

5 June 1969

Materiel Test Procedure 3-2-824*
Aberdeen Proving Ground

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

FLIGHT TESTS OF ANTITANK MISSILES

1. OBJECTIVE

— The objective of the procedures outlined in this MTP is to define the methods used to flight test and evaluate antitank guided missiles.

2. BACKGROUND

Flight tests of antitank missiles are conducted to determine the flight characteristics of the missile when fired in various environments, the effects of the guidance system on the flight, and the ability of the gunner to control the flight. These tests are conducted under the environmental conditions shown in MTP 3-2-515 (Close Support Pockets and Missiles), or as required by the Qualitative Materiel Requirements (QMR's).

Because the antitank guided missile, instead of following a free flight ballistic trajectory, has a guided flight with a human element in the guidance link, it is necessary to determine the effects of the human element on the flight and to distinguish between the gunner aiming error and errors inherent in the weapon system. Extensive range instrumentation is generally required.

Due to limited accurate means of monitoring the ability of a gunner to hold the sight on target during missile flight, several gunners (five preferred) are used to fire missiles under conditions specified in the QMR. For line-of-sight systems that permit the mounting of cameras to monitor the gunner aiming point, the gunner's tracking ability may be determined directly without firing or during firing.

3. REQUIRED EQUIPMENT

- a. Scales suitable for weighing missiles.
- b. Measuring tools and equipments (general and special purpose), including tapes, rules, calibers and micrometers.
- c. Photographic Equipment, including cameras for inspection and range cameras such as overhead cameras, side cameras, mirror tracking cameras, and calibration targets.
- d. Guidance circuit checkout equipment (missile system).
- e. Circuit tester (approved, for testing of rocket igniters).
- f. Adequate Firing Site (based on size, range and propulsion characteristics of the test item and the type of instrumentation required for data acquisition).
- g. Surveyor's Transit.
- h. Tools required for maintenance of missile and supporting systems.

* Supersedes Interim Pamphlet 70-41

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MTP 3-2-824
5 June 1969

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4. REFERENCES

- A. MTP 3-2-515, Close Support Rockets and Missiles.
- B. MTP 3-2-821, Ballistic Data for Boosted Projectiles.
- C. MTP 4-2-800, Physical Measurement of Projectiles.
- D. MTP 4-2-805, Projectile Velocity, Time of Flight, and Ballistic Coefficient.
- E. MTP 4-2-816, Photographic Instrumentation of Trajectory Data.
- F. MTP 6-2-507, Safety.
- G. MTP 3-1-002, Confidence Intervals and Sample Size.

5. SCOPE

5.1 SUMMARY

5.1.1 Technical Characteristics

The procedures outlined in this MTP discuss the flight performance testing of small guided antitank missiles that have wire link, optical-infrared tracker link, or radio link guidance systems.

The specific tests to be performed, along with their intended objectives, are listed below.

- a. Inspection and measurements - The objectives of this subtest are to inspect the test item and physical damage; to weigh, measure and photograph the test item; and to record pertinent data on the features of the subassemblies and propellant.
- b. Circuitry Checkout - The objectives of this subtest are to validate the missile firing circuits by conducting resistance and continuity checks; to conduct prefiring checkout tests of the Guidance Circuit Equipment.
- c. Missile Firing Test - The objectives of this subtest are to conduct a last-minute checkout of the missile; to fire the missile on an instrumented range and to record the data required to evaluate the performance of the entire system (missile/man system).

5.1.2 Common Engineering Tests

Not included in this MTP are the following Common Engineering Tests which apply to these commodities:

- a. 6-2-500, Physical Characteristics
- b. 6-2-502, Human Factors Engineering
- c. 6-2-505, Reliability

5.2 LIMITATIONS

This procedure applies basically to vehicle-mounted or infantry type ground-launched missiles and generally to air-launched (from helicopter) missiles.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Select test equipment ideally having an accuracy of ten orders of magnitude greater than that of the item under test, and that is in keeping with the state of the art, and with calibrations traceable to the National Bureau of Standards.

b. Record the following information:

- 1) Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.
- 2) Nomenclature, serial number, accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the particular missile under test, such as stipulated in QMR's, SDR's, and TC's.

d. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test and that the item has successfully completed MTP 6-2-507, Safety.

e. Prepare record forms for systematic entry of data, chronology of test, and analysis in final evaluation of the test item.

f. Prepare a test item sample plan sufficient to ensure that enough samples of all measurements are taken to provide statistical confidence of final data in accordance with MTP 3-1-002. Provisions shall be made for modification during test progress as indicated by monitored test results.

g. Ensure that all test personnel have reviewed all instructional material issued with the test item by the manufacturer, contractor, or government, and performed such preliminary tests as necessary to assure that the test item is in satisfactory operating condition.

NOTE: Whatever the actual calibration or test procedure to be followed, preliminary preparation of the test item should always include:

- a. Visual inspection for obvious physical defects.
- b. Operational test to point out major defects.
- c. Preliminary maintenance pointed out by the previous steps.
- d. Cleaning and lubrication according to specifications.

- e. Zero setting of all indicators.
- f. Leveling of devices which require this precaution.
- g. Determination of "intended use" position of the various instruments.
- h. Sufficient warm-up time for all electronic devices.

h. Launcher Emplacement - Select an adequate firing sight based on the size, range, and propulsion characteristics of the test item and the type of instrumentation required for data acquisition. Then tactically emplace the launcher and locate upon a preselected firing azimuth by means of a surveyor's transit.

i. Photographic Instrumentation - Select and emplace the required photographic instrumentation in accordance with MTP 4-2-816. In special cases additional photographic equipment may be required to obtain specific performance or event data. Reference Figure-1 which illustrates the various instrumentation possibilities for a firing range.

j. Electronic Instrumentation - Select and connect the required instrumentation to monitor and record the missile flight errors, command signals, time of each event and time of flight. The electronic instrumentation required will vary with the type of missile system tested. Instrumentation for measuring velocity at launch and along the flight path is described in MTP 4-2-805. All instrumentation should be furnished with a common time reference and operated through a sequence times.

NOTE: The specific instrumentation and connecting points for monitoring the required signals should be coordinated with the developing agency prior to the test, so that suitable data pickup points may be supplied with the guidance equipment.

6.2 TEST CONDUCT

6.2.1. Inspection and Measurements

a. Upon receipt, examine all test items for any physical damage that may have occurred during shipment.

b. Record and photograph all damage to the test items.

NOTE: An assessment of damage should be made and brought to the attention of the shipper.

c. Select a sampling of missiles (or systems) and weigh, measure and photograph these items.

d. Note and record the following data:

- a. Type and composition of propellant.
- b. Trapping method.
- c. Propellant grain geometry.

MTP 3-2-824
5 June 1969

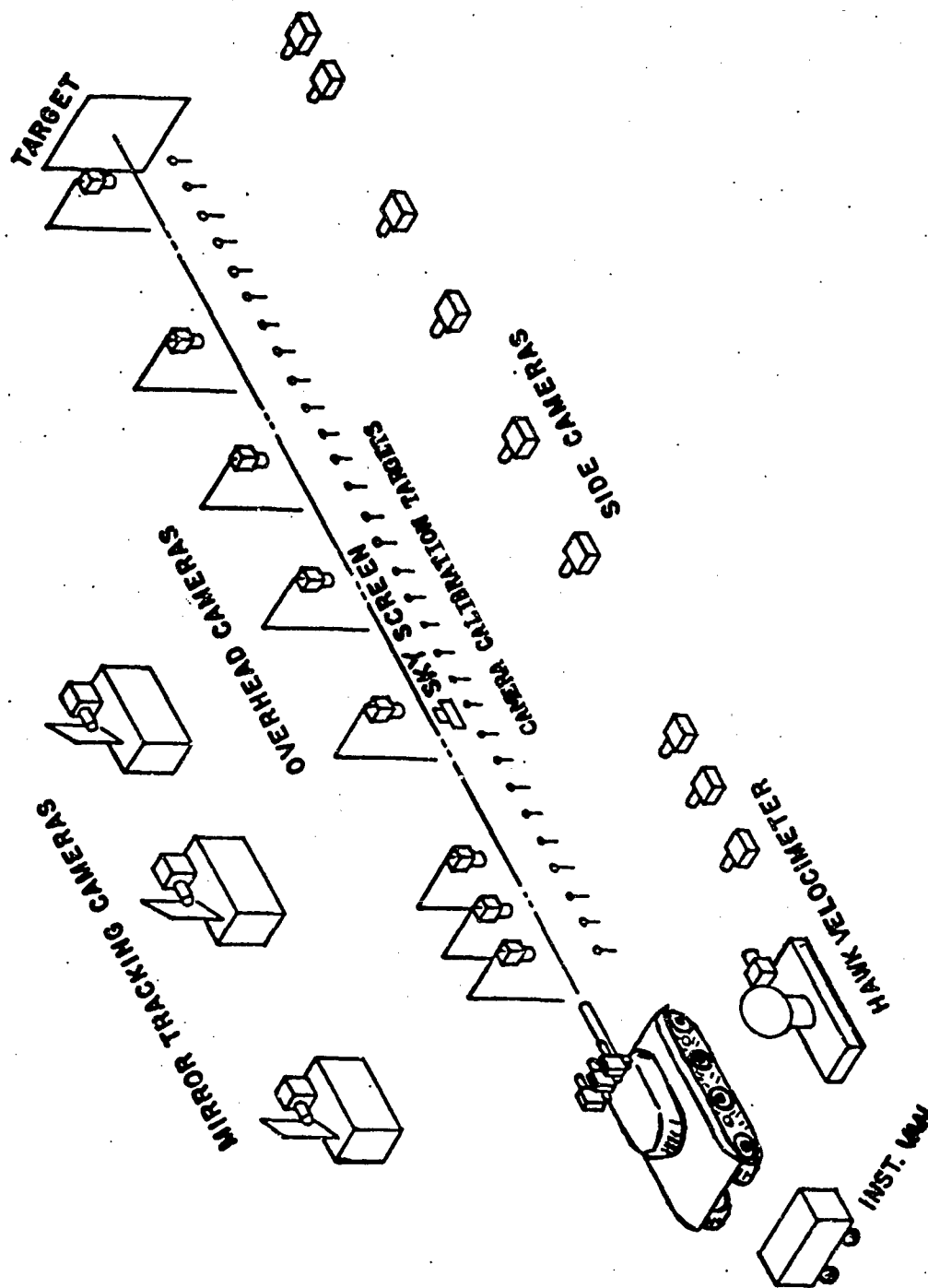


Figure-1
Range Layout Possibilities.

5 June 1969

- d. Type and method of propellant ignition.
- e. Expected motor operating pressure.
- f. Motor port-to-throat (nozzle) ratio.
- g. Nozzle cant angle.
- h. Type of warhead and fuzing system used.
- i. Type of guidance link used.

6.2.2 CIRCUITRY CHECKOUT

6.2.2.1 Missile Firing Circuits

NOTE: The following circuit tests are to be conducted with the missile in a barricaded area and restricted from movement or with the missile in a launcher, aimed downrange.

a. Using applicable system (and equipment) reference documents conduct resistance and continuity tests of the missile firing circuits.

b. Record the results of circuit tests and note if the resistance of the firing circuit is within the tolerance specified for the missile under test.

NOTE: Care must be taken to use an approved circuit tester because of the electrical sensitivity of most rocket igniters. (The igniter circuit tester model 1015-A (ALINCO) or equivalent may be used).

c. If checkout equipment is furnished with the missile, determine that the igniter circuit tester current output is within acceptable limits (usually 20 milliamperes or less).

NOTE: This test should always be conducted prior to connecting the checkout equipment.

6.2.2.2 Guidance Circuit Equipment

NOTE: Guidance circuit checkout equipment generally is furnished with each missile system except when checkout prior to firing is not required. A prefiring checkout usually is necessary for assurance that the equipment is adequate and operable.

a. Using applicable guidance checkout equipment documentation verify that all cabling, connectors and assemblies of the equipment are correct and are in good physical condition.

b. Make all preoperational and self checks of the guidance checkout equipment in accordance with the equipment documentation.

c. Make necessary checks to ensure that the interface between the guidance checkout equipment and the guidance package is compatible both physically and electrically.

NOTE: Ample descriptive material on the guidance system used on the

5 June 1969

test item should be available from the developer. It is important for test agency personnel to become familiar with the guidance technique used, as each type of system has its predominant mode of failure, environmental susceptibilities, etc. Contemporary antitank missiles use automatic command-to-line-of-sight guidance systems: the gunner has only to aim the weapon sight at the target, and the missile is automatically commanded to fly along the gunner line of sight. Future development antitank missiles may be of the indirect fire type, where the gunner is not required to stay in the guidance loop once he has launched the missile.

6.2.3 Missile Firing Test

- a. Conduct prefiring checks of all instrumentation, photographic equipment and other launch and support equipments to ensure all these items are operative, calibrated and ready for use.
- b. Determine that the timing equipment is providing the correct timing signals to all equipments.
- c. Perform a last-minute checkout of the missile and guidance system.
- d. Inform the range safety officer that firing tests are ready to commence and to institute required range safety procedures.
- e. Place the missile in its launcher and set up in firing position (some missiles may be fired from the shipping case).
- f. Sound the alert for firing.
- g. When all stations report they are ready fire the missile.

NOTE: The missile is fired through the sequence timer probe that controls the operation or timing signals for all instrumentation.

- h. During launch and firing of the missile, record the following data as applicable.
 - a. Time zero (switch closing).
 - b. Ignition delay time interval (time from switch closing to motor ignition).
 - c. Time of launch (launch occurs when the tail of the missile clears the launcher).
 - d. Time interval from launch to impact.
 - e. Launcher elevation angle.
 - f. Azimuth of launcher.
 - g. Gunner aiming error as a function of time (when applicable).
 - h. Missile flight error signals (signals generated due to missile deviation from the line of sight).
 - i. Guidance signals (signals sent to the missile to correct for the flight deviations from the line of sight - normally initiated by the guidance equipment).
 - j. Pitch.

- k. Yaw.
- l. Roll rate.
- m. Velocity at launcher muzzle and in the area of motor burnout (burnout velocity may be replaced by impact velocity).
- n. Deviations of the missile from the line of sight as a function of time.
- o. Coordinates of target impact, missile pitch and yaw at impact, and impact error from aiming point.
- p. Velocity at target impact.
- q. Range to target or impact.
- r. Surface meteorological data as required.

6.3 TEST DATA

6.3.1 Preparation for Test

Data to be recorded prior to testing shall include but not be limited to:

- a. Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.
- b. Nomenclature, serial number, accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.

6.3.2 Test Conduct

In addition to other data requirements the following items shall be preserved as a part of the test records:

- a. An engineering logbook containing in chronological order, pertinent remarks and observations which will augment test data and support engineering evaluation and analysis of the technical performance of the test item.
- b. Supporting photographs, calibration records, and recordings of test anomalies or deviations from the test plan made where necessary.

6.3.2.1 Inspection and measurements

Record all data as described in paragraph 6.2.1. Carefully note any differences between documentary descriptions (in reference documents) and actual measurements made during the test.

6.3.2.2 Circuitry Checkout

Record all data as described in paragraphs 6.2.2.1 and 6.2.2.2.

6.3.2.3 Missile Firing Test

Record all data as described in paragraph 6.2.3.h. Carefully note any unusual range or equipment conditions that might influence the evaluation of the data recorded.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data, in general, includes but is not limited to the following steps:

- a. Marking test data for identification and correlation.
- b. Organizing data into tabular and graphical form.
- c. Modifying data to correct for nonstandard conditions.
- d. Determining the statistical variation of the results in terms of the average value and standard deviation of the particular quantities, the correlation among two or more quantities, etc.

It is noted that the test directive (or operation) itself serves to define the types and characteristics of the raw test data, and the ultimate objective of the test program defines the form of the test data desired.

6.4.1 Inspection and Measurements

Evaluate the extent of damage attributable to shipping and the probable causes of this damage. Prepare a report illustrating the damage and recommending corrective action necessary to avoid the possibility of damage in future shipments.

Determine the variations in weights and measurements of the missiles received. Report any variations or trends noted in relation to the expected values (values derived from reference documents).

6.4.2 Circuitry Checkout

Review data on tests conducted and determine if equipments were electrically correct and if the workmanship and quality control techniques were up to standard acceptable levels.

6.4.3 Missile Firing Tests

Evaluate all data and prepare a comprehensive report delineating the system errors, and errors attributable to the operator, and the guidance package. Compare test results with acceptable criterion and illustrate with charts and tables the manner in which the data was reduced and evaluated. The level of data reduction and extent of the evaluation will be directed by the specific test document used.