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Materiel Test Procedure 5-3-514  
U. S. Army Armor and Engineer BoardU. S. ARMY TEST AND EVALUATION COMMAND  
COMMON SERVICE TEST PROCEDURE

## MISSILE FLIGHT FUNCTIONING

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to evaluate flight functioning characteristics of guided missiles launched from within combat vehicles.

2. BACKGROUND

Prior to issuing missiles for combat use, it is necessary to assure a very low incidence of poor performance, i.e., misfiring, inflight malfunctioning, failure to function on impact, etc. Service tests by nature are not intended to be as highly instrumented as engineering tests, therefore flight functioning data will usually be limited to that obtained by photography and observation. Target hits will determine the effectiveness of a missile system in meeting the Qualitative Military Requirement (QMR), but additional data are essential to provide an insight into the reasons for misses. These data may lead to recognition of problems caused by environments, operational procedures, or equipment changes since earlier engineering or service tests. As distinguished from the direct fire conventional artillery class weapons where hit probability of the second round is higher than the first as a result of azimuth and elevation adjustments, the second round hit probability of a guided missile is usually no better than the first. Only by detecting and reporting problems such as those noted in flight functioning can the missile reliability and accuracy be improved once the system has reached the service test stage.

3. REQUIRED EQUIPMENT

- a. Appropriate Launch Vehicle System with its inherent sighting/viewing and fire control equipment.
- b. Observation Devices separate from the appropriate launch vehicle system as may be available for use by observer personnel.
- c. Cameras (still, motion or video as available or required, with necessary film and video recorder when applicable).
- d. Appropriate Range Facilities and necessary Targets.
- e. Stop Watches.
- f. Anemometer for determining wind force or velocity.
- g. Thermometer for measuring missile stowage temperature in launch vehicle.
- h. All Appropriate Checkout and Test Sets for the missile and the missile guidance system.
- i. Boresighting or Alignment Equipment for observation devices and missile guidance system.

4. REFERENCES

- A. USATECOM Regulation 385-6, Verification of Safety of Materiel

During Testing.

- B. USAMC Regulation 385-12, Verification of Safety of Materiel From Development through Testing, Production, and Supply to Disposition.
- C. Appropriate Qualitative Materiel Requirement.
- D. Report(s) of engineering test of test item or similar material.
- E. Applicable range regulations and standard operating procedures (SOP).

5. SCOPE

5.1 SUMMARY

This MTP covers the procedures and techniques applicable to evaluating missile flight functioning. Emphasis is placed on the use of photography to determine the behavior of the missile in flight and the planning required to ensure that adequate coverage is obtained. Analysis of the data obtained along with preflight and post-flight checkout information is used to reconstruct flight trajectory when in-flight malfunction occurs.

5.2 LIMITATIONS

This MTP covers only the flight functioning of guided missiles launched from within combat vehicles.

6. PROCEDURES

NOTE: The cost of missiles and the limited quantity allotted for the service test usually prohibits firing them solely to obtain flight functioning data. Therefore, in-flight performance data will usually be obtained concurrently with other scheduled firing tests. The types of scheduled firing tests are covered in detail in their respective MTPs, accordingly the emphasis of this procedure is to the preparation for photographing and observing the missile in flight, and to the recording of all data relative to flight functioning and the acquisition of prelaunch and launch data as may be useful in determining the cause(s) of malfunctioning. Since in-flight malfunctions occur unexpectedly and are of very short duration, it is difficult, if not impossible, for an observer to see and remember sufficient details to verbally reconstruct the sequence of events, and primary reliance is on motion picture and video cameras for a permanent record of flight functioning.

6.1 PREPARATION FOR TEST

6.1.1 Safety

The project officer shall ensure that a Safety Release in accordance with reference 4A has been received from HQ, USATECOM and is understood before

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testing is begun.

#### 6.1.2 Personnel

##### 6.1.2.1 Vehicle Crew

a. Ensure that selected well-trained personnel are used for missile in-flight functioning tests unless otherwise directed and that all test personnel are trained on the specific test item in accordance with pertinent technical manuals or other appropriate documents, including the operation, calibration, and maintenance, as appropriate, for the launcher, guidance system, missile, all integral observation systems and supplemental instruments.

b. Indoctrinate each of the test personnel in the necessity for making careful observations appropriate to his assigned area of missile flight functioning, and the importance of recording any deviation from normal flight. To avoid all possible interference with crewmen performing their primary duties, ensure that at least one individual is assigned to record vehicle crew observations and comments.

c. Since visual observations are essential, determine and record the visual acuity under day and night conditions along with the following for each test participant:

- 1) Name and rank or grade
- 2) Military occupational specialty (MOS)
- 3) Experience in MOS

##### 6.1.2.2 Photographers, Observers, and Recorders

Ensure the availability of and record name, rank or grade and MOS of photographic, observer and recorder personnel and brief all participating personnel on the overall functioning characteristics of the missile/launcher/guidance control system combination so that they know what to expect. Provide for review any available films and reports of previous firing for the test or similar items. Emphasis should be placed on what is to be observed or photographed and how it is to be done in order to facilitate reconstruction of events with the precision needed to isolate missile flight function modes.

#### 6.1.3 Range Site Planning

Prepare the range site and firing points for firing the test missile using the following guidelines:

a. Consider the number and type of cameras available and position them to cover the flight of the missile from all practical angles. Since cameramen are the experts in photography, seek their advice concerning the type of equipment best suited for the coverage desired, and the location of each piece of equipment for maximum coverage throughout the entire flight of the missile and for minimum interference from obscuration or flash.

b. Determine from a review of previous firings the area(s) in which flight malfunctioning is most likely to occur and give these areas priority

coverage.

- c. Make a sketch of each firing point showing the location of the launcher and position of each camera and observer.
- d. Number each position and affix this number to each film or negative used at the camera position.
- e. Give special attention to precautions and operational limitations described in the Safety Release and appropriate QMR to ensure that all camera and observer positions are outside all probable danger areas. Potential hazards include but are not necessarily limited to muzzle blast, missile trajectory divergence, warhead blast and fragmentation.

#### 6.1.4 Missile and System Checks

Ensure that the missile and missile system has undergone all required technical inspection(s) prescribed in the applicable technical manuals and other pertinent document(s) and that all pertinent data, including missile nomenclature and serial number, results of operational checks and test equipment used to perform the checks, nomenclature and serial number of the launcher and stowed position of the missile in the vehicle and miles travelled, is recorded and available for consideration in evaluating flight functioning.

#### 6.2 TEST CONDUCT

Flight functioning of test missiles is evaluated by observing and photographing each applicable flight (day or night) from launch throughout the duration of flight, as such the following paragraphs emphasize planning what to observe and photograph, and defining or reconstructing the firing situation with the precision needed to isolate missile flight malfunctions and to identify the parameters possibly causing the malfunction.

##### 6.2.1 Launch Position Setup

- a. Station observers and cameramen at the preselected and numbered positions (paragraph 6.1.3) and verify that the personnel and the type camera or viewing device to be used at each position is accurately recorded on a sketch of the range site.
- b. Assign observers and cameramen to specific sectors of the planned missile flight trajectory and ensure that their cameras or viewing devices are checked and repositioned, if necessary, to ensure that assigned sectors are covered.
- c. Furnish each observer an appropriate viewing device and stop watch.
- d. If similar guidance systems or other potential light sources are to be used concurrently and are close enough to create possible interference with the test system, record a description of each such potential source of interference.
- e. Establish coordination to ensure that cameramen and observers receive sufficient warning in advance of missile launching.
- f. Have personnel acting as recorders available for recording crew comments immediately after each launching.

#### 6.2.2 Missile Flight Data

Determine missile flight data as follows:

a. Photograph the flight of each test missile and identify all film and negatives by the missile serial number, shutter or camera speed, and the station number from which the photographing was done as indicated on the sketch of the range site (paragraph 6.1.3).

b. Observers shall perform the following:

- 1) Determine flight time by activating their stop watches at missile launch and stopping the watches upon missile impact or breakup.
- 2) Write a brief description of the missile as observed from his station and include flight time and station number.

c. Personnel designated as recorders shall record crew comments on difficulties in loading the missile, if any, firing, initial launch and flight observations.

- NOTE:
1. The comments of the gunner are of especial importance since he is usually in the best position to observe the missile in flight and is the only one who knows when, where, and the amount of system directional changes made. He should be encouraged to report such details and make a comparison of the flight characteristics of the test missile with those missiles he may have fired previously.
  2. All comments recorded shall be identified with the serial number of the missile fired and the vehicle station occupied by the individual making the comments.

d. Record the following for each missile flight:

- 1) Wind direction and speed
- 2) Weather and light conditions
- 3) Type artificial light used, if applicable
- 4) Target type, range, and when applicable speed and direction

#### 6.2.3 Post Flight Procedures

a. Develop exposed negatives, process motion picture film and identify each item by serial number of missile, shutter or camera speed, location of camera (station number) and date of firing.

b. Identify and consolidate observer and crewmen comments to the extent practicable.

#### 6.2.4 Reconstruction of In-Flight Malfunctions

When in-flight malfunctions occur reconstruct the missile trajectory insofar as possible, in an effort to identify the reason for the malfunction, using but not necessarily being limited to the following:

- a. A detailed study of all photographic data

NOTE: When a video camera and recorder are used this can be done immediately, otherwise the study will be delayed until the negatives have been developed and the film processed.

- b. A study of impact markings on missile parts and the terrain or object on which the missile impacted.
- c. An inspection of all recovered missile parts.
- d. Additional debriefing of crewmen and observers.
- e. A check of the guidance system for proper functioning.
- f. A check for the adequacy of power supply and/or battery voltage.
- g. A check of boresight alignment.

### 6.3 TEST DATA

#### 6.3.1 Preparation for Test

##### 6.3.1.1 Personnel

Record the following for all test personnel:

- a. Name
- b. Rank or grade
- c. MOS
- d. Duty during test (gunner, observer, recorder, etc.)
- e. Visual acuity (day and night conditions)

##### 6.3.1.2 Range Site

Retain range site sketch showing the following:

- a. Number of each position.
- b. Type camera or viewing devices assigned to each station.
- c. Individual assigned and function at each station.
- d. Position of each camera and observer station in relation to weapon system and target.

##### 6.3.1.3 Missile and System Checks

Record the following:

- a. Missile nomenclature and serial number
- b. Launcher nomenclature and serial number
- c. Stowed position of missile in vehicle, when applicable
- d. Number of miles missile was transported
- e. For operational checks performed:

- 1) Results
- 2) Date of check(s)

- 3) Type and serial number of test equipment

6.3.2 Test Conduct

- a. Record the following for each missile flight:

- 1) Wind speed, in mph, and direction.
- 2) Weather conditions (rain, snow, fog, etc.).
- 3) Light conditions (day, night).
- 4) Type of artificial light used when applicable.
- 5) For each target:
  - a) Type of target
  - b) Range to target in meters
  - c) Target speed, in mph, and direction, when applicable
- 6) Results of reconstruction of in-flight malfunctions as determined from study of paragraph 6.2.4.

- b. Retain the following:

- 1) All photograph data taken
- 2) Comments of each observer to include:
  - a) Name
  - b) Station
  - c) Missile time of flight in seconds
- 3) Gunner comments on:
  - a) Target tracking procedure and tracking difficulties.
  - b) Target visibility, illumination and observation problems.
  - c) Loss of target and reacquisition during missile flight and reasons therefor.
  - d) Ability to see missile and observe missile trajectory.
  - e) Target hit or miss distance and direction
  - f) Recoil or reload effects on tracking
  - g) Missile loading problems, if any
- 4) Comments of other crewmen

6.4 DATA REDUCTION AND PRESENTATION

All data obtained from photographic coverage, visual observations, and inspection of missile parts and impact area should be suitably tabulated or otherwise arranged for correlation under the appropriate subtest within the report of test.

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