplish the applicable procedures of MTP 10-2-505 and the following general evaluation:

a. The test item shall be evaluated to determine the degree to which its physical design and revealed performance characteristics conform to recognized human factors engineering design criteria. Use the applicable requirements of Human Factors Evaluation Data for General Equipment (HEDGE), for Class IIIC equipment. Prepare checklists to evaluate the human factors characteristics to be considered during conduct of the denoted tests.

b. In some instances the HEDGE test functions and subtests may be under consideration during the conduct of other tests. Where this condition exists the HEDGE requirements will be integrated into and conducted simultaneously with the corresponding tests.

c. General considerations to be included in checklists for all tasks:

- 1) Adequacy of instructions and tools to perform the task.
- 2) Mental and physical effort required.
- 3) Design of the test item as it affects the task.
- 4) Time required to perform the task.
- 5) Personnel required for task accomplishment.

d. Perform the following tasks for the HEDGE test functions given and rate the task from a human factors standpoint. The considerations shall include, but not be limited to, the following:

- 1) Operability.
 - a) Prepare for operation.
 - b) Operate.
- 2) Maintainability.
 - a) Perform preventative maintenance.
 1. Inspect and check out.
 2. Perform routine preventative maintenance.

- b) Perform unscheduled maintenance.
 - 1. Detect malfunction(s).
 - 2. Isolate and identify causes.
 - c) Remove and replace.
 - 1. Remove malfunctioning element.
 - 2. Replace or repair on item.
- 3) Transportability.
- a) Prepare for transport.
 - 1. Place in transit configuration.
 - 2. Package.
 - b) Load/Unload.
 - 1. Lift into/out of carrier.
 - c) Secure/Unfasten.
 - 1. Immobilize items.
 - 2. Prepare for use.

6.2.10

Value Analysis

a. During the conduct of all tests, test personnel shall evaluate the test item from a value versus cost standpoint. Record all pertinent comments concerning features or components which can be eliminated or modified to accomplish cost reduction without impairment of performance, reliability, quality, maintainability, or safety. The applicable portions of USATECOM Regulation 700-1 shall be used for this evaluation.

b. Consideration shall be given to the topics listed below. Record appropriate comments for each topic.

- 1) Mission Capacity - The test item should be capable of accomplishing the specified task with only a reasonable margin of excess capability. Excess capacity and unused capability normally results in unnecessary bulk, excessive weight and unwarranted costs.
- 2) Simplicity - Unnecessarily complex components and systems, redundancy, and the use of unneeded parts will increase costs and maintenance efforts.
- 3) State of the Art - In many instances the use of recently developed, currently available, components

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and automated features will result in an overall product improvement and cost savings.

- 4) Standardization - The use of identical parts and parts currently in the military system will reduce the overall logistics burden.

6.2.11 Quality Assurance

Throughout all tests, examine the test item for compliance with the quality requirements of the applicable QMR, SDR or TC and the provisions of MTP 10-2-511.

6.3 TEST DATA

NOTE: In compiling the Test Data section, test personnel should expound upon those data procedures which are other than quantitative in nature by recording narrative descriptions which will provide full details of conditions and/or events occurring during the conduct of the test.

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

Record the following:

- a. Manufacturer, model, military specification, and other appropriate data.
- b. Method of transport used to deliver the test item.
- c. Any damage to the test item or its shipping container.
- d. Any damage or deterioration resulting from handling, improper packaging, and/or inadequate preservation.
- e. Any noncompliance with the standards for shipping, marking, preservation, and packaging.
- f. The extent of depreservation required.
- g. Any indication of defects in the following areas (describe in detail):
 - 1) Workmanship.
 - 2) Construction.
 - 3) Materials.

h. Any condition considered to be a potential hazard to the safety of test personnel or facilities.

i. Equipment, time, and personnel required to unpack the test item and comments concerning the method and materials used in packing.

6.3.1.2 Inventory

List any materials missing from the Basic Issue Item List.

6.3.1.3 Physical Characteristics

Record the data required by MTP 10-2-500 and as follows:

- a. Manufacturer and model, military specification/type/class.
- b. Center of gravity (crated).
- c. Safety equipment supplied.
- d. Weight and overall dimensions of the test item (in pounds and inches).
- e. Fuel tank data (indicate capacity in gallons).
- f. Battery data (where applicable). Indicate manufacturer, model, type, voltage, and ampere-hour rating.
- g. Other data as appropriate.

6.3.1.4 Operator Training and Familiarization

Record the data required by MTP 10-2-501 and the following:

- a. Methods used and completion of test personnel training and evaluation of technical manuals.
- b. Evidence that test personnel are sufficiently knowledgeable in objectives and procedures.
- c. The personal data required for selected personnel.

6.3.1.5 Pre-Operational Inspection, Assembly, and Functional Check

6.3.1.5.1 Inspection and Assembly -

Record the following:

- a. Any damage or defects observed. (Describe in detail).

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b. Adequacy and completeness of accessories and tools necessary for their installation.

c. Satisfactory operation of all controls and moving parts.

d. Adequacy of instructional material, instructional plates, name plates, and warning plates.

e. Overall suitability of the test item for continued testing.

6.3.1.5.2 Operational Check and Functional Verification -

Record the following:

a. Any condition of excessive noise and/or vibration.

b. Satisfactory operation.

c. Adequacy of draft technical manual(s) and other instructional material.

d. Any fault, failure, malfunction, or discrepancy noted.

e. Suitability of the test item for continued testing.

6.3.2 Test Conduct

6.3.2.1 Operation and Performance

6.3.2.1.1 Fuel Pump -

Record the following:

a. Maximum pump output (gal/hr).

b. RPM.

c. Fuel pressure (psi).

d. Any unusual noises or vibrations.

e. Any difficulties encountered.

f. Any faults, or malfunctions noted.

6.3.2.1.2 Fuel Pump Electric Motor -

Record the data as required by MTP 9-2-155.

6.3.2.1.3 Water Pump -

Record the data as required by MTP 9-2-181.

6.3.2.1.4 Water Pump Electric Motor -

Record the data as required by MTP 9-2-155.

6.3.2.1.5 Water Heater -

a. Water tank jacket.

Record the following:

- 1) Water tank capacity (gallons).
- 2) Maximum pressure applied.
- 3) Any leaks.
- 4) Tank deformation.
- 5) Adequacy of heater water tank.
- 6) Any difficulties encountered.
- 7) Any faults, or malfunctions noted.

b. Pressure relief valve.

Note the following:

- 1) Pressure required to open valve.
- 2) Any deformation.
- 3) Adequacy of pressure relief valve.
- 4) Any difficulties encountered.
- 5) Any faults, or malfunctions noted.

6.3.2.1.6 Performance -

Record the following:

- a. Fuel pressure.
- b. Ignition spark.
- c. Exhaust, transparent and smokeless.
- d. Adequacy of shower operation.
- e. Any unusual noises or vibrations.
- f. Water temperature.

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- g. Any difficulties encountered.
- h. Any faults, or malfunctions noted.
- i. Any leaks (water or fuel).
- j. Ambient weather condition.

6.3.2.2 Kits

Record the following:

- a. Kit under consideration (describe).
- b. Time required to accomplish use of the kit.
- c. Adequacy of furnished material and associated tools.
- d. Adequacy of instructional material.
- e. Adequacy of the completed product.
- f. Any faults or difficulties experienced.

6.3.2.3 Environmental Effects

6.3.2.3.1 Salt Spray Test -

Record the following:

- a. Item under test.
- b. Results of test.

6.3.2.3.2 Tropic Environment -

Record appropriate data as required by MTP 9-4-003.

6.3.2.3.3 Climatic Tests -

Record appropriate data as required by MIL-STD-810.

6.3.2.4 Electromagnetic Interference

Record appropriate data as required by MTP 2-2-613, MIL-STD-461, and MIL-STD-462.

6.3.2.5 Transportability

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Record appropriate data as required by MTP 10-2-503 and as follows:

- a. Item under test (indicate manufacturer, model, etc.).
- b. Number of bath units in the shipment.
- c. Type of container and packaging methods used.
- d. Dimensions of container.
- e. Weight of the completed package.
- f. Time required to accomplish preparations for shipment.
- g. MHE used.
- h. Number of personnel required (indicate rank and MOS).
- i. Method of transport utilized.
- j. Any damage to the test item or the shipping container.
- k. Any evidence of shifting of contents, loosening or breaking of holddowns, ties, stays, blocking, or bracing.
- l. Adequacy of tie-down/securing devices and lifting attachments.

6.3.2.6 Maintenance and Reliability

Record appropriate data as required by the applicable portions of MTP 10-2-507, and 10-2-512 and the following:

- a. Maintenance literature which is not easily understood, incomplete or ineffective.
- b. Repair parts which are not proper type or are non-standard.
- c. Ineffective or improperly specified tools.

NOTE: Ensure that collected data will permit the computation or derivation of M & R (L) indicators such as MR, MTBF, and MTTR.

6.3.2.7 Safety

Record appropriate data as required by MTP 10-2-508 and as follows:

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a. Prepare a list of all test item safety features and/or devices; indicate the following:

- 1) Type of feature/device.
- 2) Purpose of the feature/device.
- 3) Suitability of the feature/device.
- 4) Adequacy of the feature/device.
- 5) Proper operation of the feature/device.

b. Prepare a list of all warning plates, instructions, and markings. Record the location and adequacy of each item listed.

c. Any condition that might present a safety hazard including the cause of the hazard, and the steps taken to alleviate the condition.

d. Satisfactory noise level during periods of engine operation.

e. Any suggestions relative to improvement of safety features, safety measures and/or precautions.

f. Provide a safety recommendation in accordance with USATECOM Regulation 385-6.

g. The test officer will review the safety statement and assure that test personnel are briefed on the limitations of the test item.

6.3.2.8 Human Factors Evaluation

Record the data required by MTP 10-2-505.

Prepare checklists for each of the various tasks associated with each test function. Rate each task as satisfactory or unsatisfactory from a human factors standpoint. In rating the task include the specific considerations peculiar to the task and the following general considerations:

- a. Adequacy of tools and instructions to perform the task.
- b. Mental and physical effort required.
- c. Design of the test item as it affects the task.
- d. Time required to perform the task.
- e. Personnel required to perform the task.

6.3.2.9 Value Analysis

a. Record appropriate comments for each of the topics listed below:

- 1) Mission Capacity.
- 2) Simplicity.
- 3) State of the Art.
- 4) Standardization.
- 5) Materials and Methods of Construction.
- 6) Clearances.

b. When making recommendations for changes in test item features or components, record the following:

- 1) The feature or component under consideration.
- 2) Recommended change(s).
- 3) Reason(s) for recommended change(s).

6.3.2.10 Quality Assurance

Record:

- a. Data required by MTP 10-2-511.
- b. Comments as to any design shortcomings in the area of required quality.

6.4 DATA REDUCTION AND PRESENTATION

Data obtained during the conduct of the test will be summarized making use of photographs and charts as appropriate. All photographs and charts will be properly identified and labeled. Test data will be obtained for each bath unit tested, and summarized and evaluated as required.

Data obtained for each performance characteristics will be compared with established technical performance characteristics as specified in QMR's, SDR's, or other developmental criteria. Test data obtained from different types of bath units undergoing the same test will be compared. Where performance is repeated after a specific test or repair, the data obtained will be compared with the previously obtained data, and where definite differences occur, the conditions that caused the differences and the degree of difference will be summarized along with appropriate comments of the test personnel.

In addition to charts and photographs, the presentation shall include narrative reports of all phases of the test.

The presentation shall conclude with a summarization of the suitability of the test item for service testing.

APPENDIX A

I. MEAN TIME BETWEEN FAILURES (MTBF):

MEAN TIME BETWEEN FAILURES is the total operating time divided by the total number of chargeable system failures occurring during the total test period.

II. Inherent Availability (A_i).

The probability that a system or equipment when used under stated conditions, without consideration for any scheduled or preventive maintenance, in an ideal support environment (i.e., available tools, parts, manpower, manuals, etc.), shall operate satisfactorily at any given time. A_i excludes ready time, preventive maintenance downtime, supply downtime, and waiting or administrative downtime. It may be expressed as --

$$A_i = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$$

where

MTBF = Mean-time-between failure; and MTTR =

MEAN TIME TO REPAIR; that portion of the total unscheduled maintenance time which is expended to correct chargeable system failures divided by the total number of chargeable system failures occurring during the total test period.

III. Achieved Availability (A_a).

The probability that a system or equipment when used under stated conditions in an ideal support environment (i.e., available tools, parts, manpower, manuals, etc.) shall operate satisfactorily at any given time. A_a excludes supply downtime and waiting or administrative downtime. It may be expressed as --

$$A_a = \frac{\text{MTBM}}{\text{MTBM} + \bar{M}}$$

where

MTBM = Mean-time-between-maintenance; is the total operating time, divided by the total preventive (scheduled) and corrective (unscheduled) maintenance actions occurring during the total test period and

\bar{M} = Mean active maintenance downtime resulting from both preventive and corrective maintenance actions.

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13. ABSTRACT

This Engineering Test Procedure describes test methodology and testing techniques for determining performance of bath units and associated equipment.

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