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AD NUMBER

AD872619

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AD 872619

3942

26 June 1970

Materiel Test Procedure 5-2-090
General Equipment Test Activity

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

STARTER, EXTERNAL, GASOLINE & ELECTRIC

1. OBJECTIVE*

This document provides test methodology and testing techniques to determine the technical performance and safety characteristics of gasoline and electric starters 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 item's suitability for service tests.

2. BACKGROUND

The starter is a complete, portable, propulsion package intended for use with various types of aerial target and guided missiles.

Design of the starter normally includes an internal-combustion, direct-cranking, one cylinder, two cycle, air-cooled engine assembly. The necessary starting power is delivered to the transmission assembly through a centrifugal clutch.

Engine starting may be accomplished by either mechanical or electrical means depending on design.

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. Stopwatch.
c. Still Camera and Film.
d. Motion Picture Camera and Film.
e. Suitable Cell Voltage Tester for Battery (where applicable).
f. Suitable Scales for Weighing the Test Item and its Shipping Container.
g. Thermometer(s) Pressure Gages.
h. Feeler Gages.
i. Tachometer Range 0-3000 RPM.
j. Ammeter (0-400 Ampere Range).
k. Pyrometer Calibrated in °F., Range 100° - 600°.
l. Liquid-in-glass Thermometer, Range 0 - 200°F., 2°.
m. Maintenance and Lubrication Facilities.

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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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n. Sound Intensity Meter per ASA S1.4-1961.
o. Octave Band Analyzer per ASA S1.6-1960.
p. Suitable Test Site for Use in Evaluation of the Test Items.
q. Appropriate Material Handling Equipment (MHE).

4. REFERENCES

A. Army Regulations 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Conditions of Environment.
B. AMCP 706-134, Maintenance Guide for Design.
C. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
D. USATECOM Regulation 70-23, Equipment Performance Reports (EPR's).
E. USATECOM Regulation 700-1, Value Engineering.
F. USAGETA Document, Human Factors Evaluation Data for General Equipment (HEDGE).
G. FED-STD-14, Paint, Varnish, Lacquer, and Related Materials, Methods of Inspection, Sampling and Testing.
H. FED-STD-151, Metals; Test Methods.
I. FED-STD-406, Plastics, Methods of Testing.
J. MIL-STD-10, Surface Roughness, Waviness and Lay.
K. MIL-STD-101, Preservation, Packaging, and Packing Materials, Test Procedures.
L. MIL-STD-129, Marking for Shipment and Storage.
M. MIL-STD-130, Identification Marking for US Military Property.
N. MIL-STD-209, Slinging Eyes and Attachments for Lifting and Tying Down Military Equipment.
O. MIL-STD-271, Non-Destructive Testing Rquirements for Metals.
P. MIL-STD-461, Electromagnetic Interference Requirements for Equipment.
Q. MIL-STD-462, Electromagnetic Interference Characteristics, Measurement of.
R. MIL-STD-463, Definitions and Systems of Units - Electromagnetic Interference Technology.
S. MIL-STD-810, Environmental Test Methods.
T. MIL-STD-1186, Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, and Appropriate Test Methods.
U. MIL-STD-1400, Engines, Gasoline or Diesel, Methods of Test.
V. MTP 2-2-601, Electrical Systems (Automotive).
W. MTP 5-2-510, Electronic Noise Tests of Missile Systems.
X. MTP 5-2-545, Human Factors Engineering.
Y. MTP 5-2-574, Highway, Secondary, and Cross-Country (Missiles and Rockets).
Z. MTP 5-2-575, Air Transportability (Including Helicopters).
AA. MTP 5-2-600, Maintainability.
AB. MTP 5-2-602, Safety Evaluation.
AC. MTP 5-4-003, Tropic Environmental Tests of Missile and Rocket Systems.
AD. MTP 6-2-500, Physical Characteristics.
AE. MTP 9-2-102, Engines, Gasoline.

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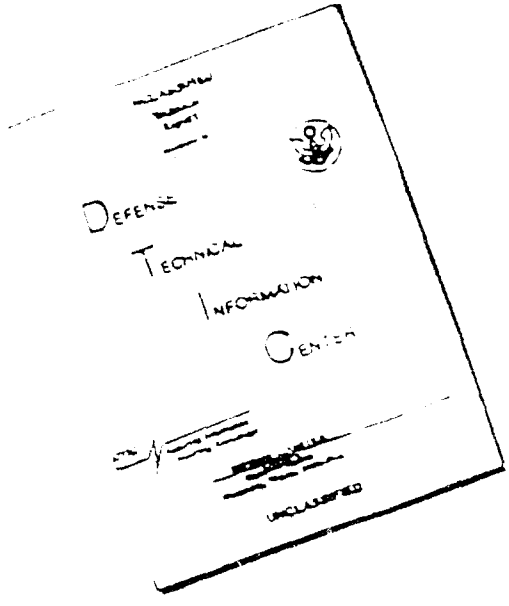

THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

AF. MTP 9-2-155, Motors, Electrical.
AG. MTP 9-2-503, Durability.
AH. MTP 10-2-501, Operator Training and Familiarization.
AI. MTP 10-2-511, Quality Assurance.
AJ. MTP 10-3-512, Reliability.

5. SCOPE

5.1 SUMMARY

This procedure describes the preparation for, and methods of, evaluating the technical performance and safety characteristics of external starters. 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.

b. Operation and Performance - a series of subtests to determine the operating characteristics of the external starter under operational conditions. Subtests include engine starting, thrust determination, and endurance testing.

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. Magnetic Permeability - An evaluation to determine the magnetic permeability of the test item.

f. Environmental Tests - A series of evaluations 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.

g. Durability - An evaluation of the test item's ability to retain original physical and performance characteristics after periods of extended operation.

h. 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.

i. 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), an evaluation of component and system durability and reliability, and the calculation of indicators which express the effects of appropriate preceding aspects.

j. Safety - An evaluation to determine the test item compliance with safety requirements and to confirm the test item's safety characteristics during conduct of all tests.

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 study to determine the quality of the test item.

5.2 LIMITATIONS

The procedures as outlined herein are intended to evaluate the test item as a unit.

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 unloaded, 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 for 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 item number 5 below, members of the inspection group should become familiar with the applicable portions of the following:

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) Proceed to 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.

NOTE: Visual inspection shall concentrate on the following:

Fiberglass/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.

Aluminum and Metallic Materials, shall be free from kinks, excessive scratches, and sharp bends. All burrs and rough edges shall be free from sharp edges which offer a potential hazard to personnel.

Castings and Forgings, shall be uniform in quality and condition and shall be free from patching, warping, tears, cracks, ruptures, inbedded 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.

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.

Painted Surfaces, shall be adequately covered, even and smooth in finish, texture, and appearance, and consistent in color.

6) Record and bring to the attention of the test officer any observed defect or condition which is considered to be a 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 Items List (BIIL) and 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 6-2-500 and record the appropriate data as follows:

a. Manufacturer and model, military specification, type and class.
b. Number of cylinders.
c. Engine bore and stroke.
d. Piston displacement.
e. Brake horsepower (indicate rpm).
f. Type of starting system (indicate electrical or manual).
g. Shifting arrangement (indicate electrical or manual).
h. Choke arrangement (indicate manual or automatic).
i. Weight and overall dimensions of the test item.
j. Gas tank data.
k. Battery data (where applicable).
l. Other characteristics as appropriate.

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 team member.

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 gasoline and electric starters.
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 machinery and precautions required.
7) Hazards associated with battery charging and precautions to be observed.
8) 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.

b. Detect and rectify prior to 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 would not be representative of the commodity item.

d. Verify 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. Perform the following and record any faults, failures, malfunctions, or discrepancies.

1) Check thoroughly for physical damage, missing parts, and loose connections.
2) Disconnect the fuel lines and spark plug wires. Proceed to rotate the starter manually to make sure that all moving parts operate freely.
3) Manipulate all controls and check for proper operation and adjustment.
4) 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 then proceed as follows:

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

b. Position the starter on starter cart assembly(ensure that the test item is properly secured to the starter cart assembly).

c. Connect the fuel lines and battery leads (where furnished).

d. Refer to the draft technical manual and start the engine.

e. Observe starter engine operation and ensure that adequate cooling air is flowing over engine.

f. Allow the engine to operate at idle speed for a period of time adequate to ensure proper engine warm-up.

g. Operate the engine through its full range of speeds.

h. Record the following:

1) Any difficulties encountered in starting the engine.
2) Any condition of excessive vibration and/or noise.
3) Satisfactory operation.
4) Adequacy of the draft technical manual(s) and other instructional material.
5) Any fault, malfunction, failure, or discrepancy observed.
6) 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 Reciprocating Internal Combustion Engine

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

6.1.6.2 Electrical Motors

Refer to the applicable procedures of MTP 9-2-155.

6.1.6.3 Electrical System

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

6.2 TEST CONDUCT

The testing program shall be arranged so as to determine by controlled, measured, documented 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 6.2.9.

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 Engine Starting

Evaluate the test item's starting system by performing the following:

a. Review the draft technical manual(s) and accomplish all appropriate service and maintenance.
b. Position the test item on a starter cart assembly. Ensure adequate engine cooling.
c. For electrical start engines, connect the battery leads.

NOTE: 1. Install an ammeter in the lead to the starter.
2. Determine and record battery voltage using a suitable voltage tester.

d. Start the engine in accordance with the draft technical manual(s).
e. Stop the engine.
f. Repeat procedure d and e for a minimum of 25 engine starts.
g. Check the engine using a tachometer and record the rpm.

h. Note and record the following:

1) Type of starting system under evaluation, i.e., electric/manual/auxiliary.
2) Ambient temperature.
3) Fuel, lubricant, and mixture ratio used.
4) Any difficulties encountered.
5) Adequacy of instructional material concerning engine starting.
6) Any faults, failures, or malfunctions.
7) For electrical starting systems record the following for each engine start.

a) Current flow to the starter during engine cranking.
b) Voltage at the starter motor during cranking.
c) Voltage between engine and the ground terminal of the battery during engine cranking.

6.2.1.2 RPM Evaluation

Determine the test item's ability to develop rated RPM as follows:

a. Obtain a starter cart assembly and install starter.
b. Start the engine and allow it to operate at idle for a period of time adequate to ensure proper warm-up.
c. Slowly increase engine speed until 1/4 maximum RPM has been obtained.
d. Determine engine RPM by means of a tachometer. Record the RPM (R_{F1}).
e. Slowly increase engine speed until 1/2 maximum RPM has been obtained. Record values of engine speed (R_{F2}).
f. Obtain readings for 3/4 and full engine speed.
g. Slowly decrease engine RPM and stop the engine.

6.2.1.3 Endurance Test

Mount the starter on a starter cart assembly to accomplish a 50 hour endurance test.

NOTE: 1. The 50 hours of operation should be without maintenance or repair. Port cleanings are permitted and spark plugs may be cleaned or replaced as necessary.
2. Mount pyrometers as necessary to monitor engine head and exhaust gas temperatures.
3. Ensure the availability of a tachometer for use in determining engine RPM.

6.2.1.3.1 Full Throttle Operation -

a. Operate the test item at full speed for a period of 10 hours.
b. Record the following:

1) Ambient temperature.
2) RPM developed; record engine RPM at intervals of 30 minutes.
3) Engine head and exhaust gas temperatures recorded at 30 minute intervals.
4) Fuel and lubricant used.
5) All service and maintenance accomplished.
6) Any difficulties encounterd.
7) Any unusual noises and/or vibration.
8) Any faults, failures, or malfunctions noted.

6.2.1.3.2 Cyclic-Load Operation - Perform the following:

a. Operate the test item in accordance with the following schedule. Repeat the cycle until a total of 30 hours of operation has been accomplished.

Throttle Setting	Duration (Hours)
1/4	1
1/2	1
3/4	2
1/2	1
1/4	1

b. Record appropriate data as noted for full throttle operation.

6.2.1.3.3 Manual Cranking System Test - Perform the following:

a. With the fuel lines disconnected and the spark plugs installed in the engine proceed to crank the engine 500 times.
b. Record any faults, failures, or malfunctions noted.

6.2.1.3.4 Operation - Perform the following:

a. Connect the starter to an appropriate target missile, or other suitable engine load device.
b. Proceed to operate the starter/missile combination under light load conditions for a period of not less than one hour at 10 minute intervals.
c. Repeat test for a total of 10 times.
d. Record any faults, failures or malfunctions.

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.
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 environmnets as specified by the applicable QMR's and as defined by AR 70-38. In the preparation for conduct of appropriate testing, test personnel should consult the appropriate 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 and 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 5-4-003. 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 QMR's. Use the following procedures and applicable tests as contained in MIL-STD-810. Record the appropriate data.

6.2.3.4.1 Rain Test -

Subject the test item to a rain test in accordance with the applicable procedures of MIL-STD-810, Method 506.

6.2.3.4.2 Low Temperature Test -

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

6.2.3.4.3 High Temperature Test -

Evaluate the test item under conditions of high temperature not to

exceed appropriate limits as established by the applicable OMR's and as defined by AR 70-38. Accomplish high temperature testing in accordance with MIL-STD-810, Method 501.

6.2.3.4.4 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 MIL-STD-461, MIL-STD-462, and MIL-STD-463; MTP 5-2-510.

6.2.5 Magnetic Permeability Property Test

Using a suitable magnetometer, measure and record the magnetic permeability properties at a specified fixed distance from all sides of the test item, to determine possible detrimental effects of the test item on the target guided missiles. Measurements should be made under the following conditions:

a. Test item not in operation.
b. Test item engine idling.
c. Test item engine operating at maximum rpm.
d. Generator operating if applicable.

6.2.6 Durability

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

a. 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, 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 of gaskets.
6) Damage to any component, material or finish.

6.2.7 Transportability

Evaluate the transportability characteristics of the test item.

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

MIL-STD-101, Preservation, Packaging, and Packing Materials, Test Procedures.
MIL-STD-129, Marking for Shipment and Storage.
MIL-STD-209, Slinging Eyes and Attachments for Lifting and Tying Down Military Equipment.
MIL-STD-1186, Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, Appropriate Test Methods.

6.2.7.1 Surface Transportability

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 5-2-574. 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.

6.2.7.2 Air Transportability

Perform the applicable procedures of MTP 5-2-575 and record the appropriate data.

6.2.8 Maintenance

Evaluate and appraise the maintenance related factors of the test item as described in MTP 5-2-600, MTP 10-2-512 and AMC Pamphlet 706-134 with emphasis on the following:

a. Organizational (O), Direct Support (F), and General Support (H) maintenance requirements.
b. Operator through General Support Maintenance Literature.
c. Repair parts.
d. Tools.
e. Test and handling equipment.
f. Calibration and maintenance facilities.
g. Personnel skill requirements.
h. Maintainability.
i. Reliability.
j. Availability.

6.2.9 Safety

Evaluate the safety characteristics and features of the test item in accordance with the applicable procedures in MTP 5-2-602.

NOTE: 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.

a. Examine the safety characteristics of the test item including the procedures for its operation and its design to ensure that maximum safety precautions have been provided which are 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) Moving parts shall be shielded and completely enclosed.
4) Environmental limitations shall be explicitly denoted.
5) Fuels shall be 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 performed 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, recording the location and adequacy of each item listed.

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.

6.2.10 Human Factors Evaluation

6.2.10.1 General Evaluation

Throughout the test, evaluate the effectiveness and characteristics

of the man-item interaction as related to human factors by performing the applicable sections of MTP 5-2-545 and the following:

a. Prepare checklists to evaluate the human factor characteristics using Human Factors Evaluation Data for General Equipment (HEDGE) for the Class III A equipment, including the following:

1) Operability

a) Prepare for operation.
b) Operate.

2) Maintainability

a) Perform preventive maintenance.

(1) Inspect and check out.
(2) Perform routine preventive maintenance.

b) Performed unscheduled maintenance.

(1) Detect malfunction(s).
(2) Isolate and identify causes.

c) Remove and replace.

(1) Remove malfunctioning element.
(2) Replace or repair item.

3) Transportability

a) Prepare for transport.

(1) Place in transient configuration.
(2) Package.

b) Load/unload by placing into/out of carrier.

c) (1) Immobilize items.
(2) Prepare for use.

6.2.10.2 Noise Evaluation

6.2.10.2.1 Preparation for test -

a. Determine the measuring locations for the microphone around the test item using the following criteria:

1) The test item shall be in its normal operating position.
2) There should be no obstructions between the measuring microphone and the test item.

3) Measuring locations for the microphone shall be 20 degrees apart along a number of circular paths with the noise source located at the center of the circle.
4) Circles should be arranged with increments of radius of 24 inches and a minimum of 4 circles shall be used.
5) No measurements should be taken at plus or minus 30° with respect to the normal leading to an open inlet or outlet.

b. Encase the microphone in a sound absorbing enclosure which will be open only on the side facing the test item to minimize indirect reflections.

6.2.10.2.2 Test Conduct -

a. Calibrate the Sound Level Meter and set the weighting network switch to the "flat response" or C position.
b. Determine the highest sound pressure level in each band over all the bands at each location, (Table I and Table II) with the test item operating at a normal level.
c. With the test item inoperative, determine the ambient noise level for the point of highest sound pressure in each band.

EXCERPT FROM HEDGE GUIDEBOOK SUPPLEMENT

TABLE I

Maximum Steady State Noise Level for Army Materiel Command Equipment
(Commercial Frequencies (ASA Z24.10-1953))

From HEL STANDARD S-1-63B

Octave Band Limits (cps)			Center Frequency (cps)	Noise Level (dB)
37.5	-	75	53	120
75	-	150	106	115
150	-	300	212	109
300	-	600	425	101
600	-	1200	850	93
1200	-	2400	1700	89
2400	-	4800	3400	89
4800	-	9600	6800	91

EXCERPT FROM HEDGE GUIDEBOOK SUPPLEMENT

TABLE II

Maximum Steady State Noise Level for Non-Electrically Aided Person to Person Communication

From HEL STANDARD S-1-63B

(Commercial Frequencies (ASA Z24, 10-1953))

Octave Band Limits (cps)	Center Frequency (cps)	Noise Level (dB)
37.5 - 75	53	79
75 - 150	106	73
150 - 300	212	68
300 - 600	425	64
600 - 1200	850	62
1200 - 2400	1700	60
2400 - 4800	3400	58
4800 - 9600	6800	57

6.2.11 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 of 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 - Unnecessary 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 and automated features will result in an overall product improvement and cost savings.
4) Standardization - The use of identical parts currently in the military system will reduce the overall logistics burden.

6.2.12 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

6.3.1.1.1 Arrival 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.

6.3.1.1.2 Inventory -

Record the following:

List of materials missing from the Basic Issue Item List (BIIL).

6.3.1.2 Physical Characteristics

Record the data required by MTP 6-2-500 and as follows:

a. Manufacturer and model, military specification/type/class.
b. Number of cylinders.
c. Engine bore and stroke, in inches.
d. Piston displacement, in cubic inches.
e. Brake horsepower (indicate RPM).
f. Type of starting system (indicate electrical or manual).
g. Shifting arrangement (indicate electrical or manual).
h. Choke arrangement (indicate manual or automatic).
i. Weight and overall dimensions of the test item (in pounds and inches).
j. Gas tank data (indicate number of gallons).
k. Battery data (where applicable). Indicate manufacturer, model, type, voltage, and ampere-hour rating.
l. Other data as appropriate.

6.3.1.3 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.

6.3.1.4 Pre-operational Inspection, Assembly, and Functional Check

6.3.1.4.1 Inspection and Assembly -

Record the following:

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

6.3.1.4.2 Operational Check and Functional Verification -

Record the following:

a. Any difficulties encountered in starting the engine.
b. Any condition of excessive noise and/or vibration.
c. Satisfactory operation.
d. Adequacy of draft technical manuals and other instructional material.
e. Any fault, failure, malfunction, or discrepancy noted.
f. 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 Engine Starting -

Record the following:

a. Type of starting system under evaluation.
b. Ambient temperature.
c. Fuel used.
d. Lubricant used.
e. Lube oil/gasoline mixture ratio.
f. Adequacy of instructional material.
g. Any faults, failures, or malfunctions noted.
h. The following data is applicable to electrical starting systems (readings are to be taken during engine cranking operations).

1) Current flow to the starter motor.
2) Voltage at the starter motor.
3) Voltage between the engine and the battery ground terminal.

6.3.2.1.2 RPM Evaluation -

Record the following:

a. Test stand data and information.
b. Engine RPM developed for each speed evaluated.

6.3.2.1.3 Endurance Test -

Record the following:

a. Full throttle operation.

1) Ambient temperature.
2) RPM developed; record engine RPM at intervals of 30 minutes.
3) Engine head and exhaust gas temperatures. Record temperature values at intervals of 30 minutes.
4) Fuel and lubricant used.

5) All service and maintenance accomplished.
6) Any difficulties encountered.
7) Any unusual noises and/or vibration.
8) Any faults, failures, or malfunctions noted.

b. Cyclic-Load Operation.

Record appropriate data as noted for full throttle evaluation.

c. Manual Cranking System Test.

Record any faults, failures, or malfunctions noted.

d. Operation.

Record any faults, failures, or malfunctions noted.

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 Record the following:

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

6.3.2.3.2 Tropic Environment -

Record the following:

Appropriate data as required by MTP 5-4-003.

6.3.2.3.3 Climatic Tests -

Record the following:

Appropriate data as required by MIL-STD-810.

6.3.2.4 Electromagnetic Interference

Record appropriate data as required by MIL-STD-461, and MIL-STD-462, MIL-STD 463 and MTP 5-2-510.

6.3.2.5 Magnetic Permeability

Record appropriate data during the conditions of paragraph 6.2.5.

6.3.2.6 Durability

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

a. Fastening failure.
b. Leaking gaskets.
c. Loose or missing hardware.
d. Excessive wear.
e. Warping and/or distortion.
f. Damage to any component, material or finish.

6.3.2.7 Transportability

6.3.2.7.1 Surface Transportability -

Record the following:

a. Appropriate data as required by MTP 10-2-503.
b. Item under test (indicate manufacturer, model, etc.).
c. Number of external starters in the shipment.
d. Type of container and packaging methods used.
e. Dimensions of container.
f. Weight of the completed package.
g. Time required to accomplish preparations for shipment.
h. MHE used.
i. Number of personnel required (indicate rank and MOS).
j. Method of transport utilized.
k. Any damage to the test item or the shipping container.
l. Any evidence of shifting of contents, loosening or breaking of holddowns, ties, stays, blocking, or bracing.
m. Adequacy of tie-down/securing devices and lifting attachments.

6.3.2.7.2 Air Transportability -

Record the following:

Appropriate data as required by MTP 5-2-575.

6.3.2.7.3 Highway Transportability -

Record the following:

Appropriate data as required by MTP 5-2-574.

6.3.2.8 Maintenance

Record appropriate data as required by the applicable portions of MTP 5-2-600, 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.

6.3.2.9 Safety

Record appropriate data as required by MTP 5-2-602 and as follows:

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

1) Type.
2) Purpose.
3) Suitability.
4) Adequacy.
5) Proper operation.

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.

6.3.2.10 Human Factors Evaluation

6.3.2.10.1 General Evaluation -

Record the following:

a. Data collected as described in the applicable sections of MTP 5-2-595.
b. Retain completed checklists.

6.3.2.10.2 Noise Evaluation

Record the following:

a. A diagrammatic layout of the starter site showing the locations at which measurements were taken.

b. The highest noise level in each band over all bands at each measuring location and the corresponding ambient noise levels at each of these frequencies with the test item inoperative.

c. A list of "out of tolerance" readings where they exist for each band.

6.3.11 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).

6.3.12 Quality Assurance

Record data collected as described in the applicable section of MTP 10-2-511.

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 external starter 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 external starters 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.

A safety release recommendation shall be submitted in accordance with USATECOM Regulation 385-6 based on the data collected related to safety.

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
US Army Test and Evaluation Command (USATECOM)
Aberdeen Proving Ground, Maryland 21005

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP
---

3. REPORT TITLE
U. S. Army Test and Evaluation Command Materiel Test Procedure 5-2-090, Commodity Engineering Test Procedure, " Starter, External, Gasoline and Electric".

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final

5. AUTHOR(S) (First name, middle initial, last name)
---

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
26 June 1970	28	36

8a. CONTRACT OR GRANT NO.
DA-18-001-AMC-1045(R)

b. PROJECT NO.
AMCR 310-6

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
MTP 5-2-090

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
---

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11. SUPPLEMENTARY NOTES
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12. SPONSORING MILITARY ACTIVITY
Headquarters
US Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland 21005

13. ABSTRACT

This Engineering Test Procedure describes test methods and techniques for evaluating the technical performance and characteristics of Starters (Gasoline and Electric Types) for use with Aerial Target Guided Missile Engines, and for determining their suitability to be subjected to further test for service use by the U.S. Army. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

DD FORM 1 NOV 65 1473 (PAGE 1)
S/N 0101-807-6811

UNCLASSIFIED
Security Classification

A-31408

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Engineering Test						
Starters (Gasoline and Electric Types)						
Aerial Target Guided Missile						
Test Procedures						
Test Methods and Techniques						

DD FORM 1 NOV 65 1473 (BACK)
S/N 0101-807-6821

UNCLASSIFIED
Security Classification

A-31409